2014 Seasonal effects of stubble treatments on *canola* establishment and grain yield in CWFS districts

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GRDC project CWF00018 – Maintaining profitable farming systems with retained stubble in Central West, NSW

Rankins Springs trial management was contracted to AgGrow Agronomy and Research

Background

CWFS are conducting trials in commercial canola paddocks to investigate the impact of different stubble treatments imposed towards the end of the fallow have on the establishment and yield of canola. The aim of the trials is to improve canola establishment and yield in stubble retained farming systems.

During 2013 CWFS conducted a trial at 3 locations - Rankins Springs, Wirrinya, and Tullamore. These trials have been previously reported.

During 2014 CWFS repeated the trials at Rankins Springs, Wirrinya and Condobolin. The CSIRO (Macfadyen S, Neave M) used the Wirrinya trial site to investigate the impact of stubble treatments on insect populations. This trial has been reported separately.

Agronomic logic to trial:

Stubble retention within cropping systems in CWFS districts is a common practice. The 2013 CWFS farmer survey (representing 47 producers managing 207,000 ha) highlighted that 70 % of producers regularly maintained stubble cover over summer whilst 20% regularly maintained fallows by cultivation alone. No simple relationship between farm size and stubble management practice could be determined. Canola is the most commonly used annual break crop in the cropping programs in the region where wheat is the major crop. It is widely accepted that three concurrent triggers need to be available for profitable canola production in the region namely: profitable market price, good stored sub soil moisture and sowing rain in April. Variable seasons in CWFS districts produce variable stubble loads for the following crops and can influence the establishment of canola. This trial seeks to develop best practice guidelines for canola establishment in the variable stubble loads experienced in the region.

Trial design
The trials were 4 ranges and 4 rows, and consisted of 4 replicates. Each replicate was 1 range and 4 rows.
There were 4 stubble treatments; standing, burnt, mulched and cultivated imposed on commercial paddocks. Plot size was 10 metres wide by 40 metres long, running between the co-operators tram tracks. The plots were farmer sown as part of their commercial canola planting program. Trial layout is shown in Figure 1.

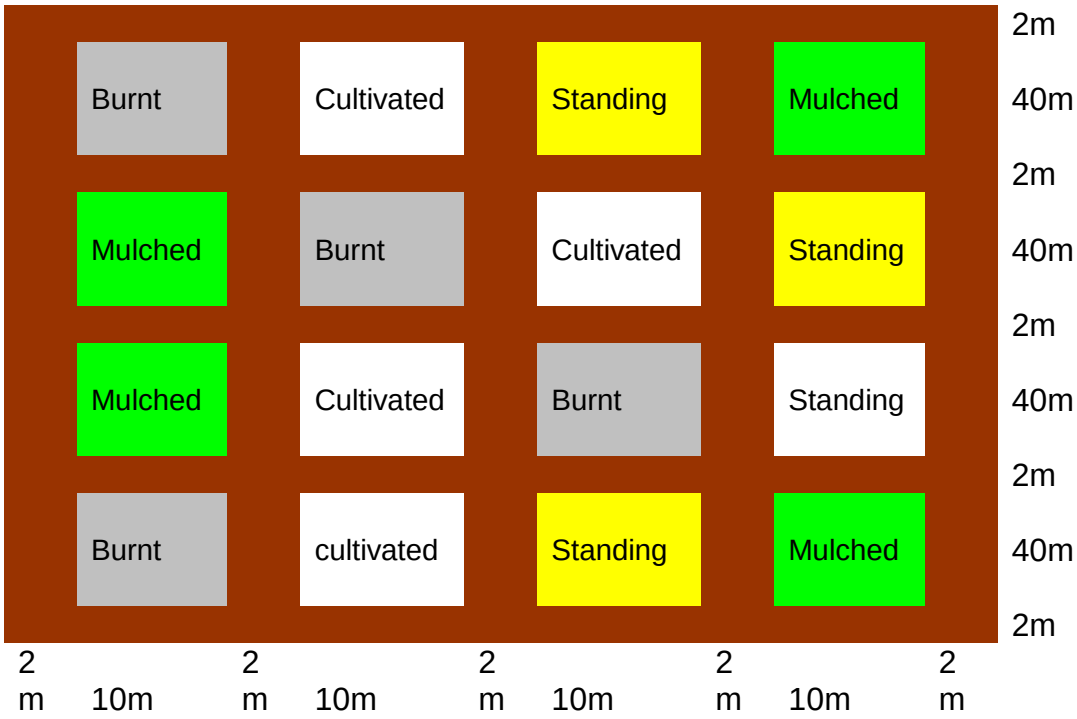


Figure 1: 2013 trial plan.

Trial sites:
Rankins Springs
Co-operator
Micheal Pfitzner, "Hill End". CWFS contracted Ag Grow Agronomy and Research to manage and harvest this trial.
Paddock History
Long term, no till continuous cropping paddock with a general rotation of wheat/Barley/legume/ wheat/ wheat canola. 2012 the paddock was sown with wheat that yielded over 3 t/ha.
Soil Type
Red mallee sandy loam
Stubble treatments imposed
31 March 2014
Sowing
17 April 2014, variety 43C80, Seeding rate 2kg/ha, 50 kg/ha MAP fertiliser with seed into moist seedbed with good subsoil moisture. Sown with a NDF disc seeder with 273 mm row spacing.
Harvest date
Harvested as standing crop on 28 November 2014
Special notes

The cultivated treatment was burnt and then cultivated with tynes.
In the cultivated treatments soil throw at planting onto the rows sown by the front units resulted in seed being sown to deep. Seedling emergence in these rows was all but zero. A similar effect could be observed in other treatments but it appeared to have no effect on emergence rates.
100kg/ha urea top dressed early June 2014.
The site was severely impacted by frosts during July and August.

Condobolin

Co-operator;

Peter Quade, Boona Rd partnership

Paddock History

Recently developed no till cropping paddock previously sown to hindmarsh barley.

Soil Type

Red sandy loam.

Stubble treatments imposed

2 April 2014

Sowing

23 April 2014, variety Victory 3002, 70 kg/ha MAP plus 100kg deepbanded urea fertiliser into moist seedbed.

Harvest

Plots were representatively sampled prior to commercial windrowing. Samples were dried and processed at Condobolin Agricultural Research Station.

Special notes

Cultivation treatment imposed with light offset discs. Crop was topdressed with 70kg/ha urea early June.

Wirrinya

Co-operator;

Angus & Kim Maslin, “Bergen Park”

Paddock Histroy

No till continuos cropping paddock with a general rotation of wheat/barley/canola. 2013 the paddock was sown with wheat.

Soil Type

Heavy black flood plain soil

Stubble treatments imposed

1 April 2014

Sowing

10 May 2014, 2 kg/ha Gem canola, 50 kg/ha MAP fertiliser and 100kg/ha Sulphate of ammonia into moist seedbed with good subsoil moisture. Sown with a NDF seeder at 25 cm row spacing.

Harvest

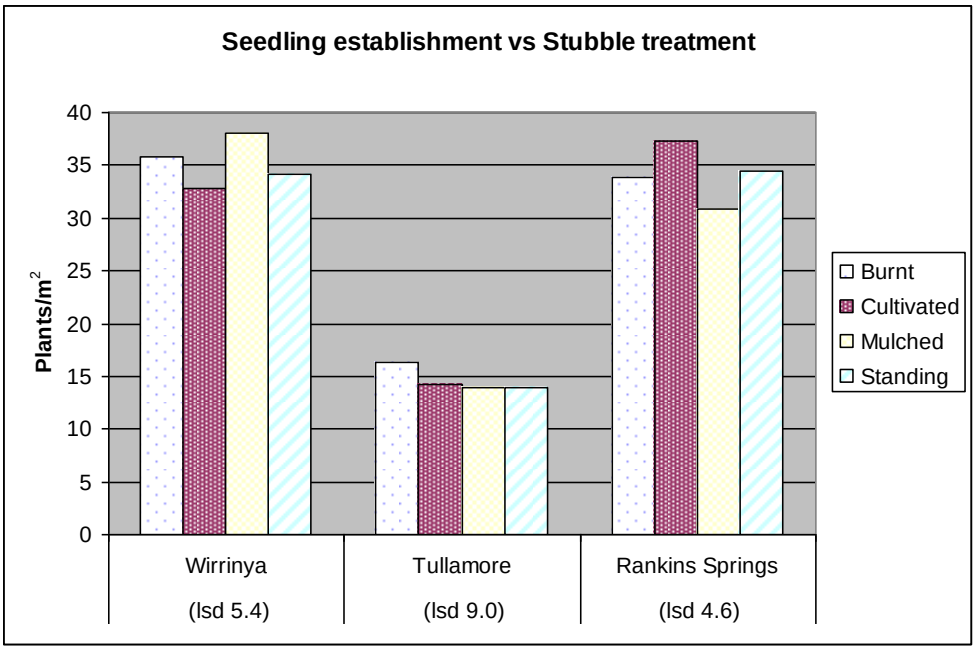
Plots were representatively sampled prior to commercial windrowing. Samples were dried and processed at Condobolin Agricultural Research Station.

Special notes

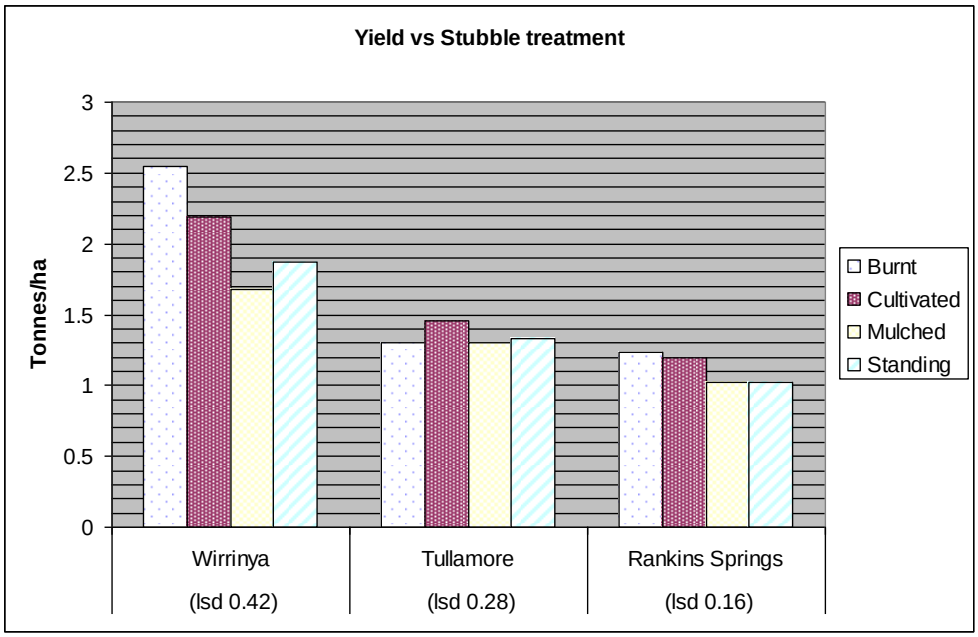
Cultivation treatment imposed with light offset discs
Topdressed with Urea 100kg/ha mid June

Results

Establishment



Yield



Discussion

Establishment

At Tullamore, which had the lowest average plant establishment across all treatment of 14.7 plants per square metre, there was no significant interaction with stubble treatments. Low plant population appeared to have been adequate for the season.

At Wirrinya and Rankins Springs, where targeted plant populations were achieved, there were significant but different interactions at each site.

At Wirrinya mulching resulted in the highest establishment which was significantly better than cultivating but not standing or burnt treatments. Cultivation resulted in the lowest plant population but not significantly lower

than standing or burnt. No definite reason can be identified for this response beyond a simple suggestion that it was related to the less than ideal seed bed moisture at sowing or surface crusting of the soil following rain soon after emergence.

At Rankins Springs cultivation ranked highest in plant establishment counts but not significantly higher than standing or burnt. Mulching resulted in the lowest plant population but not significantly lower than standing or burnt. This site had good seed bed moisture at sowing and it is proposed that the cultivation treatment allowed the seed to germinate in conditions of good seed soil contact without any impediments from stubble. There was evidence of the treatments with mulched stubble hair pinning during seeding and it is suggested that this is the likely reason for poorer emergence.

Visual differences could be observed across stubble treatments during the trial, refer to photographs 3, 4 and 5. Generally the burnt and cultivated treatments appealed to the eye as being even in colour and ahead in terms of ground cover. As all trials progressed differences became less apparent as the plots matured, although the burnt and cultivated treatments visually appeared to flower earlier with a tighter flowering period.

Timely sowing is a critical driver of profitable canola production and it appears that seasonal issues this year did bring short term agronomic benefits or risks associated with stubble conservation, burning or cultivation into play. These appear to be primarily related to seedbed moisture at sowing with the cultivated treatments and the ability to achieve good seed soil contact with mulched stubble.

Yield

Significant yield interaction between stubble treatments has been observed in crop that was sown on time and achieved a good initial plant population; namely the Wirrinya and Rankins Springs crops.

At Wirrinya the burnt and cultivated treatments with yields of 2.55 t/ha and 2.19 t/ha respectively yielded significantly higher than the mulched (1.68 t/ha) and standing (1.87 t/ha) treatments. LSD 0.42t/ha.

At Rankins Springs the burnt and cultivated treatments with yields of 1.23 t/ha and 1.20 t/ha respectively yielded significantly higher than the mulched (1.02 t/ha) and standing (1.02 t/ha) treatments. LSD 0.16t/ha.

Three obvious questions arise on the practical application of these measurements;

Is the observed response repeatable over a number of years or is it just related to the 2013 season and in particular the dry spring conditions?

It is planned to repeat these trials again in 2014 and 2015.

What can be done in the standing stubble treatment to lift the yield to be equivalent to the burning or cultivation treatments?

It is anticipated if these effects are repeated in future years that CWFS will develop research plans with other organisations in the broader GRDC Southern region stubble initiative to investigate opportunities.

What are the costs and risks associated with using strategic burning and cultivation in standing stubble treatments to lift canola yields?
Burning:
Based on discussions with producers a reasonable cash cost for burning appears to be about $4/ha. Significant management time is involved in planning any burning and needs to consider business liability, compliance with regulation issues and work place health and safety issues.
Loss of nutrient by late burning wheat stubbles at Condobolin is presented in table 1 as reported by Scott et al (2010). The replacement of these depleted nutrients as fertiliser would have a cash cost.

Nutrient	N	P	K	S	Ca	Mg
Mean kg/ha lost	9.1	0.2	4.1	2.0	0.6	0.5
range	2.8-20.6	0.1-0.5	2.2-8.1	1.3-3.2	0.3-1.2	0.3-0.8

Table 1: The amount of nutrients (kg/ha) lost by late burning wheat stubble prior to sowing at Condobolin (2.34 t/ha).(Scott et al 2010)

Fallow efficiencies for the summer following the canola crop established on burnt stubble may be reduced. Stored soil moisture at sowing is a major driver of crop yields in Central West Farming Systems districts (CWFS 2012). Canola crops themselves produce light stubble cover after harvest, and burning old stubble prior to sowing canola will result in relative low ground cover in the fallow following the canola crop. It is generally accepted that the presence of stubble during the summer increases soil moisture at sowing by a combination of improving rainfall infiltration and reducing evaporation. It also minimises wind and water erosion. The seasonal interaction is related to soil type and rainfall distribution in the summer. Further work needs to be done to quantify the potential yield penalty in the subsequent crop due to reduced soil moisture stored during the fallow.

Cultivation
Based on discussions with producers, a reasonable cash cost for cultivation appears to be about $25/ha. The savings of input costs and the environmental benefits to the soil such as reduction in wind and water erosion, improved soil water storage and maintenance of soil structure have driven the adoption of conservation tillage practices in Central West Farming Systems districts. The longer term impact of a one off strategic tillage on the farming system is a hot topic of current producer discussion and research. A major short term disadvantage to a cultivation to improve yield potential is that it may result in rapidly drying seed bed conditions at the optimum sowing time. It is well recognised that timely sowing is a critical driver to profitable canola production. Cultivation can also stimulate buried weed seeds to germinate, creating new weed issues on otherwise clean paddocks.

Acknowledgments
CWFS would like to acknowledge the support provided by the co-operating farmers, without their in-kind support the trials would never happened. The support provided by AgGrow Agronomy and Research at Rankins Springs site

was well beyond any simple contractual arrangement between themselves and CWFS. Matt McRae, Walkers Ag N Vet, Forbes is also acknowledged.

Photographs of Rankins Springs Site
This site was managed by AgGrow Agronomy and Research.

Photograph 1: Rankins Springs site prior to sowing.

Photograph 2: Rankins Springs 48 days after sowing

Photograph 3: Standing stubble treatment 48 days after sowing

Photograph 4: Burnt stubble treatment 48 days after sowing

Photograph 5 Cultivated stubble 48 days after sowing