Impact of Stubble Height on Fallow Efficiency

Trial ID: **BB2110** **Location:** **Millie** **Trial Year:** **2021**
Investigator: **Brendan Burton**

In the northern grains region, crops are generally grown on stored soil water with rainfall accumulated over fallow periods. Fallow water efficiency (the % of rainfall received that is stored in the soil) is a measure of how effectively our systems capture and retain soil moisture for following crops.

Fallow efficiency is affected by many factors including; the amount of stubble cover, rainfall pattern, length of fallow period, starting soil moisture levels and soil characteristics. In conservation tillage, average fallow water efficiency is often expected to be ~20-25%, however fallow efficiencies can be negative (soil drier at the end of the fallow compared to the start) or as high 30-50%.

'Proof of concept' research, initiated in 2014 and 2015, demonstrated that increasing groundcover from levels of ~30-35% (in commercial standing stubble) to >100% significantly improved fallow efficiency. This level of impact was created by the addition of stubble at quantities of 5-40 t/ha and resulted in depths of groundcover of ~1-18 cm. The challenge is whether it is possible to achieve significant gains under commercial cropping conditions. In recent years, NGA has been involved in assessing the impact on fallow water efficiency from changing common agronomic practices.

This trial was part of a project evaluating the impact of harvest stubble height (and management) on fallow efficiency and the performance of the following crop.

Objective:	**To evaluate the impact of harvest stubble height on fallow efficiency**		
Establishment Crop (2020):	**Wheat cv. Suntop**		
Establishment Crop Harvest Date:	**15/11/2020**		
Establishment Crop Stubble Height:	**Tall: ~67cm**	**Medium: ~33cm**	**Short: ~20cm**
Evaluation Crop (2021):	**Canola 43Y94**		
Evaluation Crop Planting Date:	**~28/04/2021**		
Evaluation Crop Harvest Date:	**3/11/2021**		
Row Spacing:	**67cm (disc planter)**		
Trial Design:	**Randomized Complete Block of 3 treatments x 9 reps**		
Plot Size:	**12m x 1000m**		
Keywords:	**Stubble height, fallow efficiency**		

A commercial wheat crop was harvested in November 2020 with a stripper front, leaving the stubble at ~70cm height. In early January 2021, the grower created comparison treatments where the stubble was slashed to a height of ~33cm or to ~20cm. In both cases, the slashed dry matter remained in the plots. The delay in imposing treatments, meant significant fallow rainfall (~200mm) had already been received prior to trial establishment.

Groundcover levels were not assessed at trial establishment. However, all treatments had groundcover levels between 65-70% when EM assessments were conducted in late April 2021.

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Fallow Efficiency Measurement

An EM38 was used to assess electrical conductivity and provide a relative measure of differences in soil water between treatments. Advantages of the EM38 are portability, the ability to rapidly capture multiple measurements in each plot and the lack of subsequent sample handling and drying. The EM38 provides a measurement of conductivity in three soil depths; to 37.5cm, to 75cm and to 1.5m.

The major disadvantage is that unless an accurate soil characterisation is available for the site, the results simply show relative differences between treatments rather than an absolute quantity of soil water. The other disadvantage is it becomes very difficult to calculate an actual fallow efficiency measurement.

EM38 Assessments during fallow

Assessment Date		24/02/2021			21/04/2021		
Assessment Type		EM38 to 0.375m	EM38 to 0.75m	EM38 to 1.5m	EM38 to 0.375m	EM38 to 0.75m	EM38 to 1.5m
Assessment Unit		mS/m	mS/m	mS/m	mS/m	mS/m	mS/m
ARM Action Codes				AL			
Trt No.	Treatment						
1	Tall - 67cm stubble	99b	144b	193-	105-	151-	206-
2	Medium - 33cm stubble	103a	147a	194-	106-	152-	206-
3	Short - 20cm stubble	103a	149a	197-	106-	151-	206-
	LSD P=.05	2.2	3.1	nsd	nsd	nsd	nsd
	Treatment Prob.(F)=	0.0015	0.0141	0.2496	0.7298	0.8645	0.9641

Means followed by same letter do not significantly differ (P=.05, LSD)
Mean comparisons performed only when AOV Treatment P (F) is significant at mean comparison OSL.
nsd = no significant difference

Evaluation Crop: Emergence and Yield

Crop Name		Canola 43Y94	
Assessment Date		25/05/2021	3/11/2021
Assessment Type		EMERGENCE	YIELD
Assessment Unit		/m²	t/ha
Trt No.	Treatment		
1	Tall - 67cm stubble	14.4b	3.63-
2	Medium - 33cm stubble	16.1b	3.64-
3	Short - 20cm stubble	19.9a	3.65-
	LSD P=.05	2.8	nsd
	Treatment Prob.(F)=	0.0030	0.9766

Yield cv = 5.4%

Means followed by same letter do not significantly differ (P=.05, LSD)
Mean comparisons performed only when AOV Treatment P (F) is significant at mean comparison OSL.

Assessment Type
EM38 = Soil conductivity
Assessment Unit
mS/m = millisiemens per metre
ARM Action Codes
AL = Automatic log transformation of X+1

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Conclusions:

This trial was initiated by the grower after harvesting a wheat crop using a stripper front in November 2020. The stripper front left standing stubble ~67 cm tall. Wet conditions following harvest prevented stubble height treatments being imposed until January 2021.
Slashing was then conducted to establish a trial that evaluated tall (~67cm stubble), medium (~33cm stubble) and short (~20cm stubble).

EM38 measurements were taken in February 2021, ~ 5 weeks after trial establishment. EM38 assessment was also conducted in April 2021, shortly prior to planting of the following crop (canola). The EM38 measures electrical conductivity and is used to obtain a measure of the treatment impact on soil water.

Conductivity measurements to 0.375 and 0.75 m soil depth in February found significantly higher readings where stubble had been slashed compared to the tall stubble. There was no apparent difference between the short and medium stubble heights. Slashed stubble was not removed from plots with the cut stubble well distributed. The difference in EM38 readings in February 2021 may have been due to increased fallow efficiency from the slashed treatments during the 5 weeks post trial initiation or simply variability across the trial site. When EM38 readings were taken at the end of the fallow there were no significant differences between treatments at any depth.

Total rainfall over the fallow from previous harvest until planting in 2021 was ~ 610mm with ~410mm received between trial establishment and planting in 2021. Site access due to wet conditions in February and March and covid border issues did not permit an interim fallow assessment. The absence of any difference between treatments may have been due to the soil profile completely refilling during the fallow period, with push probes in May 2021 indicating the soil was wet to 1.2m. Alternatively varying stubble height did not provide a significant impact on fallow water accumulation

Canola establishment was assessed in May 2021. Emergence counts in the short stubble treatment were significantly larger than in the medium and tall stubble treatments. It is suspected that the reduced emergence in taller stubble treatments was from a combination of planting difficulties in the taller stubble and possibly higher levels of mouse damage, preferring to shelter in the taller stubble plots.

The canola was harvested commercially in November 2021. There were no differences in yield between treatments. Yields for all treatments were in excess of 3.6 t/ha. The crop had compensated for any difference in plant stand.

In this situation, with a delayed trial establishment and high levels of fallow rainfall, there was no indication of any benefit in fallow efficiency or subsequent crop performance from the stubble retained at stripper harvested height.

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Crop Description	
2020 Crop 1:	Wheat cv. Suntop
Harvest Date:	15/11/2020
Harvested Width:	12m
Harvested Length:	1,000m
Harvest Equipment:	Stripper Front
2021 Crop:	Canola 43Y94
Planting Date:	~28/4/2021
Planting Equipment:	Disc
Row Spacing:	67cm
Harvest Date:	3/11/2021
Harvest Equipment:	Commercial Header

Rainfall:

Closest Weather Station:	Silo -29.8, 149.6
Distance, Unit:	~13km

Monthly Rainfall Totals:

Period	Amount	Unit
November 2020	4	mm
December 2020	170	mm
January 2021	45	mm
February 2021	117	mm
March 2021	263	mm
April 2021	12	mm
May 2021	18	mm
June 2021	48	mm
July 2021	35	mm
August 2021	28	mm
September 2021	62	mm
October 2021	39	mm
November 2021	63	mm