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Impact of Sorghum Row Spacing & Plant Population on Fallow Efficiency

Trial ID: LB2025

Location: Springvale
Investigator: Linda Bailey

Trial Years: 2020 & 2021

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 a range of 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%. Strategies that reliably improve fallow water efficiency are likely to also provide benefits in the water use efficiency of the following crop. Increased amounts of soil water at planting are likely to facilitate increased amounts of soil water being available at the critical crop stages of flowering and grain production.

One of the more manageable factors impacting fallow water efficiency is the amount and distribution of stubble cover. This trial was part of a project to evaluate the magnitude of impact from varying row spacing and plant population in the 'establishment' crop and the impact of those changes on fallow efficiency and the production of the 'evaluation' crop. Sorghum was the trial 'establishment' crop and also the 'evaluation' crop. The primary objective was to determine the impact on fallow efficiency but the impact of those changes on the 'establishment' crop production were also assessed.

Objective:	To evaluate the impact of sorghum row spacing and plant population on fallow efficiency
Establishment Crop:	Sorghum cv. A75
Planting Date 1:	13/01/2021
Planting Details:	Direct drilled using a double disc MaxEmerge XP
Standard Grower Set-up:	1 m row spacing & 60,000 seeds/ha
Harvest Date 1:	09/08/2021

Evaluation Crop:	Sorghum cv. MR Taurus
Planting Date 2:	19/11/2021
Planting Details:	Direct drilled using a double disc MaxEmerge XP
Harvest Date 2:	16/04/2022
Plot Size:	12 m x 480 m
Trial Design:	Randomized complete block with 4 treatments x 6 replications
Keywords:	Fallow efficiency, sorghum, row spacing, plant population

Methodology

This trial was primarily designed to compare 3 planting configurations:

1. 100 cm row spacing targeting a population of ~50,000 plants/ha (**Grower Standard Practice**).
2. 50 cm row spacing, standard population - achieved by double planting plots but with ~ halved planting rate in each planting row.
3. 50 cm row spacing, double standard population - achieved by double planting plots using treatment 1 planting rate.
4. In addition, the grower wanted to evaluate a double skip configuration (2 rows planted, 2 rows skipped) using 50 cm row spacing, and standard population - achieved by double planting plot, skipping rows and using treatment 1 planting rate.

Ideally, treatment 2 would have the equivalent plant population to treatment 1 but distributed over twice as many rows. Treatment 3 would have double the plant population of treatment 1 with the same number of plants/m row but twice as many rows. Treatment 4 would have the same plant population as treatment 1 with the same number of plants/m row and the same number of rows but in a different configuration.

NB Despite the planned approach, the achieved plant density for treatment 2 was significantly higher than treatment 1. Treatments 3 and 4 were close to the plant population targets. The first table on the following page shows the achieved plant stands.

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Establishment Crop Assessments

Crop		Sorghum A75		
Assessment Date		1/02/2021	1/02/2021	9/08/2021
Assessment Type		EMERGENCE	EMERGENCE	YIELD
Assessment Unit		/m row	/m ²	t/ha
Sample Size		8 m row	8 m row	12 m x 480 m
Plant 1-Evaluation Interval		19 DAP1	19 DAP1	208 DAP1
ARM Action Codes		AL	AL	
Trt No.	Planned Establishment Year Configuration			
1	100 cm row spacing, 5 plants/m ²	4.8b	4.8d	2.79a
2	50 cm row spacing, 5 plants/m ²	4.2c	8.4b	2.18b
3	50 cm row spacing, 10 plants/m ²	5.2a	10.5a	1.74c
4	50 cm row spacing, 5 plants/m ² (Double skip)	5.4a	5.4c	2.76a
LSD P=.05		0.02t	0.02t	0.171
Treatment Prob.(F)=		0.0001	0.0001	0.0001

Yield cv = 5.9%

Fallow Assessments

Crop Name		Fallow	
Assessment Date		13/08/2021	6/09/2021
Assessment Type		GROUND COVER	EM38 to 1.5 m
Assessment Unit		%	mS/m
Sample Size		Plot	4 reps/ plot
Harvest 1-Evaluation Interval		4 DAH1	28 DAH1
Trt No.	Planned Establishment Year Configuration		
1	100 cm row spacing, 5 plants/m ²	48c	183a
2	50 cm row spacing, 5 plants/m ²	56b	171b
3	50 cm row spacing, 10 plants/m ²	61a	170b
4	50 cm row spacing, 5 plants/m ² (Double skip)	37d	182a
LSD P=.05		5.0	9.6
Treatment Prob.(F)=		0.0001	0.0150

NB When planting the 'evaluation' crop, the grower planted treatments 2, 3 and 4 using his standard 1 m row and ~5 plants/m² configuration. However, he changed the planting configuration for treatment 1 to 50 cm rows on double skip. Consequently, treatment 1 results were not able to be analysed but the measured data is included in the table below.

Evaluation Crop Assessments

Crop Name		Sorghum MR Taurus			Fallow	
Assessment Date		24/01/2022	24/01/2022	14/04/2022	26/04/2022	26/04/2022
Assessment Type		EMERGENCE	EM38 to 1.5 m	YIELD	EM38 to 0.75 m	EM38 to 1.5 m
Assessment Unit		/m ²	mS/m	t/ha	mS/m	mS/m
Sample Size		4 m row	4 reps/ plot	12 m x 480 m	4 reps/ plot	4 reps/ plot
Plant 2-Evaluation Interval		66 DAP2	66 DAP2	146 DAP2	12 DAH2	12 DAH2
Trt No.	Planned Establishment Year Configuration					
1	100 cm row spacing, 5 plants/m ²	4.8*	150*	2.47*	119*	177*
2	50 cm row spacing, 5 plants/m ²	5.1a	144b	2.25-	114b	171-
3	50 cm row spacing, 10 plants/m ²	5.0ab	151a	2.26-	119a	175-
4	50 cm row spacing, 5 plants/m ² (Double skip)	4.7b	142b	2.40-	111b	167-
LSD P=.05		0.3	6.0	nsd	4.1	7.7
Treatment Prob.(F)=		0.0485	0.0221	0.2802	0.0059	0.0813

Yield cv = 7.4%

Means followed by same letter do not significantly differ (P=.05, LSD)

t=Mean descriptions are reported in transformed data units, and are not de-transformed.

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

* = not analysable due to changed planting configuration

Impact of Sorghum Row Spacing & Plant Population on Fallow Efficiency

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Location: Springvale

Trial Years: 2020 & 2021

Conclusions:

The trial was designed to investigate the impact of sorghum row spacing and plant population on fallow efficiency. A late sown crop of Pioneer A75 sorghum was made in mid-January 2021 using a double disc MaxEmerge XP planter on 100 cm rows at ~60,000 seeds/ha (grower's standard practice).

Crop establishment was assessed 19 days after planting (19 DAP1) with ~5 plants/m² in the grower's standard practice (treatment 1). The achieved plant populations allowed effective comparisons of the standard practice with 50 cm rows and 10 plants/m² (treatment 3) and 50 cm rows with 5 plants/m² on a double skip (treatment 4). Treatment 2 had a significantly higher plant population than planned (8 plants/m² rather than 5) on 50 cm row spacings.

Harvest was delayed until early August due to prolonged, poor drying conditions. There was a total of ~375 mm in-crop rainfall but ~115 mm was received after the crop was mature in mid-May. The sorghum was harvested at 208 DAP1 with the grower standard configuration yielding ~2.8 t/ha.

There was no yield benefit from any configuration compared to the grower's standard practice with only the 50 cm, 5 plants/m² double skip configuration providing equivalent yield. Treatments 2 and 3 (~8 or 10 plants/m² on 50 cm row spacing) were significantly lower yielding (-0.6 and -1.0 t/ha respectively) than both the grower's standard and the double skip with the 10 plants/m² treatment significantly lower in yield than all other configurations.

Sorghum groundcover was visually assessed 4 days after harvest (4 DAH1) with significantly increased groundcover levels (56 and 61%) from both 50 cm, increased plant population treatments compared to the grower's standard (48%). The skip row configuration had significantly lower groundcover than all other treatments (37%). Unreplicated dry matter cuts indicated the solid row configurations (treatments 1-3) had ~1-2 t/ha extra stubble than in the double skip (7-8 t/ha v 6 t/ha).

An EM38 assessment was conducted 28 days after harvest with negligible rain (~6 mm) between harvest and assessment. Despite producing higher yields, the grower's standard and the double skip treatment had significantly higher EM readings (wetter) than the 50 cm, higher plant population treatments. This is most likely due to the higher plant populations using more water in vegetative growth and running out prior to grain fill.

The site was planted to MR Taurus sorghum in mid-November 2021 after a short (102 day) fallow. Over the fallow the site received ~170 mm of rainfall. Treatments 2, 3 & 4 were planted on solid 1 m rows, but treatment 1 plots were planted using 50 cm double skip rows. Results from treatment 1 were excluded from any analysis in the 'evaluation' crop phase.

Sorghum establishment was counted in January 2022. There was a clear trend to increased counts in treatments with increased plant population in the establishment year with the population in treatment 2 significantly larger than in treatment 4 (double skip in 2021).

An EM38 assessment was conducted at the same date, following ~240 mm of in-crop rainfall. Treatment 3 (50 cm rows and 10 plants/m² in 2021) had significantly higher EM38 readings (increased moisture) compared to both treatments 2 and 4. This contrasted to the fallow assessment in September 2021 where treatment 3 was significantly drier than treatment 4.

A month prior to harvest, the crop experienced hail and fall armyworm damage. At harvest, there were no significant yield differences with yields of only ~2.3 – 2.4 t/ha. EM38 assessment 12 days after harvest, at 75 cm depth, showed significantly increased moisture in treatment 3 compared to either treatment 2 or 4. There was also a clear trend at the 150 cm depth for lower moisture levels where the skip row treatment had been planted in 2021.

This trial was conducted under unusual conditions with a very late planting in year 1 (mid-January) and a harvest delayed until August. Narrow sorghum row spacing and increased plant population used more soil moisture in the year 1 crop than the grower standard or double skip configuration. The narrow row spacing, high plant population treatments however recorded significantly lower yields than both the grower standard and double skip configuration. There was a significant improvement in fallow water efficiency in year 2 from the 50 cm and 10 plants/m² treatment when assessed both in or following the evaluation crop. However, there was no impact on yield. In this situation there was evidence that increased plant population improved subsequent fallow efficiency but no indication of any benefit in crop production in either the establishment or evaluation crop. No clear conclusions could be drawn on the row spacing impact.

Impact of Sorghum Row Spacing & Plant Population on Fallow Efficiency

Trial ID: **LB2025**Location: **Springvale**Trial Years: **2020 & 2021**Assessment Type

EM38 = Soil conductivity

Assessment Unit

mS/m = Millisiemens per metre

ARM Action Codes

AL = Automatic log transformation of X+1

DAP1 = Days after Planting 1

DAP2 = Days after Planting 2

DAH1 = Days after Harvest 1

DAH2 = Days after Harvest 2

Crop Description	
Crop 1:	Sorghum cv. A75
Planting Date:	13/01/2021
Planting Rate:	60,000 seeds/ha
Planting Method:	Direct Drilled
Planting Equipment:	MaxEmerge XP Double Disc
Row Spacing:	1 m
Harvest Date:	9/08/2021

Crop 2:	Sorghum cv. MR Taurus
Planting Date:	19/11/2021
Planting Rate:	60,000 seeds/ha
Planting Method:	Direct Drilled
Planting Equipment:	MaxEmerge XP Double Disc
Row Spacing:	1 m
Harvest Date:	14/04/2022

Rainfall:

Closest Weather Station:	SILO grid pt -27.35, 151.20
Distance, Unit:	2 km

Month	Total Rainfall (mm)	
January 2021	29	Sorghum planted 13/1
February	19	Sorghum emergence count 1/2
March	164	
April	20	
May	45	
June	50	
July	46	
August	8	Sorghum harvested 9/8 Groundcover 13/8
September	7	EM38 survey 6/9
October	82	
November	196	Sorghum planted 19/11
December	102	
January 2022	37	Sorghum emergence count 24/1
February	203	
March	124	
April	12	Sorghum harvested 14/4 EM38 survey 26/4