Integrating software tools and seasonal climate outlooks to optimise wheat gross margin profits at Merredin, Western Australia.

Meredith Fairbanks and Alexandra Edward

Department of Agriculture, Western Australia, Locked Bag 4 Bentley, WA 6983. Email mfairbanks@agric.wa.gov.au

Abstract

The Department of Agriculture (Western Australia) is developing a prototype climate analogue selection system (Global ENSO Sequence System (GESS)) which indicates potential growing season rainfall for the current season. This paper looks at how the information from GESS together with the decision support tool, Season Protein Likelihoods and Tradeoffs (SPLAT), can be used to make farming decisions to increase the potential gross margin return. The potential gross margin for Merredin in the 2002 and 2003 season, using GESS climate outlook, is compared to the expected gross margins made when expecting the average growing season rainfall, and the actual growing season rainfall. This paper found that by making decisions based on the seasonal outlook using GESS, Merredin farmers in 2002 and 2003, would receive a larger profit than if they had made farming decisions based on receiving and reacting to the average growing season rainfall.

Media summary

Farming decisions made using the prototype climate outlook developed by the Department of Agriculture, Western Australia, will potentially enhance farm profits in a wetter than normal season and reduce losses in a drier than normal season.

Keywords

Growing season rainfall, farming decisions, input costs, gross margin

Introduction

The Department of Agriculture, Western Australia (DAWA), provides a growing season outlook in February with monthly updates until the end of the season, and then projects an outlook for next years growing season in November. These outlooks include identification of five analogue years, which are calculated by DAWA's prototype Global ENSO Sequence System (GESS), through pattern matching against several climate variables such as Sea Surface Temperatures (SST) and mean Southern Oscillation Index (SOI) (Stephens and Lamond, 2001, 2003; Van Loon and Shea, 1987). By looking at the median analogue year growing season rainfall, growers potentially get a sense of when and how much rain might fall in the coming year as a basis for making tactical management decisions such as rates of nitrogen application, wheat variety and area to sow.

Methods

SPLAT is an Excel based tool which predicts the range of possible yields and proteins for a range of season types for certain wheat varieties at any given sowing date. SPLAT was used to identify optimal Gross Margin returns by varying N rate and wheat variety under three scenarios, in the 2002 and 2003 growing seasons in Merredin, considering 'light' and 'heavy' soil areas:

1 The "Average" farmer – N rate and wheat variety required to give the highest gross margin if the farmer planned for a median year (decile 5) growing season rainfall.

2 The GESS farmer - N rate and wheat variety required to give the highest gross margin if the farmer was planning on receiving the same rainfall decile as the GESS median analogue year.

3 The “Perfect knowledge” rainfall farmer –N rate and wheat variety required to give the highest gross margin if the farmer had planned with perfect knowledge of the year ahead.

Results

2002

The median growing season (April – October) rainfall (decile 5 year) for Merredin based on the last 100 years is 246 mm. In February 2002 the growing season rainfall for the five GESS analogues ranged from decile 9 to decile 1. The median of the analogue years indicated a below average growing season rainfall (decile 3, 211 mm) and the actual growing season rainfall was 170 mm (decile 1). The sowing date algorithm within DAWA’s potential yield calculator (PYCAL) indicated a potential sowing date of 16th June.

The potential 16th June sowing date suggest a short season variety would optimise Gross Margin profit in the Merredin area. In a dry season, when the yield is low, wheat with a high protein percentage gives greater returns than one with a low protein. For this reason, SPLAT indicated that a hard wheat variety (AHard) in 2002, gave a higher gross margin return than an APW variety.

2002 – Light soil paddocks

For an average (decile 5) growing season on light soil, SPLAT indicated that N application of 10 kg/ha would have given the best expected gross margin of $66 /ha. However, if farmers had put on 10 kg/ha they would actually have made a loss of $15 /ha in 2002 (Table 1).

Table 1. Decisions on nitrogen applied (kg/ha) and gross margin (GM $/ha) return from SPLAT in Merredin in 2002 on light soil.

Rainfall outlook	N applied (kg/ha)	Expected GM ($/ha)	Actual GM ($/ha)	Difference from expected GM ($/ha)	Difference from optimum GM ($/ha)
“Average” (decile 5)	10	66	-15	- 81	-10
GESS (decile 3)	0	40	-5	- 45	0
Perfect (decile 1)	0	- 5	-5	0	0

Using the GESS prediction with a decile 3 year, SPLAT indicated that no additional N would give the best possible return of $40 /ha. However, a decile 1 year resulted and the farmer would have lost $5 /ha. 2002 was an El Nino year, and the ‘perfect knowledge’ farmer would have expected a $5 /ha loss, and therefore would either not have sown on their light soil or cut costs in other areas.

By reducing other input costs (for example; reducing chemicals eg fungicide seed dressings, doing their own maintenance, borrowing equipment, etc) by 20% as a reaction to the ‘given’ seasonal conditions, it is expected all farmers would have received a positive gross margin return. The average farmer, applying 10 kg/ha N would have made $9 /ha and the GESS farmer would have made $19 /ha.

Whilst GESS did not predict a year as dry as the actual season (decile 3 expected versus the decile 1 received), the nitrogen levels suggested by SPLAT (0) were the same as those for the farmer with prefect knowledge. If however, the farmer budgeted for the expected gross margins indicated by GESS he would have only received 30% of expected returns, which although low, is far better than the 10% received by the “average” farmer.

2002 – Heavy soil paddocks

SPLAT indicated that no additional N would be best for all scenarios. The "average" farmer would have expected a positive return of $ 49 /ha from wheat on heavy soil, but instead would have received a significant loss $69 /ha (Table 2). By comparison, the GESS farmer would have expected a $7 / ha loss. If however, they reduced other input costs by 20%, the "average" and GESS farmer would have expected a positive return of $73 /ha and $17 /ha respectively, but would have had $ 45 /ha loss in both cases. So the "average" and GESS farmers would, by reducing the input costs (as the season progressed) by 20%, still would have lost money if they had farmed their heavy paddocks in 2002. Knowledge of the actual season in 2002 would have enabled farmers with duplex soils using SPLAT to predict losses on these soils and change management accordingly.

In 2002, Merredin farmers following GESS and using SPLAT would recognise financial benefits of using an Australian Hard (AHard) wheat short season variety. The impact of poor seasonal prediction is more apparent on heavy soils and consequently farms with greater proportions of heavy soils would have been more disadvantaged in 2002. Farmers who took note of GESS analogues in February would have been better prepared for a drier than normal season and made $ 10 /ha more on light soils than farming on "average", the same as if they had perfect knowledge by utilising information to optimise Gross Margin profit with wheat variety selection and appropriate nitrogen rate applications.

Table 2. Decisions on nitrogen applied (kg/ha) and gross margin (GM - $/ha) return from SPLAT for Merredin in 2002 on heavy soil.

Rainfall outlook	N applied (kg/ha)	Expected GM ($/ha)	Actual GM ($/ha)	Difference from expected GM ($/ha)	Difference from optimum GM ($/ha)
Average (decile 5)	0	49	- 69	-118	0
GESS (decile 3)	0	-7	- 69	-62	0
Perfect (decile 1)	0	- 69	- 69	0	0

2003

For 2003, the GESS analogue years selected in February ranged from decile 3 to 9. The median GESS analogue year growing season rainfall was 262 mm (decile 6), while the actual growing season rainfall was 283 mm (decile 7).

Based on the actual season, SPLAT indicated that a short season APW wheat variety would give a better return (by $40 /ha), than a medium season wheat variety, even though the sowing date of 18th May, (calculated by PYCAL), is considered a mid start and a medium season wheat variety is generally used.

2003 – Light soil paddocks

Using a short season APW wheat variety, planning for an average season and applying 70 kg/ha N would have led to a net return of $169 /ha. However, the actual return would have been $ 215 /ha with this level of N, for this season (Table 3). Based on the GESS seasonal outlook of a decile 6, SPLAT suggested that a nitrogen application of 100 kg/ha with an expected net return of $200 /ha, but as the actual rainfall was decile 7, the net return increased to $230 /ha. Both the "average" farmer and the GESS farmer's expected profit increased, with the GESS farmer receiving a further $15 /ha. As the nitrogen rate of 100 kg/ha was

also the optimum for the actual rainfall (decile 7), the GESS farmer received the same return as one who planned with perfect knowledge of the coming season.

Table 3. Decisions on nitrogen applied (kg/ha) and gross margin (GM - $/ha) return from SPLAT in Merredin in 2003 on light soil using an APW short variety wheat.

Rainfall outlook	N applied (kg/ha)	Expected GM ($/ha)	Actual GM ($/ha)	Difference from expected GM ($/ha)	Difference from optimum GM ($/ha)
Average (decile 5)	70	169	215	46	-15
GESS (decile 6)	100	200	230	30	0
Perfect (decile 7)	100	230	230	0	0

2003-Heavy paddocks

SPLAT indicated that, if farming on the “average”, applying 30 kg/ha N would give an expected return of $124 /ha, and as it turned out to be a decile 7 year, profit would have been $214 /ha. The ‘GESS’ farmer, expecting a decile 6 season, would have increased their gross margin by $46 /ha relative to their expected gross margin, through applying 50 kg/ha of N. The ‘perfect’ farmer would have applied 80 kg/ha N, making $235 /ha; $21 /ha more than the “average” farmer and $16 /ha more than the GESS farmer (Table 4).

Table 4. Decisions on nitrogen applied (kg/ha) and gross margin (GM - $/ha) return from SPLAT in Merredin in 2003 on heavy soil using an APW short variety wheat.

Rainfall outlook	N applied (kg/ha)	Expected GM ($/ha)	Actual GM ($/ha)	Difference from expected GM ($/ha)	Difference from optimum GM ($/ha)
Average (decile 5)	30	124	214	90	-21
GESS (decile 6)	50	173	219	46	-16
Perfect (decile 7)	80	235	235	0	0

Conclusions

Based on these two contrasting seasons at Merredin in WA, farmers using the GESS system to identify analogue seasons and manage accordingly can be better off than those that only manage for the average season. Further, by making use of decision support tools such as SPLAT, PYCAL and Select Your Nitrogen (SYN), farmers can identify best likely nitrogen rates, sowing opportunities, wheat varieties and expected gross margins. SPLAT can also indicate gross margin returns on two different soil types, and therefore can indicate when culling or increasing paddocks is appropriate. ‘Reacting’ positively (that is, being ‘flexible’) to in-crop seasonal conditions can further improve Gross Margin profitability.

However, it appears that there are two areas where the GESS prediction has less value. GESS system is inherently conservative as it is unlikely all (or even 3) analogues would be long way from average, even if setting up for an extreme season. Hence in 2002 farmers may not have reduced the area sown on heavier soil types as much as necessary due to the expected profit on these soil types, and in 2003 farmers would have underestimated the amount of nitrogen required to reach optimum gross margins. In both season types GESS based farmers were ahead of those farming to the "average" and did not lose significant profit compared to those having perfect knowledge of the actual season.

Only varying levels of N were used in this study, but there are a number of other inputs that can be varied accordingly to season expectations – eg fungicides and these should be considered. This study showed that applying the right level of N in the right season is far more profitable than applying N appropriate to an average season. However, as the timing of N application is now becoming more flexible with the introduction of liquid N, farmers might elect to apply some N at sowing and some later when they have a better idea of the season.

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