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Determining canola physiological maturity with remote sensing

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Key findings

- Relationships between remote sensing data and hand harvest data were identified for some varieties and sowing dates, suggesting remotely sensed data might be useful for determining canola maturity.
- Both variety and sowing date alter the relationship between remotely sensed data and hand harvested data.

Introduction

Physiological maturity is the stage at which canola is windrowed or treated with desiccants to aid harvesting. Currently, physiological maturity is determined by hand sampling and subjectively measuring seed colour change. It can be difficult to pinpoint the correct timing for optimum yield due to the speed at which seed colour can change, particularly on a commercial scale across paddocks with variable soil types, aspect and topography.

This project conducted a preliminary investigation to determine whether an objective remote sensing method could be a feasible alternative to hand sampling, and to guide further research.

Treatments

Treatments were selected out of a large variety × sowing date experiment to source a range of varieties and maturity dates to test.

Variety

Nuseed Diamond	Fast spring hybrid, conventional herbicide
Pioneer® 44Y90 (CL)	Mid–fast spring hybrid, Clearfield (CLF)
ATR Bonito^(b)	Mid–fast spring open pollinated, triazine tolerant
Archer	Slow spring hybrid, CLF

Sowing date (SD)

SD1: 27 March 2019

SD2: 14 April 2019

SD3: 30 April 2019

Methodology

Grain sampling

Peak flowering date and visual assessment were used to determine when to begin sampling each treatment before physiological maturity. The aim was to capture data before and beyond physiological maturity to accurately pinpoint the date each variety reached maturity.

Sampling consisted of cutting whole plants from an area of 30 cm × 6 rows. Samples were air dried and stored until processed to determine thousand seed weight (TSW) and harvest index (HI). These measurements were used to identify the date of physiological maturity (Graham et al., 2017). Sampling took place three times each week, subject to field conditions.

Remote sensing

On each sampling date, remote sensing data was collected with a Micasense RedEdge multispectral sensor mounted on a DJI Matrice 100 drone. Imagery was collected at the same time each day (11 am), flight height (50 m), speed (5 m/s), overlap 80% and standardised with a reflectance panel. The Pix4D

This research paper is an extract from the publication *Southern NSW Research Results 2020*, available at
https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION software package was used to process the imagery data. Normalised difference vegetation index (NDVI) maps were developed and individual plot data extracted using QGIS software. Over the two-month sampling period, 30 images were collected.

Results

Figure 1 shows the relationship between TSW and HI and how physiological maturity or windrowing date can be determined from them. As grain matures, it increases in size to a maximum seed size before it plateaus and can even decline. Increases in HI as the crop reaches physiological maturity can indicate an increase in grain size. The point at which HI starts to decline can indicate losses from pods shattering due to the crop becoming over ripe. This relationship indicates the optimum window for windrowing. In Figure 1, for Archer sown on 30 April, the optimum time for windrowing was between 6 November and 11 November.

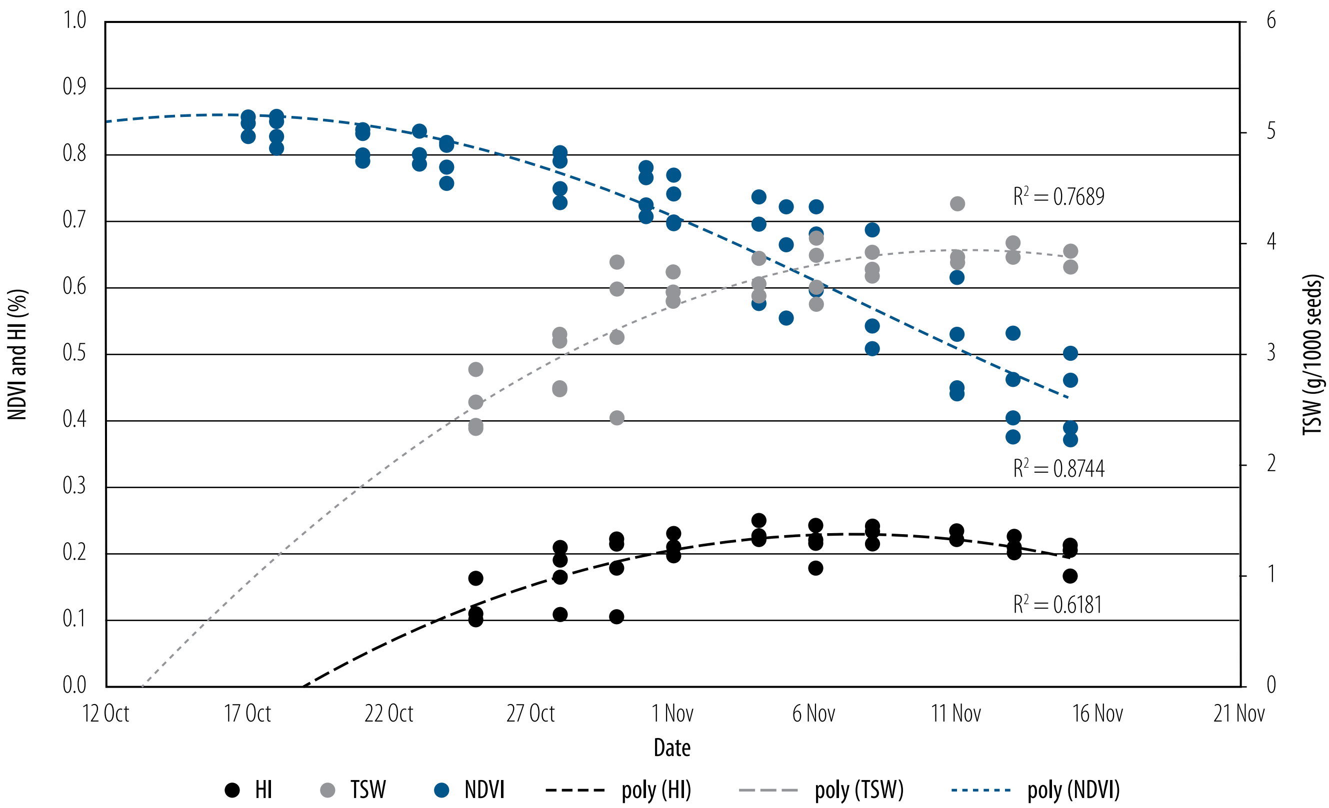

Figure 1 Time series of NDVI, TSW and HI for Archer sown on 30 April.

Some treatments had strong relationships between NDVI and TSW. ATR Bonito⁽ᴰ⁾ sown on 14 April is an example (Figure 2). As NDVI drops, seed size continues to increase until it begins to plateau at approximately 4 g/1000 seeds, at which point NDVI reduces to 0.6. In the high yielding irrigated experiment, all plots reached an NDVI of approximately 0.85. Monitoring NDVI via imaging might therefore be used to determine physiological maturity, assuming the relationship can be shown to be consistent across varieties and seasons.

Only four of the 12 treatments provided useful results for determining the relationship between NDVI and TSW: ATR Bonito⁽ᴰ⁾ sown on 27 March and 14 April, Archer sown on 30 April and Nuseed Diamond sown on 27 March all exhibited relationships between NDVI and TSW (Table 1).

- Two treatments were lodged and therefore abandoned.
- Due to the limited plot area, only a short sampling window was available so physiological maturity was missed in two treatments, with sampling being too late and TSW already reaching maximum, or too early with TSW not reaching a maximum.

- Four treatments had the correct timing for physiological maturity, however, variability in these treatments resulted in poor relationships.

Table 1 Summary of the relationships between NDVI and maturity, based on TSW.

Variety	Sowing date	NDVI at maturity	R^2 (NDVI × TSW)
Archer	30 April	0.60	0.51
ATR Bonito	27 March	0.65	0.52
ATR Bonito	14 April	0.50	0.81
Nuseed Diamond	27 March	0.55	0.69

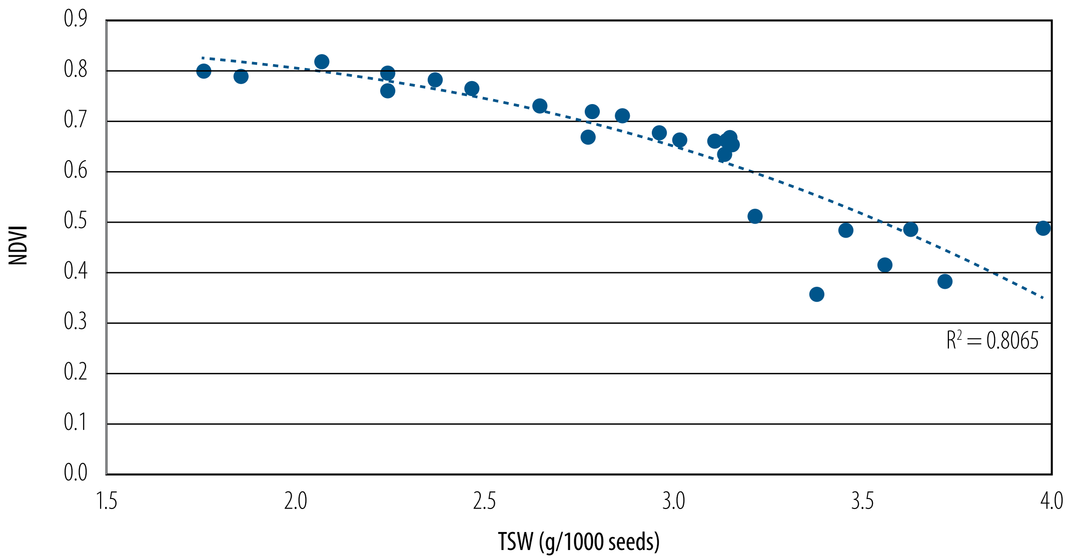

Figure 2 Relationship between NDVI and TSW for ATR Bonito[(b)] sown on 14 April.

Conclusion

The results show there is potential to use remote sensing to determine maturity with strong relationships found between NDVI and TSW for some varieties and sowing dates in this experiment. A more comprehensive experiment with larger plot areas and longer sampling periods would be needed to explore the differences between varieties and sowing dates as well as to further explore the reasons why some treatments had poor relationships as identified in this preliminary study. Data from multiple seasons would need to be collected to determine whether there are changes between seasons.

This research was only a preliminary investigation into whether the potential exists for using remote sensing in this way. Further research would need to include remote sensing data from satellite sources that would be more relevant for widespread industry use.

Reference

Graham R, Jenkins L, Hertel K, Brill R, McCaffery D and Graham N, 2017. Re-evaluating seed colour change in canola to improve harvest management decisions. *Doing more with less: 18th Australian Society of Agronomy Conference*, Ballarat, Australia, (eds GJ O'Leary, RD Armstrong and L Hafner), 24–28 September 2017.

Acknowledgements

This experiment was part of the 'Determining canola physiological maturity with remote sensing' project, BLG308, 1 September 2019 to 28 February 2020, a joint investment by GRDC and NSW DPI under the Grains Agronomy and Pathology Partnership (GAPP).

Thank you to Tony Napier for accommodating the experiment.