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Influence of photothermal quotient in the critical period on yield potential of canola

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Background:

Potential yield benchmarking is an important and established method to assess yield gaps and productivity. The relationship between temperature and radiation in the critical period for yield formation, defined as the photothermal quotient (PTQ), has been demonstrated to be an accurate predictor of potential yield in wheat. However, the relationship between yield and PTQ in the recently identified critical period for canola yield has received less attention and has not been defined for modern canola genetics (hybrids) and crop management practices. There is some evidence that the yield of canola may often be limited by low PTQ in Australia's higher rainfall zones when other agronomic factors are not limiting.

Objective:

To compile data from high-yielding (> 5 t/ha) canola crops in Australian irrigated and high rainfall environments to explore the relationship between temperature and radiation (PTQ) in the critical period on canola yield potential. We sought to determine the frequency with which PTQ was likely to limit yield relative to water and N supply under current management practices.

Methods:

We compiled data from a series of canola agronomic experiments across Australia's high rainfall zones including phenology, biomass, yield and yield components as well as water and N supply, temperature, and radiation in the critical period for canola. Relationships between PTQ in the critical period and canola yield were compared with simple and accessible seasonal potential yield calculators such as that developed by French and Schultz (1984) for water-limited yield, and more sophisticated daily timestep models such as APSIM which underpins yield predictions in the online YieldProphet calculator.

Results:

Our data revealed that the relationship between PTQ in the critical period and canola yield provides a reliable estimate of canola potential yield based on the highest yielding canola crops in Australia's high rainfall zone. This included a record 7.2 t/ha commercial crop in southern NSW. In these high rainfall environments, the relationship between water supply and yield are less reliable determinants of canola yield potential. Our data demonstrate that yield potential > 6t/ha, well above the national average, are frequent and could be achieved in higher rainfall zone sites with appropriate crop management to optimise the PTQ in the critical period. Highest yields came from a combination of higher biomass and higher harvest index suggesting the environmental drivers of these traits were favourable in the critical period.

Conclusions:

Our PTQ relationship predicts that canola yields greater than 6t/ha are attainable in the Australian HRZ if the critical period is aligned to the highest PTQ and other agronomic factors are well managed. This provides a framework for improvement for growers, agronomists, and breeders to re-consider temperature and radiation in the critical period as drivers of yield potential. A future focus for research could consider biomass accumulation and allocation during the critical period to improve yield further.

References:

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