Determining the Critical Period of Weed Control in Corn using UAV-based Remote Sensing

Anku Kenneth, Loveleen Dhillon, Rob Gulden, and Dilshan Benaragama

Department of Plant Sciences, Faculty of Agriculture and Food Sciences, University of Manitoba

Introduction

PROBLEM: Weed interference significantly reduces corn yield by over $30 million annually[1].

Current Approaches: The critical period of weed control (CPWC)
- crop growth
- generalized assumptions[2].

Though these methods are effective, yet they are labor-intensive and often overlook field variability.

GAP: Remote sensing (RS) can be utilized, yet its adoption in operational programs remains limited.

UAV-Based RS Approach

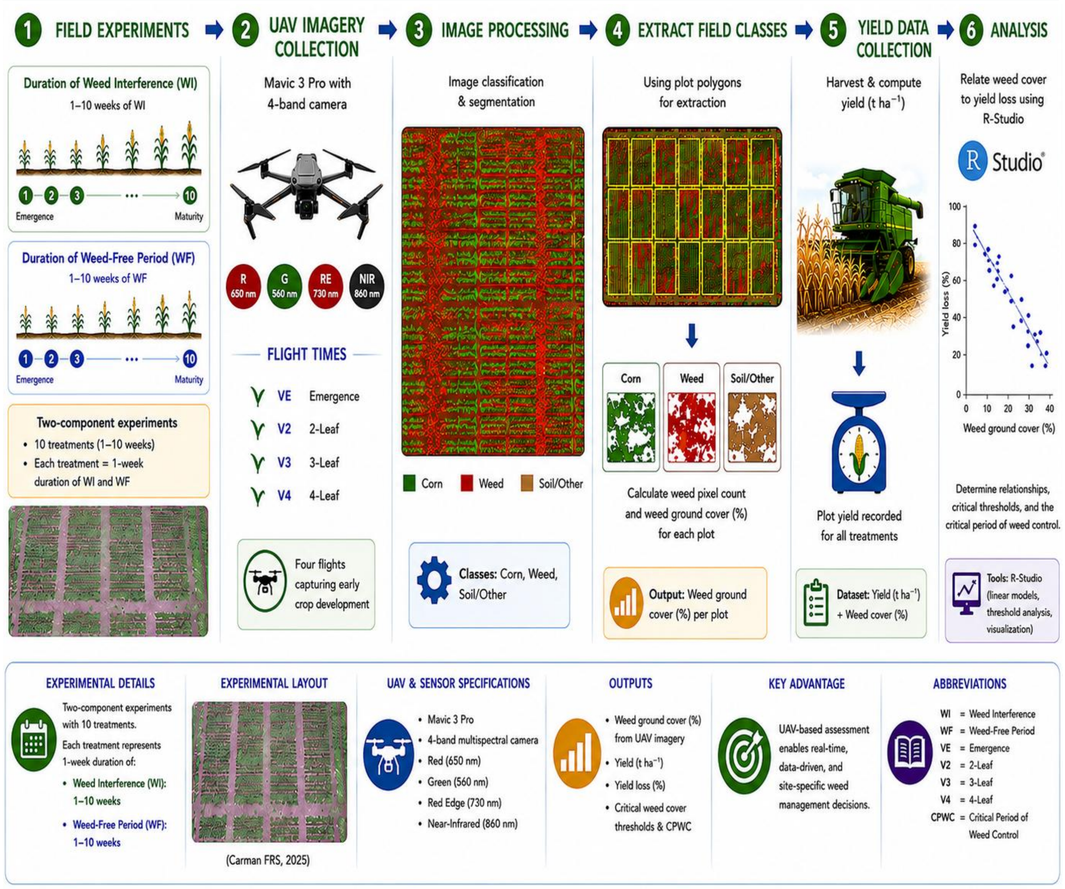
RGB & Multispectral imagery
- Crop & weed classification
  - Weed ground cover estimation
  - Yield loss prediction
  - CPWC determination

Objective and Hypothesis

Objective: This study aims to determine the optimal timing of weed management in corn using UAV-derived assessments of crop and weed growth.

Hypothesis: Weed ground cover estimated from UAV imagery can serve as a measurable indicator for determining the Critical Period of Weed Control in corn.

Materials and Methods



NB: Focus was given to only the last 3 images

Model used: Cousen's Yield Loss Model

Results and Discussion

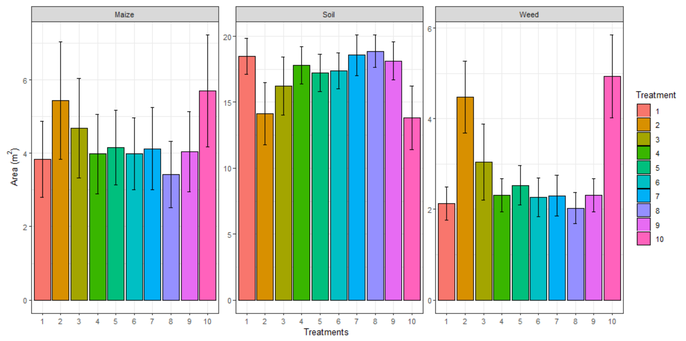


Figure 1. Estimated area of the 3 field classes for the Duration of the weed-free period trial

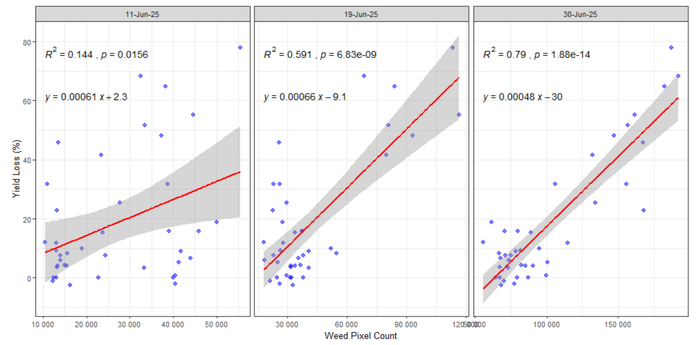


Figure 2. Relationship between yield loss and weed pixel count for the Duration of the weed interference trial

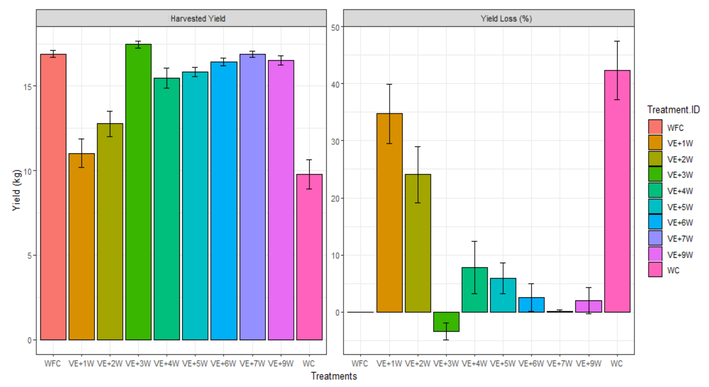


Figure 3. Treatment yield and estimated yield loss % for the duration of the weed-free period trial

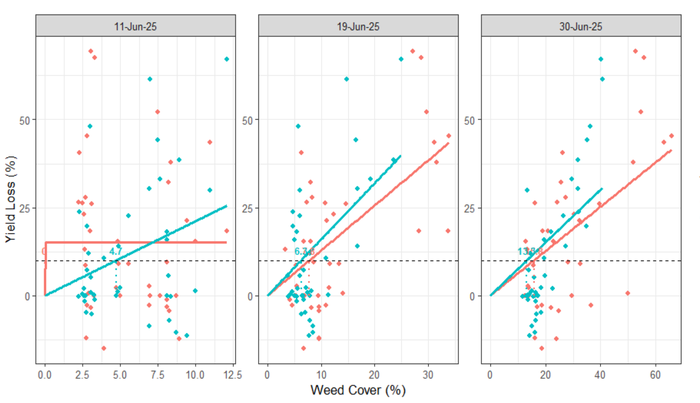


Figure 4. Cousens yield loss model for both the duration of weed interference and the weed-free period trial for 3 sampling dates

- A strong relationship exists between weed pixel count/weed ground cover (%) and yield loss (%).
- Yield loss increases with weed cover in both experiments, confirming the biological expectation that denser weed populations intensify competition for light, nutrients, and water.
- At a 10% acceptable yield loss threshold, the critical weed ground cover was estimated between 0 – 4.7% for 11th June 2025, 6.3 – 7.8% for 19th June 2025, and 13.8 – 15.8% for 30th June 2025, respectively.
- Steeper curves indicate higher yield sensitivity to weed cover which reduces the area cover demands
- Beyond the middle date, meaningful weed coverage implies that yield loss is already substantial and harder to recover from.
- Ultimately, the broad acceptable weed ground cover was estimated at between 6.8 – 15.5% for the general weed interference and weed-free experiments, respectively.

Conclusion

Critical weed-control occurred between V2-V3, the window when weed management is most effective against yield loss.

Across dates, the critical weed cover decreases over time, implying that weed control must occur earlier as the crop canopy develops and competition intensifies.

References

1. Soltani, N., Dille, J. A., Burke, I. C., Everman, W. J., VanGessel, M. J., Davis, V. M., & Sikkema, P. H. (2016). Potential corn yield losses from weeds in North America. Weed Technology, 30(4), 979-984.

2. Tursun, N., Datta, A., Sakinmaz, M. S., Kantarci, Z., Knezevic, S. Z., & Chauhan, B. S. (2016). The critical period for weed control in three corn (*Zea mays* L.) types. Crop Protection, 90, 59-65.

Acknowledgement

Sustainable Canadian Agricultural Partnership
Competitive. Innovative. Resilient.