ASSESSMENT OF THE IMPACT ON WHEAT YIELD OF THE INTERACTION BETWEEN FERTILIZATION AND YELLOW RUST THROUGH MULTI-SENSOR MACHINE VISION

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This study combined manual measurements and imaging methods to characterize the interaction between yellow rust, *Puccinia striiformis* f. sp. *Tritici*, and plant nitrogen from the flag leaf stage to the grain maturation stage of wheat, *Triticum aestivum L.*. The first goal was to assess the effect of this interaction on yield elaboration. The second goal was to compare manual scoring and machine vision quantification of yellow rust.
The trial field was located at Lonzée (Gembloux, Belgium) and consisted of three fertilization modalities combined with three fungicide modalities. Images were acquired during the 2019 season by a RGB camera and a multi-band camera (filters centered at 680 and 800 nm) located at a nadir position 1 m above the canopy. Plant traits extracted from images were plant ratio, green ratio and yellow rust damage ratio. Those traits were integrated over the different acquisition dates to provide single yield predictors taking into account the crop dynamics.
Grain yield was highly correlated to integrated green cover (R^2 = 0.87 and RMSE = 0.53 t/ha) and integrated machine vision yellow rust damage (R^2 = 0.71 and RMSE = 0.83 t/ha). Yield was mainly determined by fungicide protection. Increasing the fertilization for unprotected micro-plots resulted in lower yields. As the ear density was sufficient for all modalities, it is suggested that the disease acted by first impacting the number of grains per ear and in a second time by limiting the photosynthetic green cover during the grain filling stage.
The comparison between human and machine scoring of yellow rust revealed that the two measurements may provide different and complementary information. Human observations were useful to detect the presence of spores under leaves at an early stage of the disease, allowing a first assessment of the presence of yellow rust. At a later stage, after fungicide spraying for some micro-plots, machine vision allowed to quantify the damage of the disease more effectively that human scoring.

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