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Testing Polarization Measurements with Adjusted View Zenith Angles in Varying Illumination Conditions for Detecting Leaf Orientation of Wheat Canopy

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Abstract: The previous work revealed that the polarization of light reflected from heading wheat canopies allowed the detection of changes in the canopy structure, i.e., the leaf inclination angle. Accordingly, in order to improve measurement accuracy in this study we examined the effects of the solar zenith angle (=90°-solar elevation) and weather conditions at the time of polarization measurements for the light reflected from wheat canopies that were fertilized by different means. We measured polarization in the 660 nm spectral band from the heading canopies of wheat, which were grown in plots fertilized with a basal dressing and then top-dressed at the jointing and booting stages. The radiometric measurements were carried out at various solar zenith angles: 22°-41° on two proximal days, one overcast and the other clear. An empirical method for the adjustment of view zenith angle, based on the solar position at the time of measurement, was effective for the measurement of the degree of polarization (i.e., ratio of the polarized part of reflected light to the total reflected light energy) to eliminate interference due to the change in solar zenith angle. Although the mean values of polarization degree measured in overcast conditions were significantly lower than those measured under clear conditions, the plots top-dressed at the jointing stage could be detected via the polarized reflected light measured under both conditions of illumination.

Keywords: Jointing-stage top-dressing, Mean tip angle, Polarization, Remote sensing, View zenith angle, Wheat

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