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Full Paper

Development of A Smartphone Application For Real-Time Nitrogen Topdressing In Rice Using Digital Leaf Image Analysis

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Rice farmers seldom have proper basis for real-time Nitrogen (N) management hence, a diagnostic-recommendatory tool would be a useful and practical technology. Chlorophyll meters are commercially-available but are too expensive and normally functions only for diagnosis. PhilRice, in the past, developed the leaf color chart (LCC), a low-cost N-diagnostic-recommendation tool for rice but farmers' adoption was not too significant. This paper aimed to develop and evaluate an android-based smartphone application for real-time N fertilizer management by upgrading the technology concept of the LCC into a digital platform. Initially, a digital leaf image conversion process for dark green color index (DGCI) was developed, coded and installed in a smartphone. A variable N-rate experiment using 3 varieties in DS2017 was then established as source of leaf images with varying DGCI values and analyzed its correlation with SPAD readings. A DGCI-SPAD model was subsequently established in WS2017 to match DGCI values with topdressing N rates (kg N ha^{-1}). The PhilRice LCC App prototype was then created in DS018 that captures and convert leaf images into DGCI and recommended N rates. In WS2018 the LCC App prototype was field-tested verifying consistency of DGCI-SPAD correlations and evaluated model fitness via nRMSE. Comparative field trials against other tools were done in 2019 using NSIC Rc216 and Rc176H grown under 0N (Control), Recommended Rate (RR), Original LCC, SPAD and LCC App at 4 replications in PhilRice CES Block VI, Muñoz, Nueva Ecija. The installed image conversion tested in DS2017 had good DGCI-SPAD correlations (R^2=0.5757). The DGCI-SPAD model established was exponential ($y=0.581e^{0.0164x}$) and made matching of N rates with DGCI possible. The PhilRice LCC App was created using JAVA for Android following the software development life cycle (SDLC) process. In WS2018, good DGCI-SPAD correlations (R^2=0.5686) were proven consistent despite treatment variations with a high model fitness (nRMSE=7.14%). While DS2017 DGCI-SPAD correlations' model fitness only showed 29.93% nRMSE indicating seasonal applicability of the model. Results of 2019 field trials using NSIC Rc216 showed comparable high yields between LCC App, RR and SPAD in both seasons. While NSIC Rc176H in WS2019 also showed comparable yields between LCC App and RR. Overall, both DS2017 and WS2018 results show that DGCI and SPAD were truly correlated but observed higher model fitness in WS2018 than in DS2017 which prompted a calibrated DGCI-SPAD model for DS. Although LCC App can deliver high yields comparable with SPAD and RR, agronomic efficiency still needed improvement.

Keywords: dark green color index (DGCI), leaf color chart (LCC), PhilRice LCC App, SPAD, DGCI-SPAD model