Abstract

Post-emergence nitrogen (N) fertilizer is typically split applied to irrigated potato (*Solanum tuberosum* L.) in Minnesota in order to minimize the likelihood of nitrate leaching and to best match N availability to crop demands. Petiole nitrate-nitrogen (NO_3 -N) concentration is often used as a diagnostic test to determine the rate and timing of split applications, but using this approach for variable rate applications is difficult. Canopy-level spectral measurements, such as hyperspectral and multispectral imagery, have the potential to be a reliable tool for making in-season N management decisions for precision agriculture applications. The objectives of this two year field study were to evaluate the effects of variety, N treatment, and water stress on growth characteristics and the ability of and canopy-level reflectance to predict N stress in potato. Treatments included two irrigation regimes (unstressed and stressed), five N regimes categorized by three N rates (34 kg N ha $^{-1}$, 180 kg N ha^{-1} , and 270 kg N ha^{-1}) in which the 270 kg N ha^{-1} rate had post-emergence N either split applied or applied early in the season, and two potato varieties (Russet Burbank and Alpine Russet). Higher N rates and split applications generally resulted in higher tuber yield for both varieties. Insufficient supplemental water was found to reduce tuber yield and plant N uptake. Of the broadband indices, narrowband indices, and partial least squares regression (PLS) models evaluated, the best predictor of N stress as measured by leaf N concentration was the PLS model using derivative reflectance (r^2 of 0.79 for RB and 0.77 for AR). However, the best technique for determining N stress level for variable rate application of N fertilizer was MTCI (MERIS Terrestrial Chlorophyll Index) due to its good relationship with leaf N concentration and high accuracy. As a final aspect of the study, results from the experimental plots were used to predict N stress in a commercial potato field using aerial imagery. Reference areas were found to be necessary in order to make accurate recommendations because of differences in sensors, potato variety, growth stage, and other local conditions. The results from this study suggest that diagnostic criteria based on both biomass and plant nutrient concentration (e.g., canopy-level spectral reflectance data) were best suited to determine overall crop N status for determination of in-season N fertilizer recommendations.