

# Chlorophyll Meter Readings to Determine Nitrogen Needed in Potatoes At Field Scale



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## INTRODUCTION

Proper in-season nitrogen (N) management is critical for obtaining optimum yields in potato production. Currently, weekly petiole nitrate ( $\text{NO}_3^-$ ) sampling is used to determine if a crop will be responsive or non-responsive to additional N fertilization. Analyses of petiole  $\text{NO}_3^-$  samples require three to seven days for results, and the subsequent delay in fertilizer application could affect the yield and quality of tubers. A quicker and more accurate method is needed to determine N status for potato. A hand held chlorophyll meter (CM) provides an instant assessment of N in the leaves and could be used to determine whether a potato crop would be responsive or non-responsive to N fertilization.

The objectives of this study were:

- Compare CM readings with petiole  $\text{NO}_3^-$  at plot and field scale for determining response or non-response to N fertilization
- Determine if CM readings can be used to determine when to apply N fertilizer at field scale.

## MATERIALS AND METHODS

### Plot Scale

- Statistical design was a randomized complete block design with 5 treatments and 3-4 replications.
- Nitrogen fertilizer treatments were 0, 56, 112, 168, 224 and 280  $\text{kg/ha}^{-1}$ .
- Samples were taken weekly for 7 weeks starting the first week of July.

### Field Scale

- Fields were located in the Columbia Basin of Washington State.
- Fertilizer treatments were determined by growers and agronomist on a weekly basis in relation to the soil and petiole samples
- Meter readings were taken with samples on a weekly basis while the potatoes were in stages II, III and IV

### Sample and Data Analysis

- Chlorophyll meter readings (Konica Minolta SPAD-502) and leaf petiole  $\text{NO}_3^-$  samples were taken from the fourth newest branch on each main stem.
- Petiole  $\text{NO}_3^-$  was determined using an ion selective electrode.
- Regression analysis and ANOVA were performed using IBM SPSS Statistics 21.0.

## RESULTS AND DISCUSSION

### Plot Scale

- Threshold values for growth stages 2-4 were calculated for determining potato response to N fertilization using a regression model for CM readings and petiole N, and threshold values are the point where the regression line crosses the petiole N threshold (Fig. 1 and Table 1).
- Chlorophyll meter readings accurately determined whether potatoes were responsive to N fertilization at stage II 91%, stage III 69%, stage IV 78%. (Fig. 1 and Table 1). 3 years
- Threshold values decreased from 46.9 to 37.4 over the growing season (Table 1). The decrease in threshold values may be the result of factors not related to N such as disease.

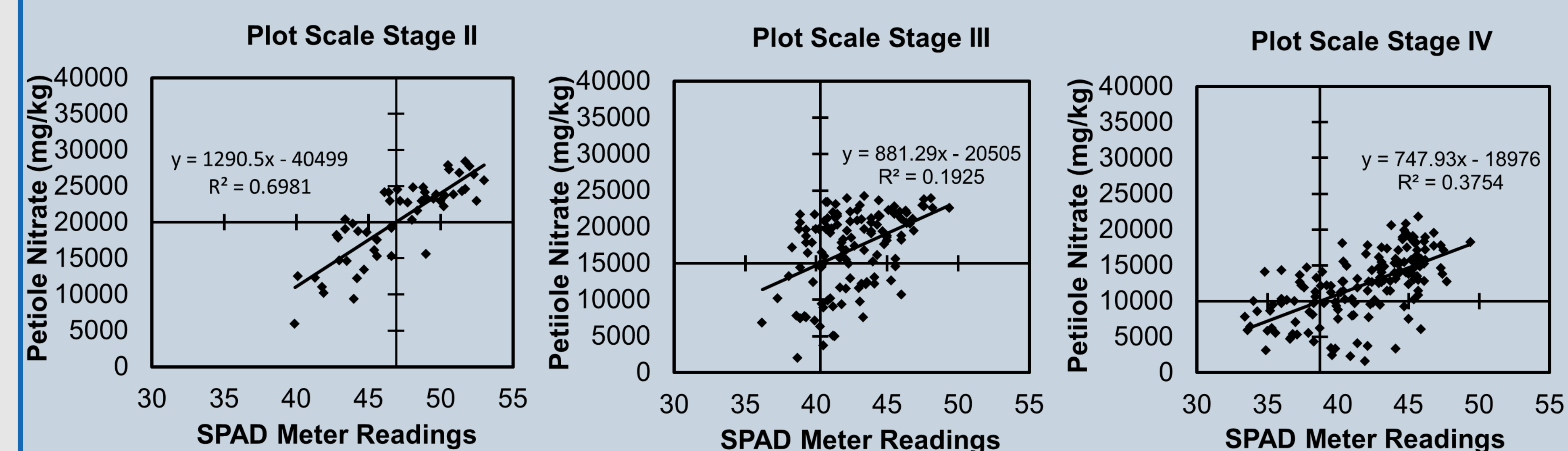
### Field Scale

- Threshold values for petiole and chlorophyll meter from small plot study were used to determine field scale response
- Chlorophyll meter readings accurately determined whether potatoes were responsive to N fertilization at stage II 91%, stage III 69%, stage IV 78%. (Fig. 2 and Table 1).
- Type 1 and 2 errors were higher in the field scale. This could be due to weather and variance in conditions, different practices among growers, or time of day samples were taken.

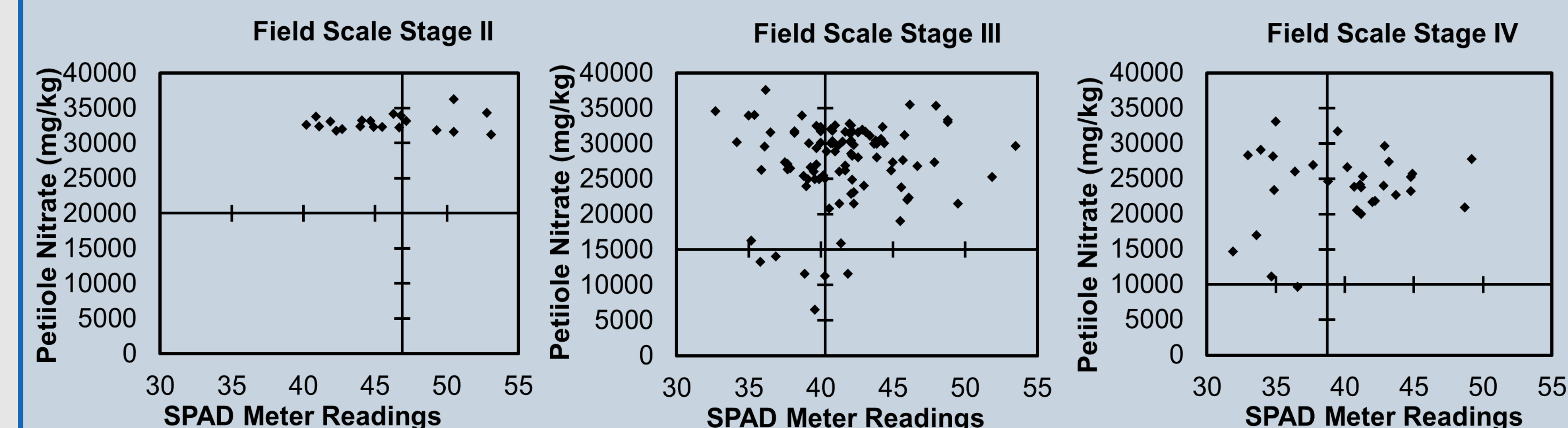
## CONCLUSION

The plot scale readings, taken from 2008 through 2012 were accurate for stages II and III. The field scale study done in 2013 had less accurate results for all stages. Many variables could have caused the inconsistency of the results. One of the factors could have been time of day. The time of day that a sample is taken greatly effects the nitrogen reading. Sample times varied from 6 AM to late afternoon. In the heat of the day the N readings become less accurate.

## FIGURES AND TABLE



**Figure 1.** Petiole nitrate versus chlorophyll meter (SPAD) readings by growth stage for determining response (lower left quadrant) or non-response (upper right quadrant) to N fertilization in potatoes in small plots. The in-figure 'x' and 'y' axes indicate the threshold values for SPAD readings and petiole nitrate (respectively).



**Figure 2.** Petiole nitrate versus chlorophyll meter (SPAD) readings by growth stage for determining response (lower left quadrant) or non-response (upper right quadrant) to N fertilization in potatoes at field scale. The in-figure 'x' and 'y' axes indicate the threshold values for SPAD readings and petiole nitrate (respectively) as determined by small plot studies.

**Table 1.** Number of data points that were non-responsive, responsive, or errors for the SPAD meter versus petiole  $\text{NO}_3^-$  analysis, percent correct, and chlorophyll meter threshold value for determining fertilizer responsiveness. Type 1 error is data that is N responsive according to CM meter, but non-responsive for petiole  $\text{NO}_3^-$  and type 2 error is the inverse.

Stage	Non-responsive	Responsive	Type 1 Error	Type 2 Error	Correct (%)	Threshold Value
Plot Scale						
II	26	22	1	4	91%	46.9
III	99	24	23	12	78%	40.3
IV	72	13	26	12	69%	38.7
Field Scale						
II	6	0	0	14	30%	46.9
III	62	4	21	31	53%	40.3
IV	20	1	0	10	68%	38.7