### Supplementary Materials

Supplementary Table 1: Treatment effects of main plot treatment factors (Cultivars; growth regulator in 2014) on the reference traits dry matter (DM), N concentration (NC), and N uptake (Nup) and tested/selected vegetation indices for years with differing main plot factors.

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<th>NIR(_{\text{red}})</th>
<th>R760(_{\text{730}})</th>
<th>R780(_{\text{740}})</th>
<th>R900(_{\text{970}})</th>
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Supplementary Table 2: Treatment effects of N fertilization (N level) on the reference traits dry matter (DM), N concentration (NC) and N uptake (Nup) and tested/selected vegetation indices.

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Supplementary Table 4: Significant (p < 0.05) coefficients of determination ($R^2$) for the whole data and for data subsets (by main plots: Cultivars; growth regulator in 2014 as indicated in Error! Reference source not found.), calculated across N levels.

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Supplementary Table 5: Index ranking by data and statistical approach. Absolute RMSE (not shown) and normalized RMSE values result in same index rankings. Two numbers indicate differing rankings depending on the data level.

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<th>NNI</th>
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Supplementary Figure 1: Quadratic response of the vegetation index R760_730 to incremental N fertilization (N levels) by sampling dates (year/month/day) and main plot treatments. The applied nitrogen corresponds to 0–420 kg N ha$^{-1}$ in total fertilized nitrogen, applied in four doses. For NNI, the threshold used (NNI $> 0.8$) for dividing the data into two intervals is drawn as a horizontal line. Interval 1 (NNI $< 0.8$) and interval 2 (NNI $> 0.8$) are indicated as circles and rectangles, respectively.
Supplementary Figure 2: Relationships between target traits by measurement dates. Curves indicate best-fit quadratic relationships.
Supplementary Figure 3: Coefficients of determination ($R^2$) of the REIP within dates across main plot treatments for linear and quadratic relationships.

Supplementary Figure 4: Point of saturation (plateau point) relative to the present data range and in absolute values, identified as the first point of non-positive slope between index and target trait.
Supplementary Figure 5: $R^2$-values found from linear regression analysis for both NNI-based data intervals, based on the NNI-threshold 0.8. Black numbers indicate the number of data points (n) included in the intervals.
Supplementary Figure 6: RMSE-values found from linear regression analysis for both NNI-based data intervals based on the NNI-threshold 0.8 for DM [kg ha⁻¹], NC [%], NNI [unitless] and Nup [kg ha⁻¹]. Black numbers indicate the number of data points (n) included in the intervals.