OPTI-SCIENCES, INC. Application Note: #0109

Macro and Micro Nutrient Stress Measuring Issues

Plants require both macro and micro nutrients for good health so detecting all types of nutrient deficiency stress is of value. Oceans of research have shown that Fv/Fm, Yield, and ETR correlate well with CO2 fixation and so they are popular measuring parameters for stress.

It is important to know that for these parameters do have limitations for some types of nutrient stress. Some can detect early stress, some moderate stress, and some tests will only detect severe stress or starvation level stress. Nutrient stress levels that do not affect PSII will in general will not be detected until the stress level is severe or at starvation levels.

For this reason other fluorescent and absorption tests have been developed and used for different types of stress. Having the capability to do several types of tests offers a significant advantage for researchers doing nutrient stress research.

This table provides limitation information for the most popular fluorometer measuring parameters Fv/Fm, and Yield.

Fv/Fm – Dark adapted test

1. Fv/Fm is not sensitive to nitrogen stress until very low levels are reached. (Baker 2004)
2. Fv/Fm is not sensitive to sulfur stress until starvation levels are reached. (Baker 2004)
3. Not sensitive to nickel stress. (Joshi 2004)
4. Not sensitive to zinc stress. (Joshi 2004)

Yield or ∆F/Fm' - Light adapted test

1. Yield is not sensitive to sulfur stress until starvation levels are reached. (Baker 2004)

Note:

Fv/Fm requires dark adaption and is available on all Opti-Science fluorometers including the lower cost OS30P. Yield measurements are made in light under steady state photosynthetic conditions without dark adaption. Yield is available on the OS1-FL, and the OS5p. The K-Step, Performance Index, NPQ, qP, FRFex360/FRFex400 are only available on the OS5p. The absorption test for sulfur stress and nitrogen stress is available on chlorophyll content meters such as the CCM-200. For additional information or a complete "Stress Guide" please contact Opti-Sciences.

The following table provides a guide to previous research results regarding nutrient stress. It has been assembled from a review of world wide nutrient stress research without regard to chlorophyll fluorometer manufacturer.

Nutrient	Test	Reference	Fv/Fm	Yield
Boron	Yield and ETR	Kastori R., 1995	Unknown	Yes
Calcium	Fv/Fm	Shmidts-Eiberger 2002	Yes	Unknown
Chlorine	Lack references	-	-	-
Cobalt	Yield	Joshi 2004 Tripathy 1983	Unknown	Yes
Copper	1. Yield, 2. Fo/F 5 minutes	1. Joshi 2004, Lanaras 1993 2. Adams 2000, Kriedemann 1985	Unknown	Yes
Iron	K Step in OJIP	Jiang 2006	Unknown	Unknown
Manganese	Performance Index in OJIP	Hermans 2006	Unknown	Unknown
Molybdenum	Lack references	-	-	-
Nickel	ETR	Joshi 2004 Tripathy 1981	No – Joshi 2004	Probable
Nitrogen	1. FRFex360/FRFex440 2.Yield at high light level 3. K-Step 4. Absorption measurement in the green and infrared range to measure chlorophyll content. 5. Yield 6. qP	1.Sampson 2000 2. Cheng 2001 3. Strasser 2004 4. Peterson 2006 5.Cavender- Bares 2004, Baker 2004 6. Baker 2004	Only at severe levels Baker - 2004	Works best at high light levels – Cheng 2001
Phosphorus	1. Performance index in OJIP 2. Fv/Fm	1. Ripley 2004 2. Stark 2000	Yes	Unknown
Potassium	1. Yield 2. NPQ 3. qP	1, Weng 2008 2. Weng 2008 3. Weng 2008	Unknown	Yes
Sulfur	Absorption measurement in the green and infrared range to measure chlorophyll content.	Peterson 2006	Only at starvation levels – Baker 2004	Only at starvation levels – Baker 2004
Zinc	Fs in Yield	Joshi 2004 Tripathy 1980	No - Joshi 2004	Less sensitive than Fs

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