

Applicability and limitations of multiparametric fluorescence measurements to assess pigment concentrations in leafy vegetables

Lilian Schmidt ^a, Laura Verena Junker ^b, Jana Büchsenschütz ^b, Anika Wiese-Klinkenberg ^b,
Jana Zinkernagel ^a

^a Hochschule Geisenheim, Institut für Gemüsebau, Von-Lade-Straße 1, 65366 Geisenheim

^b Forschungszentrum Jülich GmbH, Institut für Bio- und Geowissenschaften IBG-2:

Pflanzenwissenschaften, 52428 Jülich

Lilian.Schmidt@hs-gm.de

There is growing interest to monitor plant stress responses, developmental processes and concentrations of health-promoting pigments in vegetables by non-destructive measurements. One device for non-invasive monitoring of plant performance and quantification of pigment concentrations in vegetables is the portable fluorescence sensor Multiplex® (Force-A, Orsay Cedex, France). Here, plant pigment concentrations are estimated based on vegetation indices derived from multiparametric fluorescence measurements. This method is increasingly used to monitor stress-related changes in plant pigments and flavonoids in horticultural experiments, but there is little evidence for an exact quantification of these leaf compounds.

In this study, we assessed the applicability, but also limitations of the Multiplex® sensor in monitoring of plant stress responses and quantification of pigment concentrations in leaves of vegetable crops. We conducted two studies: First, we investigated changes in leaf metabolism of tomato plants subjected to nitrogen deficiency, and linked fluorometric measurements using the Multiplex® with biochemical analyses of foliar pigment and flavonoid concentrations. Second, we tested if fluorometric measurements using the Multiplex® are useful for predicting pigment concentrations of leafy vegetables. Here, we correlate biochemically assessed concentrations of chlorophylls in spinach and anthocyanins in red cabbage to non-invasive quantification derived from Multiplex® data. In order to measure samples with varying pigment concentrations, spinach as well as red cabbage plants were grown in the field either supplied with 50% or 100% of the recommended nitrogen supply. For both experiments, fluorometric measurements with the Multiplex® were performed on leaves. Immediately after, leaf samples were frozen for biochemical analysis of pigment content. Preliminary results show that measurements with the Multiplex® represent the onset of stress-related changes in leaf metabolism of tomato plants subjected to nitrogen deficiency well. Nevertheless, there was high variation in the quantification of pigment content of leaves and vegetables by biochemical and fluorometric analyses. In consequence, the correlations between pigment concentrations assessed by biochemical analysis and Multiplex® measurements were rather weak. We conclude that the Multiplex® sensor can be of advantage in monitoring of plant development and stress responses, but is of limited use for non-invasive quantification of the concentration of foliar pigment concentrations in leafy vegetables.