



**PRACTICE ABSTRACT No. 3**

# Screening for nitrogen fixation in soybean

**PROBLEMS:**

- Soybean yield and product quality are highly dependent on nitrogen fixation by symbiotic root bacteria (rhizobia).
- Soybean varieties and breeding lines have different nitrogen fixation efficiencies but measuring fixation rates is complicated and slow.
- Simple and rapid methods are needed to determine the nitrogen fixation capacity of breeding lines in the field.



*Fig. 1: Soybean leaflets of genotypes differing in N<sub>2</sub> fixation (left: high fixation; right: low fixation).*

**SOLUTIONS:**

- Soybean leaves and the colour intensity of the green biomass are a suitable indicator of biological nitrogen fixation in the field (Fig. 1).
- Measurement of hyperspectral reflectance (visible and infrared wavelengths of light; Fig. 2 gives a good indication of the nitrogen status of the plant during the growing season.
- Soybean protein content can be used as a final parameter to determine nitrogen fixation capacity at the end of the season.
- Seed protein content below 35% is found in lines/varieties with low nitrogen fixation



*Fig. 2: Hyperspectral reflectance measurement of soybean breeding lines in the field with a handheld sensor. (Photo credits: J. Vollmann)*

capacity. Breeding lines with protein content above 45% are suitable for soybean food production and can be identified by hyperspectral measurements.

## PRACTICAL RECOMMENDATIONS:

- Several measurements at different developmental stages between flowering and senescence would be required to fully assess the nitrogen fixation/uptake status of different lines.
- Drones equipped with hyperspectral reflectance cameras could be used for high-throughput screening of breeding material in the field.

## FURTHER INFORMATION

Vollmann J, Walter H, Sato T, Schweiger P (2011). Digital image analysis and chlorophyll metering for phenotyping the effects of nodulation in soybean. *Computers and Electronics in Agriculture* 75: 190-195. doi: [10.1016/j.compag.2010.11.003](https://doi.org/10.1016/j.compag.2010.11.003)

Schweiger P, Hofer M, Hartl W, Wanek W, Vollmann J (2012). N<sub>2</sub> fixation by organically grown soybean in Central Europe: Method of quantification and agronomic effects. *European Journal of Agronomy* 41: 11-17. doi: [10.1016/j.eja.2012.01.011](https://doi.org/10.1016/j.eja.2012.01.011)

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## ECOBREED CONSORTIUM



### ABOUT ECOBREED:

ECOBREED is a 5-year (2018-2023) project funded by European Union's Horizon 2020 research and innovation programme that will improve the availability of varieties and seed suitable for organic and low-input production. Activities will focus on four crop species i.e. wheat, potato, soybean and common buckwheat, selected for their potential contribution to increasing the competitiveness of the organic sector.

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