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Deciphering the genetic diversity of WOSR seed yield elaboration and NUE in the field: what is the relative contribution of plant growth, leaf area dynamics, N uptake and N use efficiencies during the crop cycle ?

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Winter Oilseed rape cultivars improved for the nitrogen use efficiency (NUE) would help stabilizing seed yield (SY) for various cropping systems characterized by fluctuating or low nitrogen (N) conditions.

This relies on genotypes displaying higher N utilization efficiency (NUtE) and/or higher N uptake efficiency (NUpE). The genetic variability of SY, NUE, NUtE and NUpE is usually assessed at harvest. But the contribution of the underlying ecophysiological processes throughout the crop cycle is poorly documented.

This study aims at characterizing dynamically the genetic variability of these processes along the cycle, and their correlation with SY and NUE. During vegetative period, the targeted processes consisted in N uptake, biomass accumulation and shoot area dynamics, all these traits contributing to NUpE and being involved in radiation interception and N storage, whereas the processes targeted during reproductive period consisted in N and C reserves use, accounting for seed set and underlying NUtE.

We trialled 20 genotypes, known for their contrasted NUE, in field, under 2 N conditions, during 2 years, in France. Plants were harvested at 7 dates during the whole crop cycle and divided into tap roots, fallen leaves, green leaves, stems, pods and seeds. Leaf area index, biomass and N content of the different fractions were assessed. At harvest, seed weight and seed number were determined separately for main stems and branches.

A genetic variability was identified for NUpE and NUtE. Seed yield differences between genotypes and N treatments were explained by the amount of N absorbed during the vegetative period, that itself determined lateral branches seed number. Consequently, SY was highly correlated with NUpE during the vegetative period, itself correlated to contrasted dynamics of growth and N partition in green leaves and stems. NUtE was highly correlated to absorbed N amount, harvest index, nitrogen harvest index and main stem seed number.

Pertinent ecophysiological mecanisms were identified to decipher SY elaboration. For a wide range of genetic diversity, our results underlined the interest of considering NUpE during vegetative phase to improve NUE at harvest. As the most efficient genotypes for NUpE and NUtE differed, this reveals ways of NUE potential genetic improvement.

Key words: Brassica napus L, genetic diversity, Nitrogen Use Efficiency, Nitrogen Uptake Efficiency, LAI, plant architecture.