Impacts of genotypic variations in sulfur distribution and branching characteristics on nitrogen efficiency of oilseed rape (*Brassica napus* L.)

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Oilseed rape (*Brassica napus* L.) is an important agricultural crop in Europe that is characterized by the highest nitrogen (N) balance surplus as compared to other crops. Due to low reproductive N uptake and incomplete N remobilization from source organs to seeds, this crop usually leaves high amount of mineral and residual N in the field. To solve the N balance surplus problem and meanwhile to avoid severe yield penalties, a main approach is breeding and selection of cultivars that can efficiently use the available N. To facilitate the breeding process of N-efficient cultivars, many studies have been carried out to identify the secondary plant traits contributing to N efficiency, which highlighted the major importance of the reproductive growth for a high yield under conditions of low N supply, and a minor importance of vegetative growth. This thesis therefore addresses two possible aspects that are associated with plant reproductive growth, i.e. genotypic variations in sulfur distribution and in branching traits, with the aim to evaluate their impacts on N efficiency.

Objectives of the present study were (1) to determine genotypic variation in the involved S metabolites that can lead to a difference in leaf N remobilization as well as S distribution to developing organs, (2) to check if the observed genotypic variation in S distribution can be linked to yield and harvest index and thus act as a valuable plant trait to improve yield and N efficiency of oilseed rape and (3) to reveal how branching characteristics influence rapeseed yield and N efficiency. In order to investigate the impacts of genotypic variation in sulfur distribution on seed yield and N efficiency, 22 of cultivars have been grown under low N conditions in a series of hydroponic experiments, and also been evaluated under both low and high N conditions in a three-location field experiment. The influences of genotypic variation in branching traits on N efficiency were checked by a pot experiment conducted under three N rates including three oilseed rape cultivars.

In the experiments substantial genotypic variation in S distribution to developing organs was found. In particular, compared with double low cultivars high glucosinolate-containing cultivars had significantly superior ability in distributing S into developing leaves during vegetative growth, and accordingly a higher seed S harvest index at maturity. However, no indication was found that higher S distribution into reproductive organs can lead to higher yield.

Significant genotypic variations were also found in primary/secondary branching characteristics at all three N rates. At moderate and high N conditions, cultivars with more secondary branches retained more residual N in these branches. These secondary branches also had more flower abortion, leading to low productivity as well as low flower N remobilization. As a consequence, they seem to form ‘parasitic’ sinks for N assimilates during reproductive growth, which resulted in deceased N harvest index and lack of responsiveness to N fertilizer.

It has been concluded that selection of genotypes with improved ability to remobilize S to support reproductive growth is not necessary to improve yield capacity and N economy of oilseed rape, although selection for favorable S distribution in rape seedlings has been found indeed suitable to reflect processes during reproductive growth. Cultivars with preferential N investigation in primary rather than secondary branches might be promising for reducing N balance surpluses, especially at ample N conditions.