

INCREASED NITROGEN USE EFFICIENCY THROUGH PLANT BREEDING IN WINTER WHEAT – A LONG-TERM ANALYSIS OF OFFICIAL VARIETY TRIALS IN BAVARIA

Samuel Knapp, J. Peter Baresel, Urs Schmidhalter

Chair of Plant Nutrition, Technical University of Munich, Freising, samuel.knapp@tum.de

Increasing nitrogen use efficiency is central for future crop production. This is also highlighted by stricter fertilizer regulations aiming to decrease nitrogen emissions to the environment. Cultivation of varieties with increased NUE is very promising, since it does not depend on any further investments or additional resources. We investigated (1) if breeding progress towards increased N uptake can be observed in German wheat varieties and (2) the possible effect of varieties on N uptake in single trials and its relation to the breeding progress.

Using grain yield and protein content data from the official winter wheat variety trials in Bavaria (Landessortenversuche, LSV) from the years 2006 – 2015 we estimated the breeding progress for grain yield, protein content and N uptake employing a mixed model approach following Piepho et al. (2014) to account for the unbalanced data structure due to changing variety sets and to separate genetic from non-genetic changes. Only data from trials with use of fungicides and growth regulators, in locations that were tested for more than 10 years, and varieties being tested at least for 3 years were analysed, resulting in 117 trials and 57 varieties. The absolute effect of varieties on N uptake was assessed by the difference between the three varieties with highest and lowest N uptake to avoid possible bias effects of single varieties.

While the overall increase (genetic and non-genetic) in N uptake of 4.45 kg N/ha/year ($p < 0.001$) was very dependent on the chosen period, the genetic increase (if agronomic and climatic conditions were assumed to be constant) due to the breeding progress of 0.43 kg N/ha/year ($p < 0.01$) was very robust. This increase was mainly due to the increase in grain yield (0.41 dt/ha/year, $p < 0.001$), while the protein content remained constant ($p > 0.05$).

The absolute effect of varieties on N uptake, measured as the difference between the three varieties with the highest and lowest N uptake within trials, ranged considerably from 16 to 63 kg N/ha (Figure 1). While this difference was generally greater in trials with a higher mean N uptake, decreased differences were also observed in trials with high mean N uptake and vice versa. However, when estimating the breeding progress within single trials, trials with wide ranges of N uptake did not show a higher estimated breeding progress ($p > 0.05$).

It can be concluded that variety development and appropriate choice of varieties can have a substantial contribution to increasing N use efficiency.

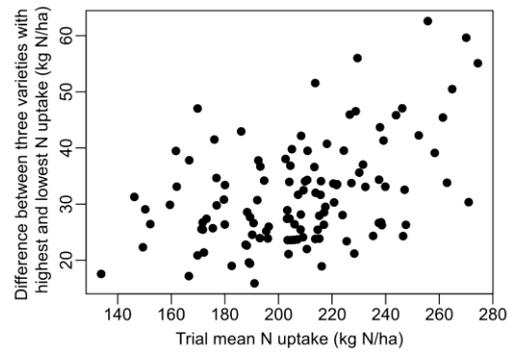


Figure 1: Difference in N uptake within trials (each dot represents one trial).

Acknowledgements

Data from the LSV trials were kindly provided by the Bayerische Landesanstalt für Landwirtschaft (LfL). We gratefully acknowledge the support of our project. Financial support by the BMBF through the INSUSFAR project within the IPAS initiative is thankfully acknowledged.

References

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