

Breeding of CMS-F1-Hybrids in *Lolium perenne* with improved nitrogen use efficiency

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Introduction The environmental pollution by nitrogen losses from dairy farms can be reduced by improving the nitrogen use efficiency (NUE) of grass varieties. The main goal is to develop varieties with a better nitrogen utilisation. These “low input varieties” can produce acceptable yields at a low level of N-fertilisation. High input varieties express their high yield potential only at high N-supply. These varieties are less preferable, because N-losses increase at higher levels of nitrogen application. The breeding of CMS-F1-Hybrids can be a successful strategy for developing varieties with a higher NUE. In F1-Hybrid varieties higher heterosis effects can be achieved than in populations or synthetic varieties.

Material and methods In a field trial at 2 locations the responses of 35 F1-Hybrid varieties and 2 high yielding control varieties, ‘Respect’ and ‘Fennema’, at 3 different levels of N-fertilisation (200, 270 and 360 kg N/ha) were investigated. The time of cutting was the same for all N-levels at a location. In total 4 cuts were made. By using amplified fragment-length polymorphism (AFLP)-markers, genetic distances between the F1-Hybrid combinations were calculated. Between 12 F1-Hybrids the heterosis could be calculated with the formula: F1-value – mid-parent value. This experiment was part of the EU-project NIMGRASS.

Results Table 1 shows that low input varieties can be found with a 9 – 12% higher dry matter yield (DM-yield) at the low N-level than the control varieties. At the high N-level the production of these varieties was not significantly higher. One variety, Hybrid 2, had a 10% yield elevation at both the low and high N-level.

Table 1 Relative DM-yield (%) of F1-Hybrid varieties and control varieties at 3 N-levels (kg N/ha)

N-level	200	270	360
Fennema	100	101	98
Respect	100	99	102
Hybrid 1	112	104	99
Hybrid 2	110	105	110
Hybrid 3	109	111	109

An increase of 10% in the NUE allows a reduction by 25-35% N-input for the same dry matter production: The F1-Hybrids reach the DM-yield of the controls at the high level of 360 kg N/ha with 100-125 kg N/ha less Nitrogen (figure 1).

The relative high correlation between heterosis and the genetic distance (GD) (figure 2) shows that crossing of unrelated parent lines probably will be worthwhile, as in this trial the combination with the highest genetic distance had the highest heterosis, but there were also exceptions.

Conclusions The results of the experiment show, that F1-Hybrids can be selected with a higher nitrogen use efficiency (low input varieties). The higher NUE allows an N-input reduction of 25-35% to achieve the same yield as the control at the high N-level. Estimating genetic distance by using AFLP can be a useful tool for selecting good combining parent lines.

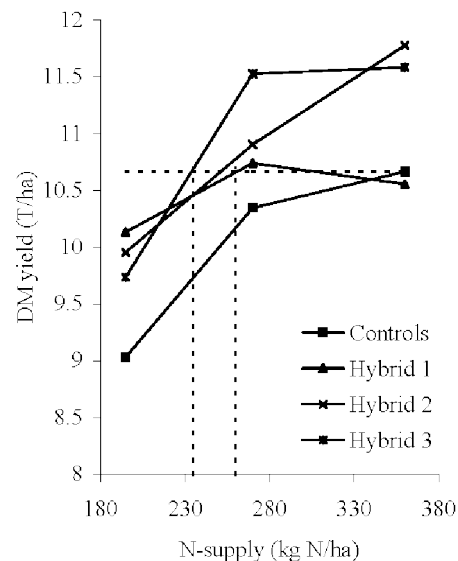


Figure 1 DM yields of F1-Hybrids

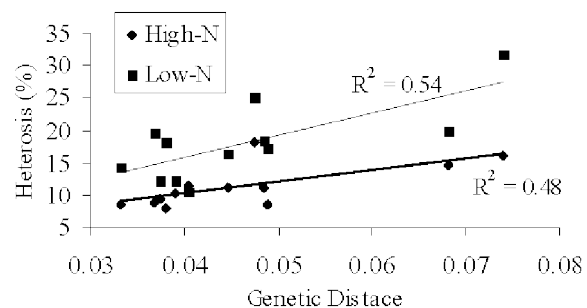


Figure 2 Relation between heterosis and GD