From an environmental point of view, it seems correct to vary the amount of nitrogen fertiliser in relation to the predicted yield. However, this will not appeal to the farmer unless he has an economical gain from the spatial application of nitrogen fertiliser.

In Denmark experiments with site-specific nitrogen fertilisation have only shown 0-3 per cent increase in grain yield of cereals when compared to uniform application.

Several field trials have shown that the optimal level for nitrogen fertilisation has a spatial variation of the same size as the yield itself.

This paper demonstrates a method where predictions of optimal nitrogen application is obtained by comparing yield figures from neighbouring tramlines with different levels of fertilisation.

A METHOD FOR OPTIMAL SITE-SPECIFIC NITROGEN FERTILISATION

Guidelines

The method include the following main elements:

1. Uniform application of nitrogen fertiliser at two levels. Even and uneven numbered tramlines are fertilised with low and high levels of nitrogen, respectively.
2. The even and uneven tramlines are harvested separately.
3. Spatial variation in yield differences between neighbouring tramlines, N high - N low, is used for calculating the optimal nitrogen fertilisation level for the next growing season.

The N-application maps for DIFMS and Optimal for 1998 was based on yield maps of spring barley in 1997 uniformly fertilised in tramlines with 0 and 94 kg N ha$^{-1}$.

The contour plot above illustrates the yield differences DIFMS - Uniform (Y$_i$-Y$_k$) and Optimal - Uniform (Y$_j$-Y$_k$) in t ha$^{-1}$ when described by the yield with no N-application (YN$^0$) and by the average N-level (N$_l$). The model is described at the button in statistics.

- There was a significant difference at 5% level for the parameter estimates between each model except for the reciprocal action between N$_l$ and YN$^0$. Neither of the describing parameters YN$^0$, the average N-level (N$_l$), and their reciprocal action could be removed at 5% level of significance from the hypothesis.

- Looking at the contour curves a nitrogen application by use of DIFMS seems to be better the lower the average N-level is independent of yield potential with no N-fertiliser when compared uniform N-application.

- The Optimal management was performing best in areas where there was a lower yield potential with no N-application (YN$^0$). Compared to uniform N-application there was a negative effect in the yield for both models at high N-levels and high yield potential without any N-application.

Conclusion

The Optimal site-specific management seems to be able to facilitate the implementation of site specific nitrogen fertilisation especially when combined with local knowledge about spatial variation of soil characteristics.

The data were described through a variance component model with random effects in each unit (see illustration of field trial design 1998) and systematic effects of average N-level and N-application model (uniform, optimal, or DIFMS). It was the performance differences in the yields between Optimal or DIFMS compared to uniform N-application (YN0 or YN$_i$) which were interesting. By analysing the differences Y$_i$-Y$_j$ and Y$_l$-Y$_k$ the random effect cancels. Thus, the variance model was reduced to the following model:

$$\begin{align*}
N_l & = \alpha_i + \beta_j + \varepsilon_{ij}
\end{align*}$$

$\varepsilon_{ij}$ denotes the distribution (law) of the argument. $\alpha_i$ for the differences$Y_i-Y_k$ and $\beta_j$ for the differences $Y_j-Y_k$. Since the variation between model i and j was not independent the model was transformed before further analysis. In order to obtain a model with independent variables having the same variation the model was transformed as shown below.

The Optimal site-specific management seems to be able to facilitate the implementation of site specific nitrogen fertilisation especially when combined with local knowledge about spatial variation of soil characteristics.

Statistics

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