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STUDY OF THE DYNAMIC OF UPTAKE BY WINTER WHEAT OF SPLIT APPLIED NITROGEN AND OF THE ROLE OF EACH DRESSING TO IMPROVE NITROGEN BALANCE AND CROP'S ECONOMIC OPTIMUM

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In Belgium, N fertiliser for winter wheat is split applied at GS25, 30 and 37. Fertiliser advice for a particular plot is based on an evaluation of the actual situation (soil and crop) before each dressing, and on a practical experience backed up by the results of a very large number of field experiments performed over a period of 10 years.
Starting from 150 kg N ha^{-1} as a reference (Falisse et al), the recommendations are modified for the characteristics of the plot. Simple parameters (agricultural region, soil, organic status, previous crop, actual state, amount of nitrogen already applied) are used to tune the N advice.
An important ongoing experimentation aims at improving the recommendations and the nitrogen balance.

Methods: The nitrogen dressing trials were performed in the different regions of Belgium and based on protocols exploring for each situation a very large range of total doses (0 - 360 - kg N ha^{-1}) and each of the three dressings (0 - 120 kg N ha^{-1}) according to a composite design (Oger 1985). The results interpretation is done by calculation of response surface, using the following model (Oger 1994):

$$Y = a + \sum_{j=1}^{3} b_i \, 0,99^{xi} + \sum_{j=1}^{3} \sum_{i<j}^{3} b_{ij} \, 0,99^{(xi + xj)} + b_{123} \, 0,99^{(x1+x2+x3)} + \sum_{j=1}^{3} d_i \, x_j$$

In order to study the fate of fertilizer N, $^{15}NH_4{}^{15}NO_3$ enriched at 5,7 % was applied in microplots (steel cylinders 30 cm in diameter and 50 cm in depth).

Results: An extremely large variability of economically optimal fertilisation has been observed (table 1).

Table 1. Range of optimal fertilisations (and mean doses) during the last four years of trials (in kg N ha^{-1}).

Year	Fractions			Optimal
(Nbr of trials)	1st (GS25)	2nd (Gs30)	3rd (GS37)	total dose
1990 (6)	0-80 (37)	0-100 (40)	60-100 (87)	120-240 (164)
1991 (10)	0-100 (22)	0-100 (52)	40-100 (68)	60-200 (142)
1992 (7)	0-80 (40)	0-80 (31)	20-100 (57)	80-200 (128)
1993 (6)	0-100 (27)	40-100 (90)	0-80 (57)	100-220 (174)

The GS37 dressing played a major role. The differences in the soil mineral N level were not sufficient to explain the important variations in the optimal total rates and in the best combination (Bodson et al).
The crop's ability to recover N as a function of its development and of its sanitary status seemed of prime importance. Since

1992, a field experimentation with ^{15}N labelled fertilisers has been set up to study the absorption dynamics of the different split dressings, in particular the tillering application (GS25) and their impacts on yield formation.
The observed optimal modes of fertilisation were 80 - 0 - 60 in 1992 and 0 - 100 - 80 in 1993, respectively producing grain yields of 8 918 kg ha^{-1} and 9 040 kg ha^{-1}.
In 1992, maximum recovery by the plant of the GS25 dressing was found earlier for 20 and 60 kg N ha^{-1} than for 100 kg N ha^{-1}; in 1993, it was found 69 days after the dressing date for all treatments (Fig. 1).
At harvest, as observed in many other experiments (Destain et al.), recoveries of GS30 and GS37 dressings were higher than recovery of GS25 dressing and were not affected by rate of N applied at tillering (Table 2).
When 20, 60 and 100 kg N were applied at GS25, soil derived N in the plant was respectively 86, 89 and 93 kg N ha^{-1}.

Figure 1. Recovery by winter wheat of applied N at GS25

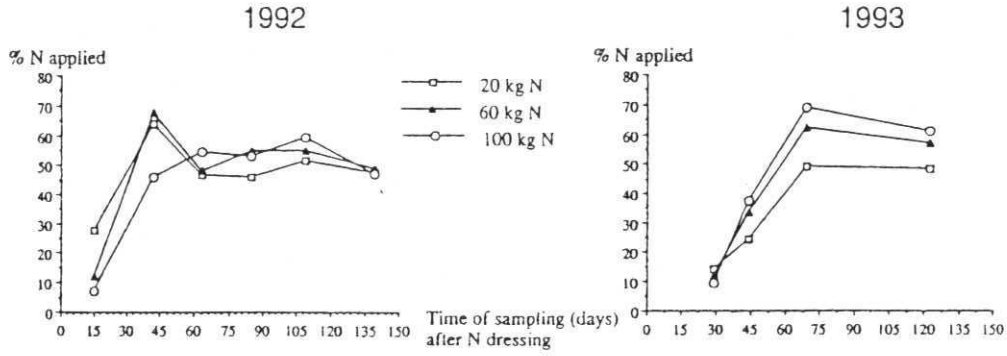

Table 2. Recovery by winter wheat of applied N (Measurement at harvest in 1993)

Rate of N applied at GS25 (kg ha^{-1})	Recovery (% N applied)			
	GS25 dressing	GS30 dressing (40 kg N)	GS37 dressing (60 kg N)	Total (GS25+30+37)
20	48.1 ± 1.1	74.4 ± 3.5	72.9 ± 3.0	69.3
60	57.0 ± 1.6	73.3 ± 7.1	74.7 ± 2.6	67.7
100	61.1 ± 2.7	71.9 ± 3.0	76.6 ± 1.0	67.9

Conclusions: In order to achieve good yields and high recovery levels of N, the assessment of optimal dressing has to be made for each individual field. The last N application fraction (GS37) is very effective on yield and quality and leads to the highest recovery level by the crop.

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