

## FERTILISATION

# NITROGEN INJECTION

## reduces ammonia losses

**The Innov.AR project aims to provide farmers with the most relevant agro-ecological solutions for the Upper Rhine area. The injection of nitrogen into the soil is one of the innovations with promising preliminary results.**



Agriculture must find ways of reducing its environmental impact, particularly with regard to fertilisers (losses in the soil or volatilisation), while optimising costs. This is especially true in densely populated areas such as the Upper Rhine region (Alsace-Bade-Wuerttemberg). The CULTAN (Controlled Uptake Long Term Ammonium Nutrition) method is therefore being tested in cross-border

work bringing together technical institutes and businesses from France and Germany<sup>(1)</sup>.

Maize fertilisation using this "long-term controlled ammonium absorption" method was first implemented in Germany in the 1970s. It involves injecting the total dose of nitrogen in one pass, in the form of a concentrated ammonium deposit, located in every other inter-row at a consistent depth of 15 cm to 18 cm.

The concentration of ammonium would lead to localised toxicity for micro-organisms, thereby reducing nitrification and loss through adsorption to soil colloids. The plant would then take up a larger proportion of its nitrogen nutrition from ammonium (NH<sub>4</sub>), and more efficiently, by concentrating its root system around the nitrogen deposit.

## Same yield level

Since 2012, the cross-border projects INDEE and then Innov.AR<sup>(1)</sup> have helped to establish a large amount of reference data on the CULTAN method tested in field conditions. The initial choice of fertiliser favoured a form of urea with a nitrification inhibitor. However, comparisons with plain urea did not show any differences; urea 46% was chosen for many of the trials.

Conventional fertilisers were either spread on the ground or hoed in. Several forms of fertiliser were used (ammonia nitrate, Alzon, etc.). Looking at a wide yield range, the results do not indicate a particular trend in favour of conventional fertilisation or of the CULTAN method. However, poorer results with surface urea can be attributed to losses due to volatilisation. When using the same rate, CULTAN fertilisation yields similar results to conventional fertilisation, regardless of the parcel's yield level.

## Reduced rates did not produce any effect, nor did they boost efficiency

Based on the hypothesis that the CULTAN method would improve nitrogen utilisation, trials were carried out using lower rates of nitrogen (comparison of complete response curves and comparison of X-20% rates). In sixteen situations where all the relevant data was available, the results show that reducing the N balance (nitrogen rate calculated using the balance-sheet method) by 20% and injecting the nitrogen according to the CULTAN method does not reduce the yield compared with that obtained using the balance-sheet method (+47 kg/ha). Yield losses are greater (-240 kg/ha) when the 20% reduction is implemented with conventional fertilisation (surface or hoed in fertiliser). However, the differences between these results are not significant enough to categorically conclude that the CULTAN method helps to reduce rates.

A nitrogen efficiency approach was implemented by measuring the nitrogen absorbed by plants that had been fertilised in different ways. Response curves showed similar apparent nitrogen utilisation

coefficients. Based on the comparison of 50 different plant pairs, it is not possible to show a significant difference in the amount of nitrogen absorbed.

The Innov.AR project is continuing in 2019, not only to measure the effect of a starter fertiliser when added to CULTAN fertilisation, but also to determine the most favourable input date (particularly before sowing using RTK steering). The effect of the CULTAN method on the following crop may be the subject of a subsequent study.

## Avoiding volatilisation

Establishing a physical barrier, by placing fertiliser into the ground, whether it is applied in ureic or ammonium form, limits ammonia loss into the air. Work carried out since 2012 with the CULTAN method confirms this principle, especially when using a fertiliser with a nitrification inhibitor. The aim of the 2018 trials, conducted with a more sophisticated prototype, was to determine the effect that placing fertiliser into the ground has on the volatilisation of the plain, and cheaper form of urea.

The results obtained in Rumersheim-le-Haut (Alsace region) show that, following the first nitrogen input<sup>(2)</sup>, the amounts of ammonia (NH<sub>3</sub>) escaping from the parcel are low. However, the emission "hierarchy" is clear. Incorporation by hoeing reduces flows, but pellets can remain on the ground surface and cause ammonia losses. The use of a urease inhibitor (NBPT), which slows down urea hydrolysis, is very effective under the specific conditions of this trial. Urea injection using the CULTAN method, however, totally prevents volatilisation. After the second fertiliser input in Rumersheim-le-Haut, the percentages of nitrogen lost depending on the input method are unequivocal: 12% with surface urea, 8% with hoed in urea, 3% for urea with NBPT, and 0% with injected urea.

(1) INDEE and INNOV.AR benefit from a financial support by a cross-border INTERREG program

(2) 130 kg N/ha for surface urea, hoed in urea and urea with NBPT; 220 kg N/ha for injected urea using the CULTAN method.

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