Sound nutrient management with nitrogenous fertilizers: a sustainable solution

- The efficient use of agricultural inputs must be further improved to reduce emissions to the environment and to meet specific emission targets which are being set by international political agreements. In the case of nitrogenous fertilizers, the appropriate nutrient management can reduce nitrate leaching losses as well as emissions of ammonia and nitrogen oxide to the air.

- In general, all the commonly used mineral nitrogen fertilizers can be equally effective when the principles of Best Agricultural Practice are followed.

- For economic reasons, and in order to limit nutrient losses which could impose pressure on the environment, it is in the farmer's and society's best interests to use nitrogen as efficiently as possible. This is the basis of sound nutrient management.

FERTILIZER FEEDS THE WORLD

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UREA

CODE OF BEST AGRICULTURAL PRACTICE

For healthy growth, plants depend upon various nutrients of which nitrogen is needed in the largest quantity. With nitrogenous fertilizers, farmers and growers supply nitrogen to the plants in order to achieve optimum crop yields and sustainable agricultural production.

These guidelines focus on the nitrogenous fertilizer urea. They are designed to provide general recommendations for its effective use on agricultural crops under European conditions.

Best Agricultural Practice

Crops require an adequate supply of nutrients if satisfactory yields and high quality are to be maintained. The growth and harvest of any crop takes nutrient from the soil reserves, which must be replenished. Nitrogenous fertilizers contain nitrogen in a high quality mineral form which can be applied with precision. The rate of application for all types of nitrogen fertilizers should be based on Good Agricultural Practice, a concept described in EFMA's "Code of Best Agricultural Practice - Nitrogen". This Code provides a basis for efficient fertilizer use. It includes the following principle elements:

- **Nutrient Budget**
  The crop's nitrogen requirement is considered with regard to local climate and growth conditions as well as yield expectation. This is then related to the crop-available nitrogen in the soil (analysis of mineral nitrogen) in order to determine the amount of fertilizer required.

- **Fertilizer Plan**
  First, the nitrogen contribution of the farmer's own recycled material (manures, slurries, etc.) is assessed. This is done for each nutrient in order to select the appropriate type of fertilizer, which is then applied at the correct rate, at the optimum time, in single or split dressings, using the appropriate application technique. Weather conditions and crop growth are also taken into consideration.

- **Fertilizer Practice for Water Protection**
  The fertilizer practice must respect local, regional and European legislation for water protection (e.g. the requirements of the EU Nitrate Directive 91/676/EEC).

Specifics of Urea

Urea is a naturally occurring compound contained in urine from mammals. It is manufactured by combining carbon dioxide with ammonia and is the most commonly used nitrogen fertilizer worldwide. With more than 46% nitrogen, it has the highest nutrient concentration among the commercially available solid nitrogen fertilizers. It can be applied in a solid prilled or granulated form. Although soluble in water, its application in fluid form is uncommon.

In the soil, urea is converted from carbamide nitrogen to ammonium ions (NH_4^+) by a series of enzyme reactions. Under normal soil conditions, the ammonium ions are adsorbed by the soil (i.e. become attached to the negatively charged soil particles) and the nitrogen becomes available to the plant, either in its ammonium form or as nitrate following microbial oxidation. Urea derived ammonium behaves in exactly the same way as that from other ammonium based nitrogen fertilizers. This breakdown of urea to release ammonium ions normally occurs within a week.

The most favourable conditions for the efficient adsorbtion of ammonium ions are

- when urea fertilizer is incorporated or well washed into the soil;
- when the soil has a high adsorbtion capacity;
- when the soil is sufficiently moist;
- when the soil has a low pH;
- at low temperatures.

Unfavourable conditions, such as

- persistent drought;
- high temperatures and strong winds;
- soil which has a low capacity for adsorbing ammonium;
- soil which has a high pH

may promote measurable gaseous losses of ammonia (NH_3) which has been converted from ammonium and released to the atmosphere (after the application of fertilizer).

Guidelines

The following criteria are based upon scientific evidence and agronomic experience of urea fertilizer use. These measures contribute to ensuring efficient use of nitrogen in urea whilst minimising ammonia emissions:

- Urea should be incorporated into the soil during a tillage operation, if possible.
- On bare, light (sandy) soils, urea should only be used for the first nitrogen application, and only on condition that it is incorporated as soon as possible.
- On medium and heavy soils, urea can be used for both the first nitrogen application to the soil and for top dressing.
- Urea is well suited for top dressing of winter cereals during early springtime on all soils.
- Urea should preferably be spread when rain is forecast, or should be washed into the soil by irrigation.
- Urea use on grassland is appropriate during the early growing season, during periods of rainfall or if there is irrigation after application.
- On alkaline soils (pH > 7.5), urea should be incorporated into the soil immediately after spreading.
- At high temperatures and when the soil is dry, urea should only be applied if it can be incorporated without delay. It should not be applied during the hottest part of the day.
- Do not use urea soon after liming.
- Do not spread urea on top of slurry, manure toppings, crop residues or anything that will impede the quick adsorbtion of ammonium ions by the soil.
- Urea can be applied to both dry land and irrigated land as a top dressing and as a base dressing. Depending on the local conditions, rates of 250 kg/ha urea or more should be spread in two applications.