

SLOWUREA[®] - increasing the efficiency of urea fertilizers



Importance on the efficiency of agricultural production is growing. The reasons are growth of the world's population, competition and also the greening of agricultural production. In order to cover increasing demand for food, it is necessary to apply mineral nitrogen fertilizers based on ammonium nitrate or urea regularly. However, the intensive application of nitrogen containing fertilizers significantly interferes with the natural cycles of nitrogen transformation in the environment. It is estimated that more than 50% of the applied nitrogen is not utilized by plants due to various biological, physical and chemical processes. These are the leaching of nitrates (NO_3^-) into water and the emission of ammonia (NH_3) and nitrogen oxides (N_2O , NO_x) into the atmosphere. The relatively low efficiency of nitrogen utilization thus leads to a significant impact on the environment.

In addition, N_2O is a strong greenhouse gas and is one of the most important ozone harming factors in the stratosphere. By estimation, agriculture contributes to 70% of all anthropogenic N_2O emissions, mainly due to an increase in the amount of nitrogen containing materials in the soils from which N_2O is released as a by-product of microbial processes - nitrification and denitrification.

The inefficient utilization of nitrogen not only causes economic losses to farmers, but it is also the reason for the significant increase of greenhouse gas concentration and contributes to climate changes.

To increase the efficiency of nitrogen utilization, in addition to good agrotechnical practices, inhibitors of nitrification and inhibitors of urease are also used. The inhibitors have potential to reduce NH_3 or N_2O emissions into the atmosphere and reduce the amount of NO_3^- leached from the surface layers of the soil.

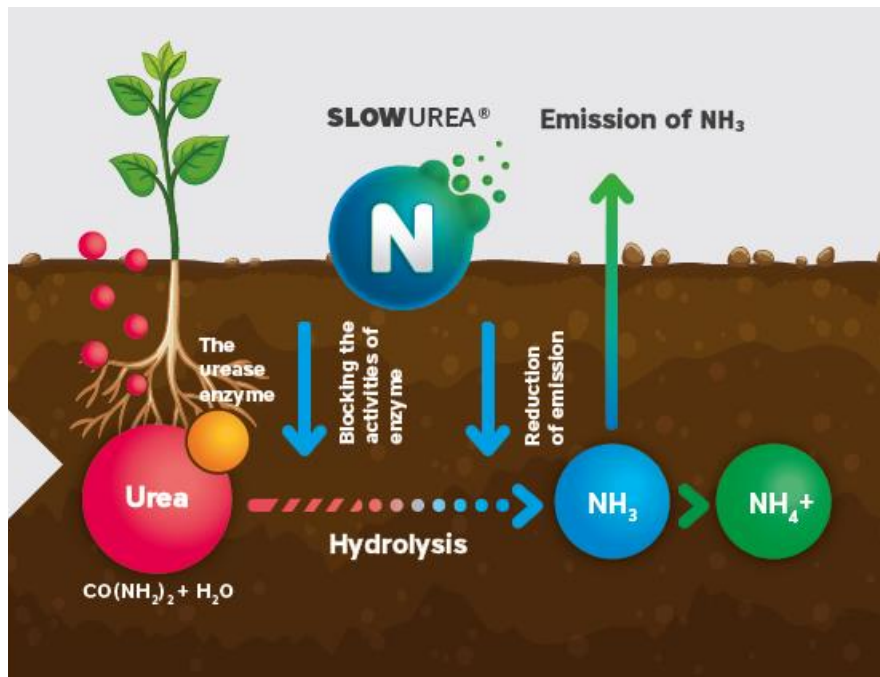
The inhibitors of urease block the activity of the urease enzyme. This enzyme is found in soil or plant residues. In urea-containing fertilizers, nitrogen is converted from the amide form to the ammoniacal form under the influence of enzyme and water. Ammoniacal nitrogen is either absorbed by the soil or it escapes. Rapid hydrolysis of urea can thus result in the loss of ammonia by its escape into the atmosphere.

Urease inhibitors help to keep acceptable forms of nitrogen in the soil for a longer period of time and allow their more efficient utilization by the root system of plants. By incorporating urease inhibitors into fertilizers containing urea nitrogen, it is possible not only to reach the

positive environmental impact but also to increase the profit from the production of fertilized crops.

The most common urease inhibitor is **NBPT** (N- (n-butyl) thiophosphoric triamide). Many scientific studies have shown that NBPT is effective in reducing NH_3 and N_2O emissions into the atmosphere.

Urea and UAN are the most widely used nitrogen fertilizers worldwide. But direct absorption of urea nitrogen from these fertilizers is difficult and inefficient for plants. In order to use this nitrogen source by plants, it is necessary to convert it to ammonium cation (NH_4^+) and nitrate anion (NO_3^-). For the first steps of transformation in the soil are responsible the urease enzymes. Urea is easily soluble in water, so the decomposition process usually starts immediately. The result of this decomposition is NH_3 and CO_2 .



Mechanism of SLOWUREA 's effect

The water content of the soil and its pH value initiate the conversion of the formed NH_3 to NH_4^+ . Under the influence of urease, an alkaline zone is formed around the urea granule, which leads to a local increase in pH. In addition, the increased pH promotes the formation of additional NH_3 and subsequent gaseous emissions.

The urease inhibitors reduce NH_3 emissions when using urea fertilizers. They effectively prevent the action of the urease enzyme, consequently the pH around the urea granules does not increase and thus the formation of NH_3 is reduced. It is estimated that the use of inhibitors of urease enzyme can reduce ammonia losses by up to 70%.

A new inhibitor of urease enzyme for solid and liquid urea-based fertilizers, called **SLOWUREA®**, has been developed at the Research Institute of Chemical Technology (VUCHT a.s.).

This liquid solution containing NBPT is easily applied to the surface of granular or prilled urea. It is also readily soluble in liquid urea-based fertilizers.

The application rate of SLOWUREA solution is not high, for individual types of fertilizers it is listed in the following table.

| Fertilizer | SLOWUREA® |
|---------------|--|
| Urea | 2.2 – 4.0 lit. / 1,000 kg |
| UAN | 1.0 – 1.7 lit. / 1,000 lit. 0.8 – 1.3 lit. / 1,000 kg |
| UANS 24-3S | 0.7 – 1.2 lit. / 1,000 lit. 0.6 – 1.0 lit. / 1,000 kg |
| Urea solution | 1.0 – 1.8 lit. / 1,000 lit. 0.9 – 1.6 lit. / 1,000 kg |
| SAM 240 | 0.7 – 1.2 lit. / 1,000 lit. 0.6 – 1.0 lit. / 1,000 kg |
| SAM 19N-5S | 0.8 – 1.3 lit. / 1,000 lit. 0.6 – 1.1 lit. / 1,000 kg |

Granulated urea after application of Slowurea.

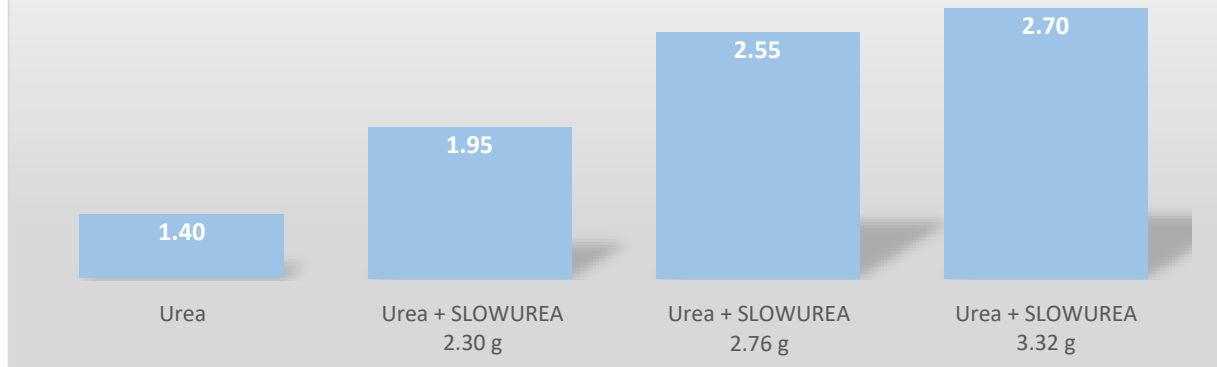


Ecological and economic benefits of adding SLOWUREA to urea-based fertilizers:

- Easy to use by utilizing a worldwide used urease inhibitor (NBPT)
- Blocking the activity of the urease enzyme and slowing down the decomposition of amide nitrogen in the soil
- Significant reduction of ammonia losses
- Improving the utilization of applied nitrogen by plants and thus increasing the efficiency of fertilization
- Protection of environment

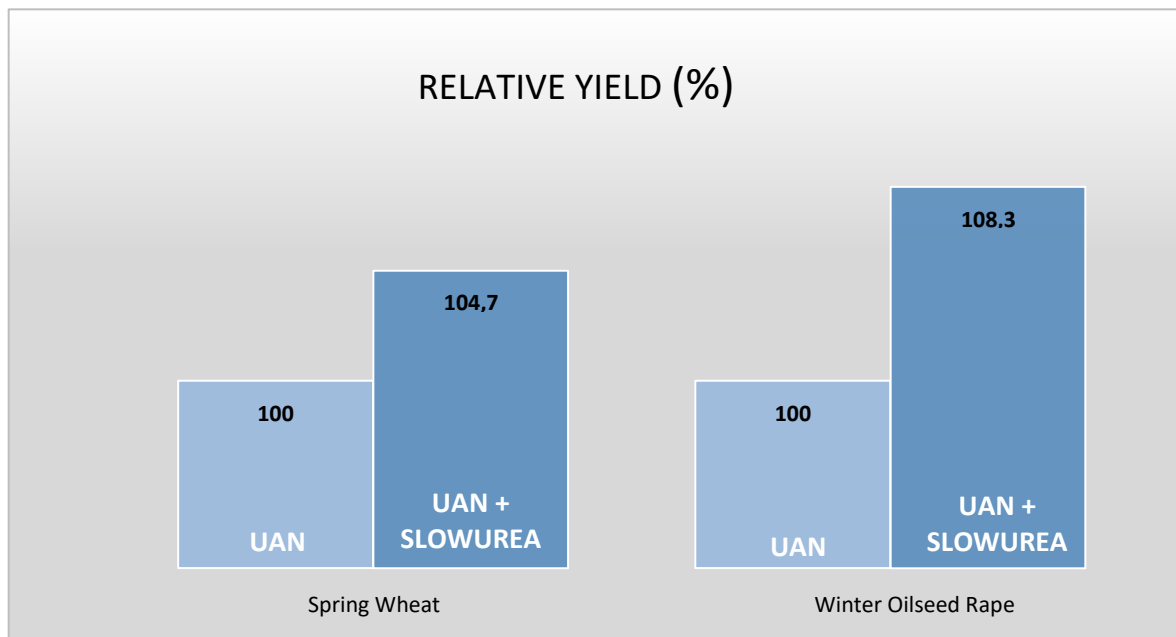
SLOWUREA has been successfully tested in pot experiments and field experiments. Pot experiments on grasses (Italian Rye Grass) with urea by three different concentrations of NBPT fixed to the urea surface by means of SLOWUREA showed an increase in the weight of the harvested grasses. The higher the dose of SLOWUREA in the urea, the higher the final weight of the grass.

WEIGHT OF GRASSES DEPENDING ON THE ADDITION OF SLOWUREA TO UREA



Also, field experiments with liquid fertilizers, UAN and UAN with the addition of SLOWUREA on spring wheat and winter oilseed rape in the seasons 2019 - 2020 showed an increase in grain or seed yield using fertilizer with the inhibitor of urease enzyme.

RELATIVE YIELD (%)



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