

# Limus<sup>®</sup>



For improved nitrogen use efficiency

 **BASF**

We create chemistry

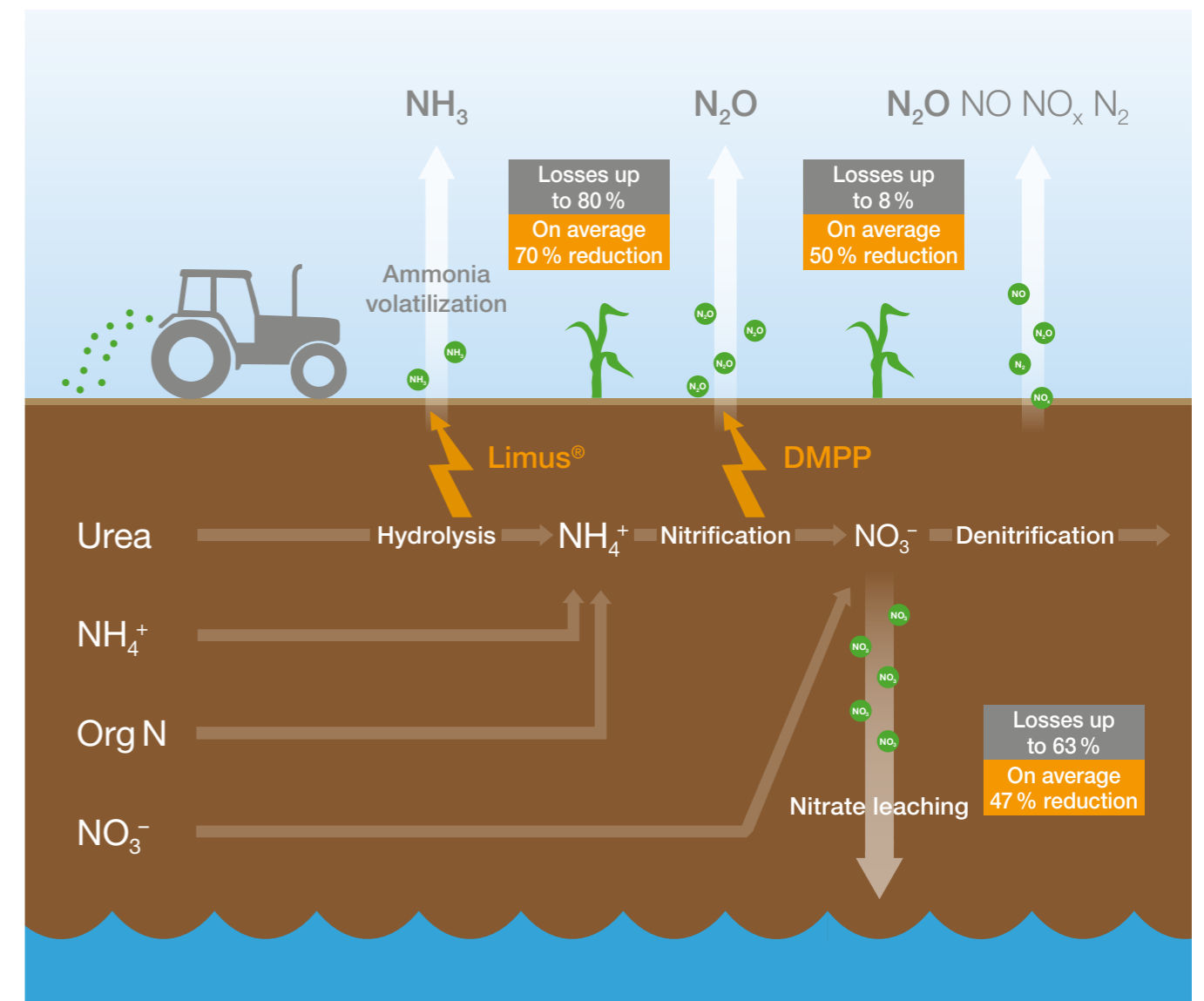




## HOW CAN WE REDUCE NITROGEN LOSSES?

Nitrogen is an essential nutrient for all forms of life and is of fundamental importance for the healthy growth of plants. However, the use of nitrogen in agriculture can lead to considerable environmental problems. Nitrogen can get lost to the atmosphere in the form of ammonia and nitrous

oxide, and as nitrate in deeper soil layers and the aquifers. The nitrogen management portfolio of BASF offers various solutions for the reduction of nitrogen losses, and therefore, increasing nitrogen use efficiency.



## BASF solutions for reducing nitrogen losses

The nitrogen management portfolio by BASF focuses on nitrogen use efficiency by increasing the availability of nutrients, avoiding nitrogen losses to the environment and increasing crop yields.

Two different types of different stabilizers are offered by BASF – nitrification inhibitors (Vibelsol<sup>®</sup> and Vizura<sup>®</sup>); and urease inhibitors (Limus<sup>®</sup> for urea and Limus<sup>®</sup> for UAN).

Limus <sup>®</sup>	Limus <sup>®</sup>	Vibelsol <sup>®</sup>	Vizura <sup>®</sup>
for urea for granular urea based fertilizers	for UAN for liquid urea-containing fertilizers	for ammonium based fertilizers	for liquid manure and biogas digestate
<b>Urease inhibitor</b> for the reduction of nitrogen losses in the form of ammonia		<b>Nitrification inhibitor</b> for the reduction of nitrogen losses in the form of nitrous oxide and nitrate	



## The importance of urea and the challenges arising from its use

Urea is a valuable nitrogen fertilizer and an important aid to agricultural production. Urea itself can be taken up by plants but only to a limited extent. It is mainly available as a source of nitrogen for plants after it has been broken down into ammonium and afterwards to nitrate.

Nitrogen losses in the form of ammonia volatilisation into the atmosphere can occur in the conversion process of urea into ammonium. The urea fertilizer type, climate, and soil pH value can impact the total amount of losses. The European Environmental Agency (EEA) assumes average ammonia losses between 12% – 17% from the applied nitrogen.

For farmers, lost nitrogen means lower yields and financial losses. For the environment, ammonia emissions can contribute to acidification and excessive nitrogen in habitats. This can cause long-term harm to sensitive habitats. For public health, ammonia can combine with nitrous oxides and sulphur dioxide contributing to the formation of smog which has significant health impacts.

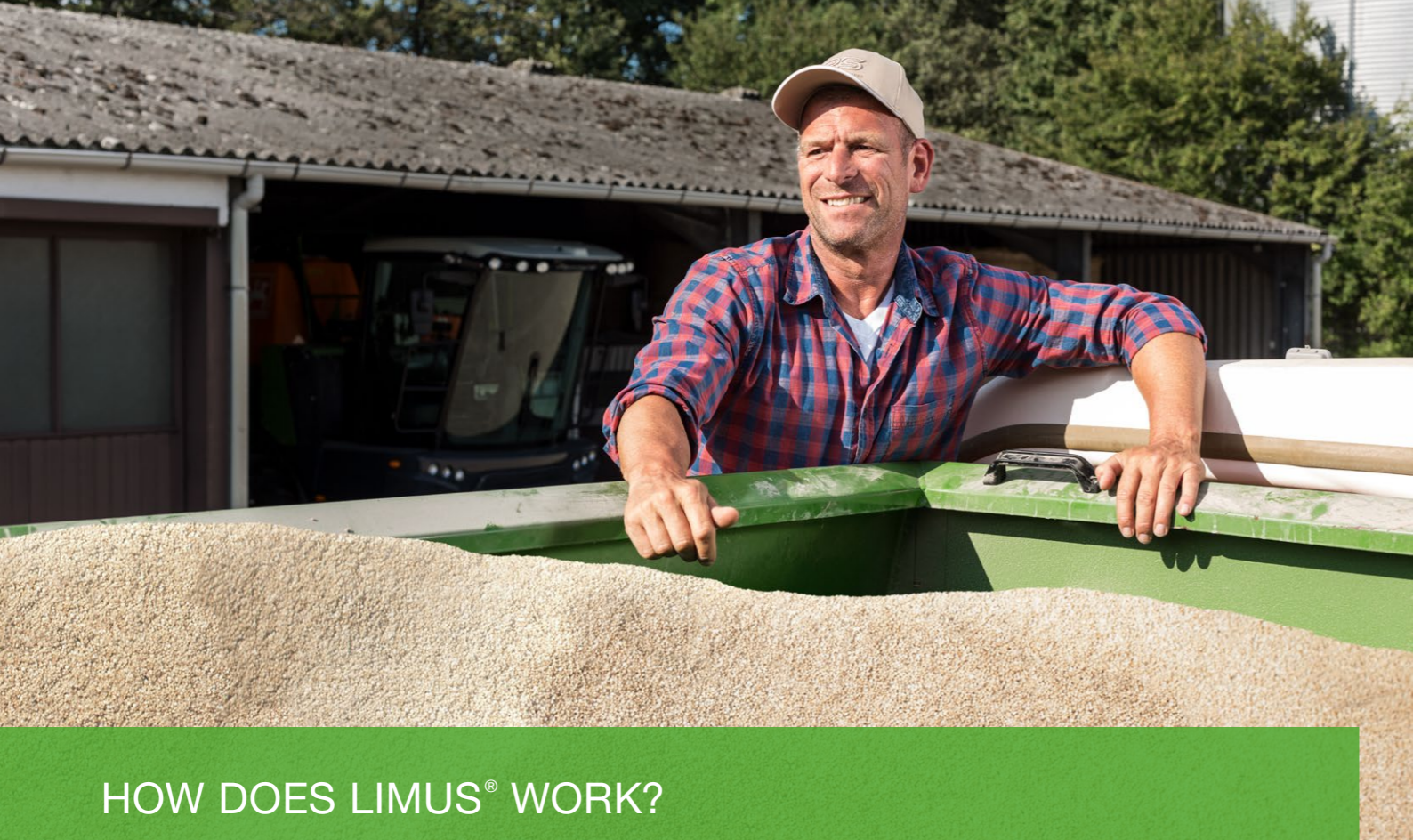
Ammonia losses can be reduced, for example, by:

1. **Mechanical incorporation** of the nitrogen fertilizer into the soil,
2. **Incorporation of the fertilizer** into the soil by rain or irrigation,
3. **Urease inhibitors**. These inhibit the activity of the urease enzymes needed for the conversion of urea into ammonium.

## Regulation is beginning to impact the use of fertilizers

§ Example from Germany: With effect from 1<sup>st</sup> February 2020, the new fertilizer regulation will allow the application of urea in Germany only in combination with an urease inhibitor, provided that urea cannot be incorporated into the soil within a period of four hours after application.





## HOW DOES LIMUS® WORK?

Limus® is a urease inhibitor developed and patented by BASF. It is a very effective urease inhibitor – in biological terms and with regard to its formulation.

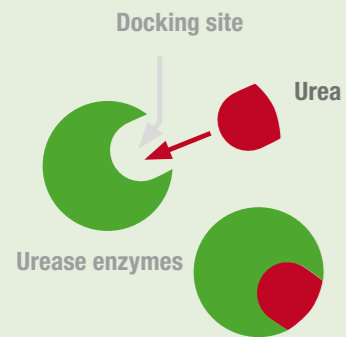
The unique combination of two active ingredients is particularly effective in inhibiting the hydrolysis of urea and reducing gaseous ammonia losses.

### The unique effect of Limus® is due to its combination of two active ingredients

There are multitudes of different urease enzymes. They are produced by organisms in the soil (bacteria, fungi) and plants. The inhibition of different urease enzymes requires various urease inhibitors which fit to their specific hydrolysis active sites.

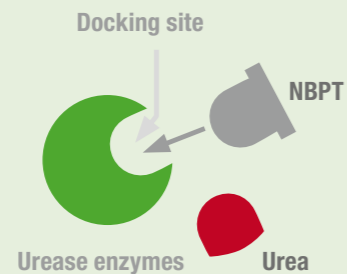
The uniqueness of Limus® depends on the combination of two active ingredients with a synergistic effect – NBPT and NPPT. In comparison to products with only one active ingredient, Limus® shows better effectiveness.

#### Mechanism without urease inhibitor



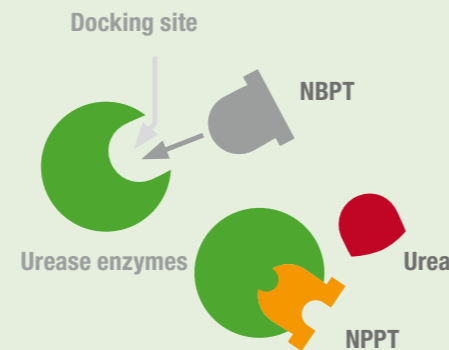
Urease enzymes possess a docking site for hydrolysing the urea into ammonia and carbon dioxide.

#### Urease inhibitor with one active ingredient

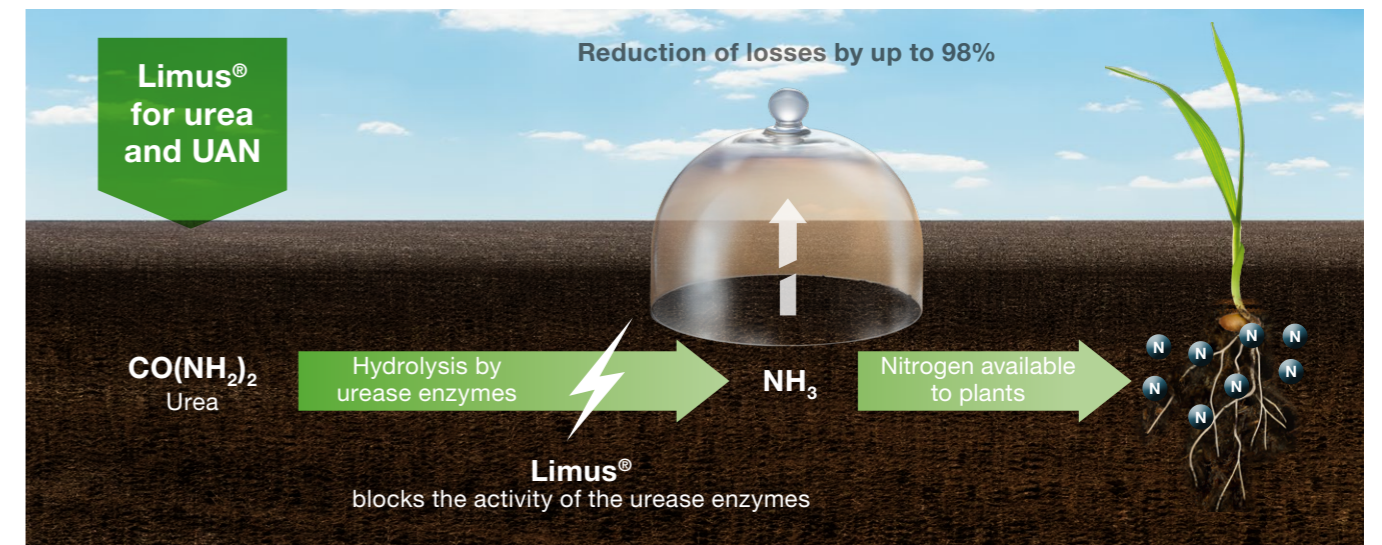


Urease inhibitors occupy this docking site to prevent urea conversion. The soil, however, contains numerous different urease enzymes that cannot all be blocked with a single active ingredient.

#### Limus®, the unique urease inhibitor with two ingredients



Different urease enzymes require different urease inhibitors. Thanks to its two active ingredients, NBPT and NPPT, Limus® is considerably more effective than a product with only one active ingredient.



### Limus® offers highest nitrogen use efficiency

The use of Limus®, the new urease inhibitor from BASF, is a very effective solution for the reduction of ammonia losses and for increasing nitrogen uptake by plants from urea containing fertilizers.

This enables the reduction of gaseous ammonia losses by up to 98%. The nitrogen is therefore available to the plants ensuring crop yields.

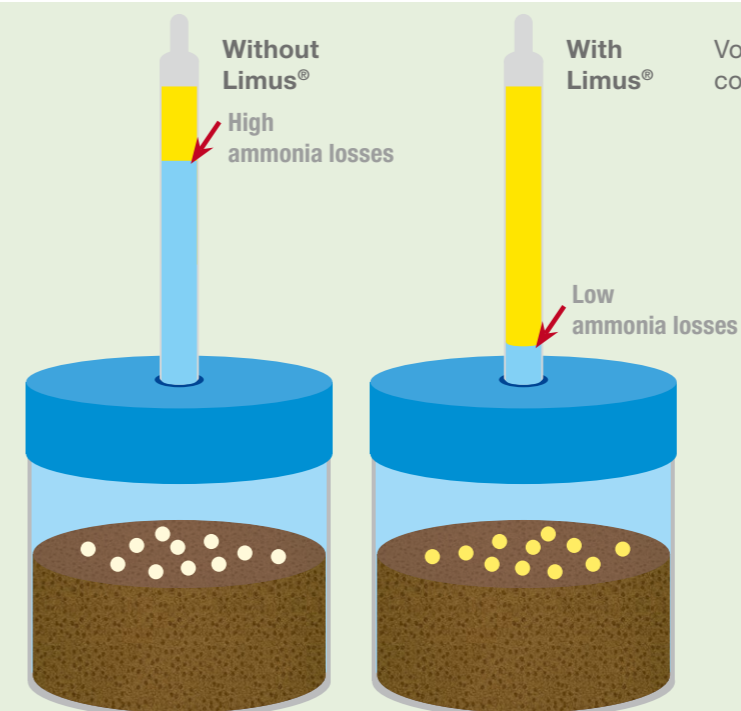
The two active ingredients in Limus® block the urease enzymes that are responsible for the conversion of urea into ammonia and carbon dioxide. Consequently, it protects the nitrogen.

Limus® is unique in terms of efficiency and stability. Its special feature is the combination of two active ingredients that synergistically complement each other.

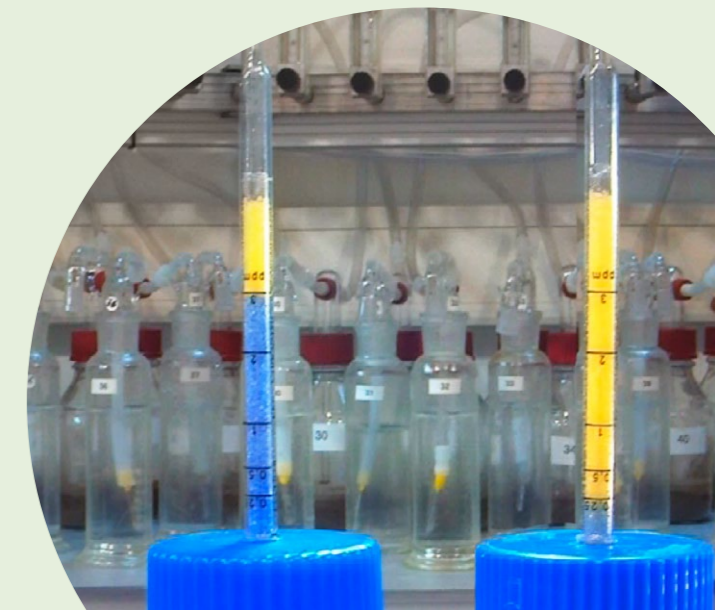
### Lower nitrogen losses with Limus®

Nitrogen losses have to be avoided to ensure sufficient nitrogen is available to satisfy the needs of the growing plants. A simple test set-up clearly illustrates the nitrogen losses reduction effect of Limus®. Untreated urea (left) and urea treated with Limus® (right) is added to small containers filled with soil.

Both containers are hermetically sealed, and only an ammonia measuring tube sticks out at the top. After 48 hours, the much higher ammonia losses in the sample without Limus® are clearly visible.



Volatilisation of ammonia after 48 hours (at the left, conventional urea; at the right, urea treated with Limus®)





Whichever way you look at it Limus<sup>®</sup> is always the right choice!

## Limus<sup>®</sup> for urea

### LIMUS<sup>®</sup> FOR UREA FOR GRANULAR UREA FERTILIZERS

- New urease inhibitor with a unique combination of two active ingredients
- Reduces ammonia emissions by up to 98%
- More nitrogen available to plants increases yield levels
- Complies with the requirements of the fertilizer regulations
- Increased flexibility and certainty for farmers



## Limus<sup>®</sup> for UAN

### LIMUS<sup>®</sup> FOR UAN FOR LIQUID UREA-CONTAINING FERTILIZERS

- New urease inhibitor with a unique combination of two active ingredients.
- Reduces ammonia emissions by up to 98%
- Optimal nitrogen availability and use efficiency
- Increases yield and quality
- Flexibility in application timing





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