May 2023

"Urea Blue" – pelletized water soluble Urea with Nitrification Inhibitor

Gat Fertilizers is launching a new product, “Urea Blue”, a unique fertilizer developed exclusively by Gat Fertilizers: solid Pelletized Urea with added Nitrogen Inhibitor (preserves the nitrogen as ammonia for an extended period). This product complements the BLUE fertilizer solutions series, rich in ammonia and urea with the required addition of Nitrogen Inhibitor compound. Over the last two years this application has expanded significantly, in a variety of sizes.

The added Nitrogen Inhibitor prevents decomposition of ammonia into nitrite and nitrate in the nitrification process, making nitrogen fertilization more efficient and contributing to the additional advantages of plant nutrition. In soils containing clay minerals (that lack sand), after fertilizing with ammonia or urea that turns into ammonia within a day or two in the mineralization process at hot temperatures (ammonization), but also under low temperature conditions, the ammonia binds to the clay soils. The ammonia bound to clay soils is equivalent to the chemical weight of ammonia in the soil solution and constitutes a “store house” for providing ammonia to the soil solution. When the plant's roots absorb ammonia from the soil solution, the ammonia resulting from binding to the soil it released immediately into the soil solution, ensuring continuous nutrition for the plant. The ammonia’s soil mobility (NH_4^+) (binding is minimal the greater the clay in the soil; addition of nitrogen stabilizer prevents nitrate decomposition) (NO_3^-) which transported easily with the water flowing to the depth of the soil section after irrigation or rain. Delaying ammonia decomposition increases nitrogen availability in the rhizosphere and prevents nitrogen leakage to the margins of the wet area where rhizosphere activity is less effective or leaching beyond the root area.

Another advantage of ammonia nutrition - that ammonia absorption by roots causes acidification of the rhizosphere (in the soil solution near the roots), with the result that phosphorus and micronutrient absorption is more efficient. The nitrogen stabilizer at hot temperature or basic soil conditions prevents poisoning of the plants resulting from nitrite (NO_2^-) accumulation in the rhizosphere area. Excess application of ammonia is likely to cause nitrite accumulation during the nitrification process, resulting from delay in the microbial activity that decomposes nitrite to nitrate. When applying BLUE fertilizers, delay of nitrification by microbes significantly reduces the process.

If there is surplus water in the plant area and lack of ventilation, then denitrification processes occur with microbes, decomposition of nitrites to gaseous nitrogen and loss of nitrogen from the soil; then a decrease in amounts of nitrites in the soil from addition of nitrogen stabilizer significantly prevents or reduces this process.

The basic assumption is that fertilization with Urea BLUE of winter crops is more efficient. As a result of the delayed nitrification process which prevents leaching of nitrite throughout the soil, fertilization will be more efficient and there may be savings in fertilizer from the outset, since the majority of the nitrogen contained in the base compound will be maintained in the rhizosphere as ammonia.

At the Gilat - Vulcani Research Institute, Dr. Ran Arel and Adi Kushmaro-Biar conducted an experiment to characterize the process of delayed nitrification in Urea-BLUE fertilizer, comparing it to regular urea fertilizer, under controlled laboratory conditions.

Following are the results of an experiment report at the Gilat Laboratory:

Examination of nitrate leaching from loess soil after fertilization with urea and urea with a Nitrification Inhibitor (Gat Fertilizers) - Ran Arel, Adi Kushmaro-Biar

Procedure: the examination was conducted at the Gilat Research Center of Dr. Ran Arel under temperature and light controlled conditions (18^{o}C.) (Darkened laboratory) over 48 days (25.8.20 – 12.10.20).

The experiment was conducted using 5-liter pots, 17.5 cm in diameter, cross section area: 0.024 m^2.

Each pot contained about 5 kg of loess soil (75% sand) taken from a wheat field in the Ruhama [a kibbutz in the Negev] area.

Three treatments:

1. Urea
2. Urea with nitrification inhibitor (hereinafter called: Urea blue)
3. Without fertilizer (Control)

In each pot 652 mg of urea was injected (with inhibitor and without) into the top 4 cm of the pot, in total 300 mg nitrogen in each pot.

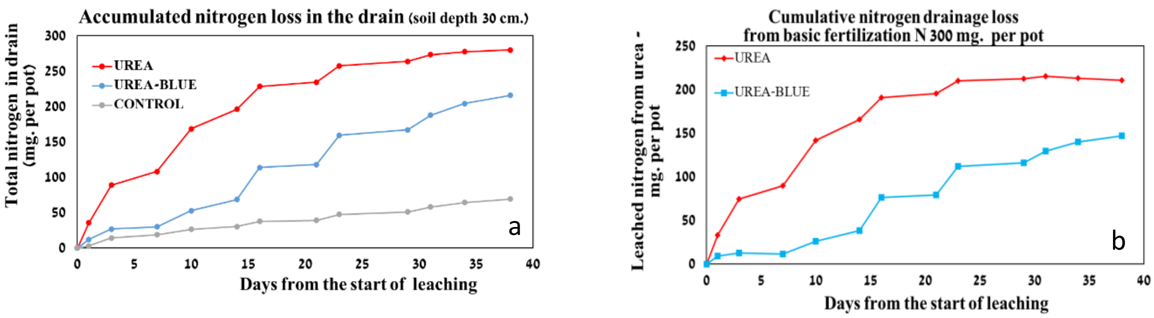
(Urea blue contains 45% nitrogen, and the amount of nitrogen added was 293 mg).

The pots were irrigated with purified water with a peristaltic pump at a very low flowrate of 0.5 ml/min (illustration1) and were irrigated twice per week, during the first 9 days at 300 cm and thereafter 400-500 cm until the end of the experiment; in sum, each pot received 6 liters of water (equivalent of 250 mm of precipitation). After each irrigation, the volume of drainage was measured, and an analysis of the nitrate and ammonia was carried out using the Gallery Discrete Analyzer ™ by Thermo Fisher Scientific Company.

Results: In general, ammonium concentration in the drainage was incredibly low, and the nitrogen leaching originated exclusively from nitrate (not shown).
In Graph 1a/b it can be seen that the pots which received only urea lost the greater part of the nitrogen given to them after about 30 days, about 75% (Graph 2), unlike the pots that received urea Blue, with a far slower leaching rate of nitrates; in the first month less than half of the nitrogen was leached below the 21cm measured (about 39%, minus the control). After 45 days of urea treatment, there was a minor release of nitrate, as opposed to Urea Blue, where about 45% of the nitrogen leached from the added amount (Graph 2) . Similarly, it may be seen that even in the control group treatment, in which no nitrogen-containing

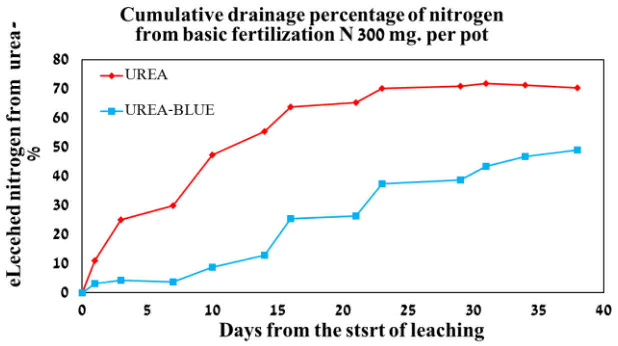
fertilizer was applied of any kind, there was nitrate leaching, due to mineralization of the organic nitrogen found naturally in the soil.

Figure 1: -Nitrogen loss accumulates in the drains in the three different treatments (mg nitrogen per plant) over a period of 48 days. (a) the three treatments, and (b) nitrogen cleansing in the control



In Graph 1: the nitrogen concentration in the drainage water was very high during the first 2-3 weeks after application. This finding indicates that: (1) Fast leaching of nitrates that were in the soil solution (see treatment of the control); and (2) Fast decomposition of urea accompanying fast nitrification that led to significant leaching of the nitrogen in the urea treatment in the first 20 days. By contrast, with the Urea Blue treatment, nitrogen leaching in the first two weeks does not differ from the control group, and we may therefore determine that there was an absolute inhibition of nitrification during the first two weeks after application. After two and half weeks the rate of leaching in Urea Blue increases, and after 3 weeks where about 30% of the nitrogen leached from the added amount (Graph 2).

Figure 2: The percentage of leached nitrogen from urea fertilizer in the beyond 30 cm soil depth



Conclusions:

We can conclude that nitrification with Urea Blue effectively inhibited the rate of nitrification for about two weeks, after that there is reduced inhibition maintained throughout the period of the trail. Inhibition of nitrification significantly reduces leaching of nitrogen at the depth of the soil profile, as compared to fertilization with regular urea, where the rate of leaching was faster (more than 50% of the nitrogen leached after 3 weeks). These findings are consistent with an experiment conducted last year, in which we found that most of the urea turned into nitrates in the brief period of 7-14 days.

Even after 45 days the inhibitory action of treatment with Urea Blue is maintained, so that we cannot determine precisely how long the inhibitory action lasts. It is possible to evaluate the bound ammonium concentration to establish a mass balance (not tested in this limited framework). Under laboratory conditions, the Urea Blue appears to be a product with significant inhibitory ability for a prolonged period. Such dynamics have immense potential for reducing nitrogen loss due to leaching in light soil and/or in rainy years (primarily early in the season). In addition, absorption of nitrogen in its ammoniac form is preferable for many types of plants, both in metabolic terms as well as to encourage absorption of phosphorus and iron. These findings need to be evaluated under field conditions.

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Summary – Significance of conclusions for field fertilization management (Yaron Yutal): After 30 days of fertilization with urea, about 72% of the nitrogen applied leached as nitrate beyond a depth of 21 cm. (the soil height in the pot). This signifies that under field conditions, the nitrogen leached to a depth of the irrigated surface, according to the amount of water that seeped into the soil.

In the experiment the amount of irrigation water is equivalent to 250 ml per dunam, meaning that the depth of irrigation is about 50-70 cm. according to soil type. The amount of rain accumulating in the first month after planting depends on Heavenly compassion, when in some years there is 50 mm while in other years there may be 150 mm or more. The conclusion is that during wheat sprouting and root development most of the nitrogen is found beyond the area of development with rain over 50 mm. Development of wheat roots is slow during winter conditions in the initial months, so that most of the nitrogen that is leached as nitrate is found at a depth unavailable to the roots.

When fertilizing with Urea Blue, about 60% of the nitrogen remains in the upper layer after 3 weeks, in an area where the root system develops in the first month of sprouting. In most cases this season, Gat Fertilizers, has introduced exclusively in Israel a special, innovative fertilizer, and recommends applying "**Urea Blue"** as a basic nitrogen-rich fertilizer, either to spread on soil or to cover in the soil , with a nitrogen stabilizing additive that improves efficiency of nitrogen fertilizer, prevents leaching of nitrates below the rhizosphere, and improves absorption of other essential nutrient elements there will be no need to do head fertilization with urea, usually applied in leaf stage 4-6.

For amounts and dosages, we recommend consulting with the Gat Fertilizers agronomist.

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