

# HAIFA *CoteN*<sup>TM</sup> - CONTINUOUS NITROGEN NUTRITION FOR ARABLE CROPS

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## Abstract

*CoteN*<sup>TM</sup> and *CoteN Mix*<sup>TM</sup> are new Haifa products featuring polymer- coated urea prills and granules. *CoteN*<sup>TM</sup> is made of fully coated urea, while *CoteN Mix*<sup>TM</sup> is a blending of coated and uncoated urea. These products have been developed for situations where crops require reliable, intensive and continuous application of nitrogen. The short-term *CoteN*<sup>TM</sup> products have quasi-linear release curves.

Nitrogen losses from soil that had been base-dressed with *CoteN*<sup>TM</sup> and *CoteN Mix*<sup>TM</sup> were minimized.

We report here the results of recent field trials with maize in Israel and Italy, rice in Korea and wheat in Israel that showed consistent beneficial effects. These effects were: similar or increased production of biomass, grain (15-30%) and grain protein (3–10%) and higher (14%) plant nitrogen content, in spite of considerable reduction in nutrients applied.

These results proved that careful implementation of *CoteN*<sup>TM</sup> products guarantees:

- ❖ Savings of 30% on the total expenditure for nitrogen fertilizers and their application.
- ❖ An advanced solid method of coping with current and future regulations, limiting total application rate of nitrogen in arable crops.
- ❖ Reduction of worldwide environmental impact of nitrogenous fertilizers.

## Introduction

Arable crops are generally fertilized by the minimum possible field operations in order to save on application costs. The full rates of phosphorus and potassium are, for the same reason, generally applied as pre-plant base dressing. Nitrogen, due to its mobility in the soil, has to be applied by several operations in order to make it as efficient as possible. Otherwise, nitrogen losses by both volatilization and leaching will result in marked inefficiency, reduced biomass production and adverse environmental impacts.

Multiple applications of nitrogen, to best address crop requirements, on the other hand, incur additional costs that make the cultivation less economic.

The state of the art technology of coating of fertilizer granules by polymeric membranes is acquiring wide recognition by advanced growers of horticultural crops worldwide. The use of controlled release fertilizers (CRF's) has established its value for growers of open- field

vegetables, fruit trees, nurseries and ornamental plants. Preliminary field trials with plants fed by *CoteN*<sup>™</sup> and *CoteN Mix*<sup>™</sup> showed that they enjoyed optimal mineral nutrition that was expressed by considerable increase in biomass, although the total rate of nitrogen applied was 30% lower than the commercial reference. This biomass increase can be attributed to improved uptake rate of nitrogen, phosphorus and potassium, lower mean EC values and markedly higher water use efficiency.

We, hereby, suggest adopting this method for arable crops too, due to its considerably more economical application and the full control over its nutrient release rate.

The following results summarize Haifa's recent experiments in lysimeters and in fields, worldwide.

## **Materials & Methods**

*CoteN* products are made of urea granules or prills, fully- or partly- coated by a permeable polymeric film. The nitrogen release rate from the granules is determined exclusively by the coating materials, coating thickness and by the ambient temperature. Different *CoteN* products differ in the coated / uncoated granules ratio and in the release rate.

Once the fertilizer granules are applied to the soil, soil water vapor gets into them and a saturated urea solution is formed within the granules. The polymeric coating then acts as a flow controller, allowing pre-determined and continuous diffusion of nutrients to the soil solution.

Different coating ratios and different thicknesses of the granules coatings enable to produce any release profile required by the grower.

The advantage of *CoteN* products over fertigation and several side-dressings was validated under laboratory conditions, in lysimeters and under commercial agricultural conditions in a series of experiments carried out in Israel, France, Korea and Italy.

The following products were checked:

*CoteN* 2M = fully coated urea prills for nominal two-months release of its N at 21<sup>0</sup>.

*CoteN* 4M = fully coated urea prills for nominal four-months release of its N at 21<sup>0</sup>.

*CoteN* mix = a blend of coated and uncoated urea prills.

## **Results and Discussion**

**A. *CoteN* release profile.** The release curves depicted in paragraph A of the poster show that both products released 80% of their nitrogen contents during the designated time period. The release curve was linear for *CoteN* four-months and slightly convex for *CoteN* two-months. It is therefore concluded that these products have a quasi-linear release profile making them, thus, a reliable source of N for the designated period.

**B. The lysimeter experiment,** using basil (*Ocimum basilium*) plants showed that highest yield was obtained in the treatment employing pre-plant applied 80% of the control nitrogen in the form of *CoteN* + 80% of the P & K, all in the form of partly coated fertilizers. Somewhat lower yield was obtained in the treatment employing pre-plant applied 80% of the control nitrogen in the form of *CoteN* with soluble P & K fertilizers. Both treatments employing conventional, fully soluble fertilizers that were applied 4 times during the season, obtained considerably lower yields. There was hardly any difference between the treatments employing the full rate of nutrients and the one employing only 80% of this rate, (see paragraph B of the poster).

Another clear result obtained in this experiment is the considerably reduced rate of nitrogen leached from the lysimeter. As can be seen in the second figure of paragraph B, highest leaching losses took place in the treatments employing 100% and 80% of the fully soluble fertilizers. Considerably lower losses were recorded in the treatments of the partly or fully coated fertilizers. Additionally, the *CoteN* treatment was superior to the other treatments in terms of water-use efficiency, and N, P and K use efficiency (data are not shown). It is therefore concluded that although the coated products were applied by one pre-plant application, at 80% of the conventional rate, their efficiencies were markedly higher than the efficiency of the soluble fertilizers.

**C. The field experiments** were conducted in commercial fields, treated with full scientific care.

1. The maize (hybrid of “600” class) experiment in Northern Italy showed that one base-dressing of *CoteN mix* at 70% of the conventional N rate, was significantly superior to the following treatments:
  - ❖ Two applications of urea, at full N rate.
  - ❖ One base-dressing of urea, at 70% of the conventional N rate.
  - ❖ *ENTEC* (DMPP-urea) applied by one base-dressing, at 70% of the conventional N rate.
2. The rice (cv. *Chucheongbyeon*) experiment in Korea showed that *CoteN* applied once, as base dressing at 80% of the control N, was equivalent or better than the control, in terms of total yield, number of panicles and spikelets per area unit, and grain protein content, although the control treatment was applied by 3 dressings. The *CoteN* treatment in which the N was applied once at the full N rate scored the best yields in terms of the above-mentioned parameters. It is concluded, therefore, that the efficiency of *CoteN* is markedly and significantly higher than that of plain urea. A given N rate will produce considerably higher rice yields if applied as *CoteN*, and saving of two field operations is an additional bonus for the grower. Alternatively, same yields can be obtained if *CoteN* is applied once, as base dressing at 80% only of the control.
3. The wheat (cv. *Rotem*) experiment in Israel showed that *CoteN* applied once, as base dressing at the full rate of the control N, was markedly better than the control in terms of total yield, grain protein content, N leaf content and grower’s income, although the control treatment was applied by 2 dressings. This result is in full accordance with the phenomenon found in the two previously analyzed crop cases.

**In view of all the above it is concluded that the main benefit of *CoteN* products to arable crops growers is based on the following advantages:**

- ❖ **Continuous and flexible supply of nitrogen throughout the growth season by a single pre-planting application.**
- ❖ **A marked saving of 20 – 30% of the N application rate, while maintaining or exceeding the yield obtained by conventional treatments.**
- ❖ **Help in complying with the environmental regulations issued to control nitrogen application rates.**