16th Nitrogen Workshop – Turin 2009
"Connecting different scales of nitrogen use in agriculture"

CoteN$_{mix}$: Continuous nitrogen nutrition for arable crops

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Introduction

The Problem

In agriculture Nitrogen, due to its mobility into the soil, has to be applied by split operations in order to make it as efficient as possible.
Otherwise, Nitrogen losses by both volatilization and leaching result in:

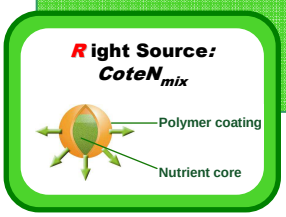
- marked inefficiency (additional costs due to several passages)
- reduced biomass production
- adverse environmental impacts on soil and wather

The Challenge

To solve this problem, in the last 10 years Haifa has been developing a controlled-release nitrogen source for arable crops: CoteN.
CoteN is made of Urea granules coated by a permeable polymeric film (PPF) which release all the nutrient core in several months, depending on the thickness of the PPF

The Answer

Fertilizer BMP (Best Management Practice) can be than expressed as the 4 ***R***'s:



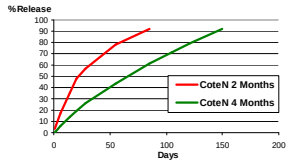
R **ight Time**: studied to syncronize the nutrient release with the plant uptake of N, CoteN$_{mix}$ is applied *1 time* and perform a controlled release up to *4 months* (see ch. *A.1*)

R **ight Rate**: thanks to CoteN$_{mix}$ efficiency, the same yields compared with the Farmer Practice (FP) can be obtained saving *up to 20-30%* of the standard applied N (see ch. *C.4*)

R **ight Place**: CoteN$_{mix}$ distributed in *banding application* shows higher efficiency

A. Release

A.1 Nitrogen release rate of CoteN products



- CoteN 4 Months shows an almost-linear curve
- Steady release rate, continuous availability
- The mix with CoteN 2 Month guarantees a modular N supply to plants

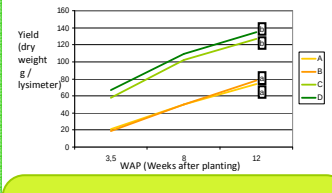
B. Experimental trials: Lysimeter

Avi Shaviv, the Technion, Israel Institute of Technology, Israel

Basil (*Ocymum basilium*) grown on sandy loam (CEC=5 meq/100 g)
Irrigation: 3 drippers, delivering 2 L/hour placed on soil surface 2-3 times a week.

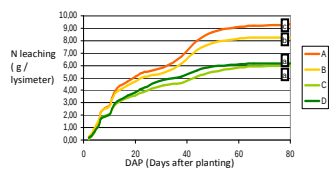
	Treatment	N° of applications
A	Conventional, Full rate (16 g N)	4
B	Conventional, 80% of full rate	4
C	CoteN, 80% of full rate	1
D	CoteN, 80% of full rate + coated P, K	1

B.1 Cumulative yield in lysimeter- grown basil plants



- No significant differences between full rate and 80% of CAD (Conventional Applied Dose)
- The use of CoteN: with 20% of the Nitrogen input less, an increase of 100% of the yield
- CoteN+coated P-K shows the highest performances

B.2 Cumulative leaching of nitrogen in drainage of basil lysimeters



- No significant differences between full rate and 80% of CAD (Conventional Applied Dose)
- After 50 days from planting, the N leaching shown by CAD was 50% more than CoteN

C. Experimental trials: Field

In the last 5 years over than 70 field trials have been performed in different countries to test CoteN$_{mix}$ performances at different climate and soils conditions, management systems and on different crops

Material

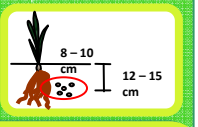
CoteN$_{mix}$: blend of 3 different compounds in various ratios:
Coated Urea – 4 Months longevity
Coated Urea – 2 Months longevity
Uncoated Urea

Methods

Distribution of CoteN$_{mix}$ (*R Source*) at different applied doses (*R Rate*)

Maize: 1 application at sowing time (*R Time*)
in band, 10 cm on side of the plant, 15 cm deep (*R Place*)

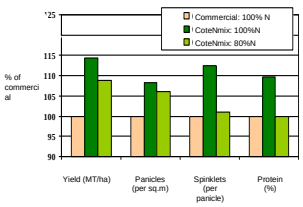
Rice: broadcast, split into 3 applications (*R Time*)
base dressing (*R Place*)



C.1 CoteN$_{mix}$ Rice, Korea, 2003

Commercial treatment (FP) was 150 kg/ha of N, split into 3 applications
CoteN$_{mix}$ treatments were applied as base dressing

Prof. B. W. Lee, Agriculture and Life science college, Seoul National University, Korea



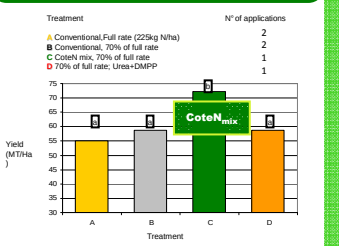
Trends

- CoteN$_{mix}$ at 100% on the FP shows the best performances (i.e. yield 15% more than the FP)
- CoteN$_{mix}$ at 80% still shows higher (8% more than FP yield) or equal performances than CAD

C.2 CoteN$_{mix}$ Maize, Italy, Summer 2004

Maize cv. Hybrid "600" class
Conventional treatment on silage yield compared with CoteN$_{mix}$ performances at 70% of FP

Adriano Altissimo, Landlab studio associato, Quinto Vicentino-VI, Northern Italy



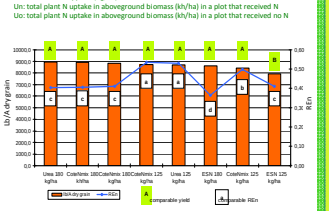
- Higher yields are always obtained applying just the 70% of the CAD
- Significant differences are shown by CoteN$_{mix}$: saving 30% of the N input, the yields are more than 15% higher of the full rate dose

C.3 CoteN$_{mix}$ Maize, Michigan-USA, 2006

Yield vs REn[1] of different fertilizers at two N level

Michigan State University, Trowbridge Road, Lansing, MCH, USA

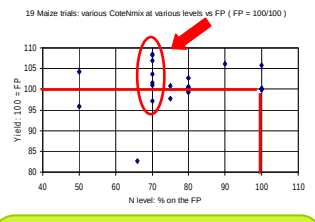
[1] **REn** -crop Recovery Efficiency- : Kg increase in N uptake per kg N applied
REn = (Un – Uo) / Fn
Fn: amount of N applied (Kg/ha)
Un: total plant N uptake in aboveground biomass (kh/ha) in a plot that received N
Uo: total plant N uptake in aboveground biomass (kh/ha) in a plot that received no N



- CoteN$_{mix}$ 125 kg/ha shows the same efficiency values (REn=0,5) and yields (9000 lb/A) than CoteN$_{mix}$ 180 kg/ha and Urea 125 kg/ha
- The important issue is that CoteN$_{mix}$ 125 kg/ha and 180 kg/ha were spread in 1 application, while Urea in 2-3 split applications

C.4 CoteN$_{mix}$ Maize, Europe-USA-Mexico, 2004-2006: Synthesis

Comparison: yields obtained at different N% levels on the FP



The chart shows that reducing up to 20-30% the N input on the FP (100%), 14 times on 19 the yield remains equal or even superior

Conclusion: CoteN$_{mix}$ shows higher N-NUE (Nitrogen- Nutrients Use Efficiency)

Agronomical advantages

- Improvement of the soil fertility (nutrients and O.M.)
- Increase of the N-NUE (see ch. *C.3*)
- Continuous and flexible supply of nitrogen throughout the growing season by single pre-planting application
- Applied at sowing time, CoteN$_{mix}$ avoid the farmer from difficulties or delays due to non-optimus soil conditions (wet terrain, sudden rains, etc.)

Environmental advantages

- Reduction of Urea leaching risk (see ch. *B.2*)
- Reduction of Ammonium volatilization risk
- Help in complying with the environmental regulations on nitrogen application rates

Economical advantages

- A market saving of 20-30% of the N application rate, maintaining or exceeding the yields obtained by conventional treatments (compare ch.s *C.1 - C.2 - C.4*)
- No passages needed to spread N during the growing season
- Enhacement of the net income – higher economical efficency