

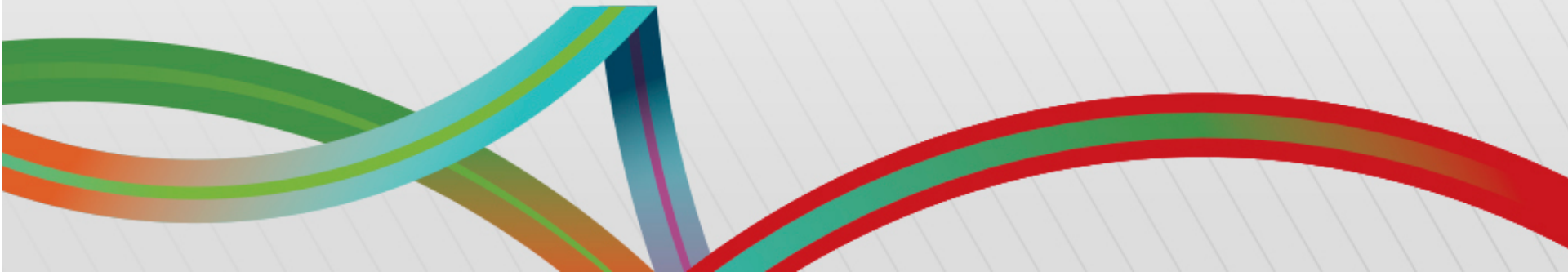


Where needs take us

CURRENT DEVELOPMENTS IN CONTROLLED RELEASE FERTILISERS

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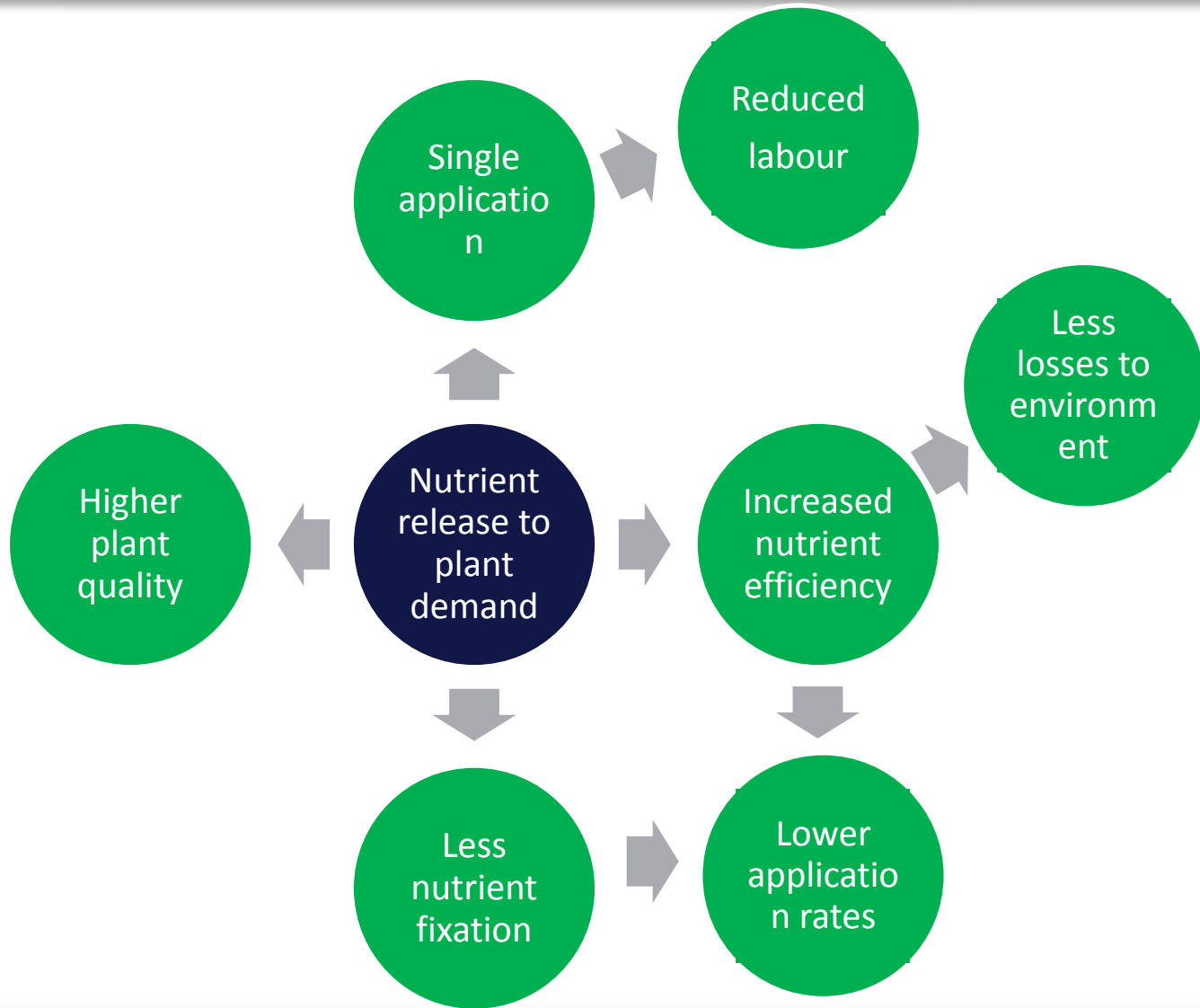
- Controlled Release Fertilizers (CRF) are traditionally used for Ornamentals Plants and Turf and Landscaping. Agricultural applications are increasing.
- Main benefits: limited applications, nutrient efficiency, reduced losses to the environment, lower rates.
- Recent developments:
 - Tailored release profiles
 - Several 'new' nutrients as CRF
 - Improve cost equation for end user
 - Increased mineralization of coating

1. Introduction
2. Characteristics of CRF
3. Agronomy with CRF
4. Degradation of coatings
5. Conclusions

Introduction: CRF are coated mineral fertilizers

Osmocote





954,555



PATENT SPECIFICATION

954,555

DRAWINGS ATTACHED.

*Date of Application and filing Complete Specification :
Oct. 12, 1960. No. 35002/60.*

*Application made in United States of America (No. 846,088) on
Oct. 13, 1959.*

Complete Specification Published : April 8, 1964.

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Index at Acceptance :—C1 B(2, 3C1, 3C2, 3C3, 3C4, 3C5, 3F1, 3F2).

International Classification :—C 05 b, c, d, f.

COMPLETE SPECIFICATION.

Improvements in or relating to Delayed Action Granular Fertilizers.

Archer Daniels Midland

CRF has in the last 20 years also moved into Agriculture....



- Container Nursery
- Bedding- & Potplants



- Sportsfields
- Golf
- Landscape



- Specialty Ag.
- Broad Acre Crops
- Forestry & Plantations

1967

1980

1990

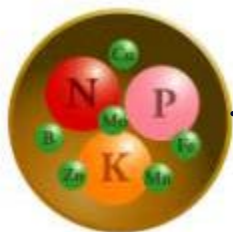
Controlled release fertiliser: *Fertiliser in which nutrient release is controlled, meeting the stated release rate of nutrient and the stated release time at a specified temperature*



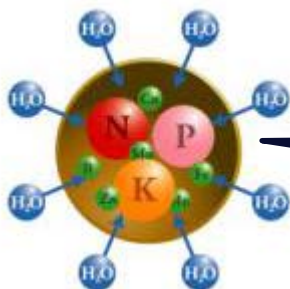
Slow release fertiliser: *Fertiliser, of which, by hydrolysis and/or by biodegradation and/or by limited solubility, the nutrients available to plants is spread over a period of time, when compared to a "reference soluble " product e.g. ammonium sulphate, ammonium nitrate and urea*

Source: ISO 8157:2015

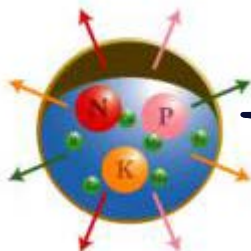
Release of Polymer coated CRF



Release mechanism explained for coated NPK+trace element granule



Water (vapor) penetrates through coating and start dissolving nutrients and creates osmotic pressure



Nutrients dissolve and highly concentrated nutrient solution is pushed out continuously over time due to osmotic pressure



After release of all nutrients generally coating fragments and very slowly degrades

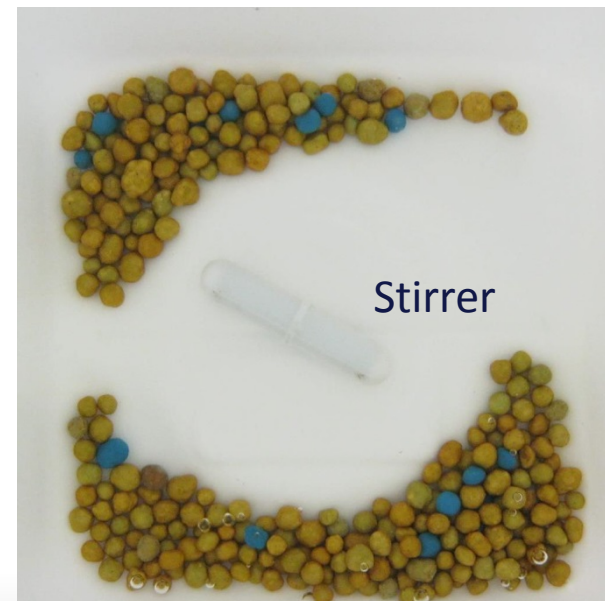
Characteristics of CRF: testing

Release testing of CRF in water: 10-12.5 g is placed in 200-500 ml of water at 25-30°C. **REAL TIME**

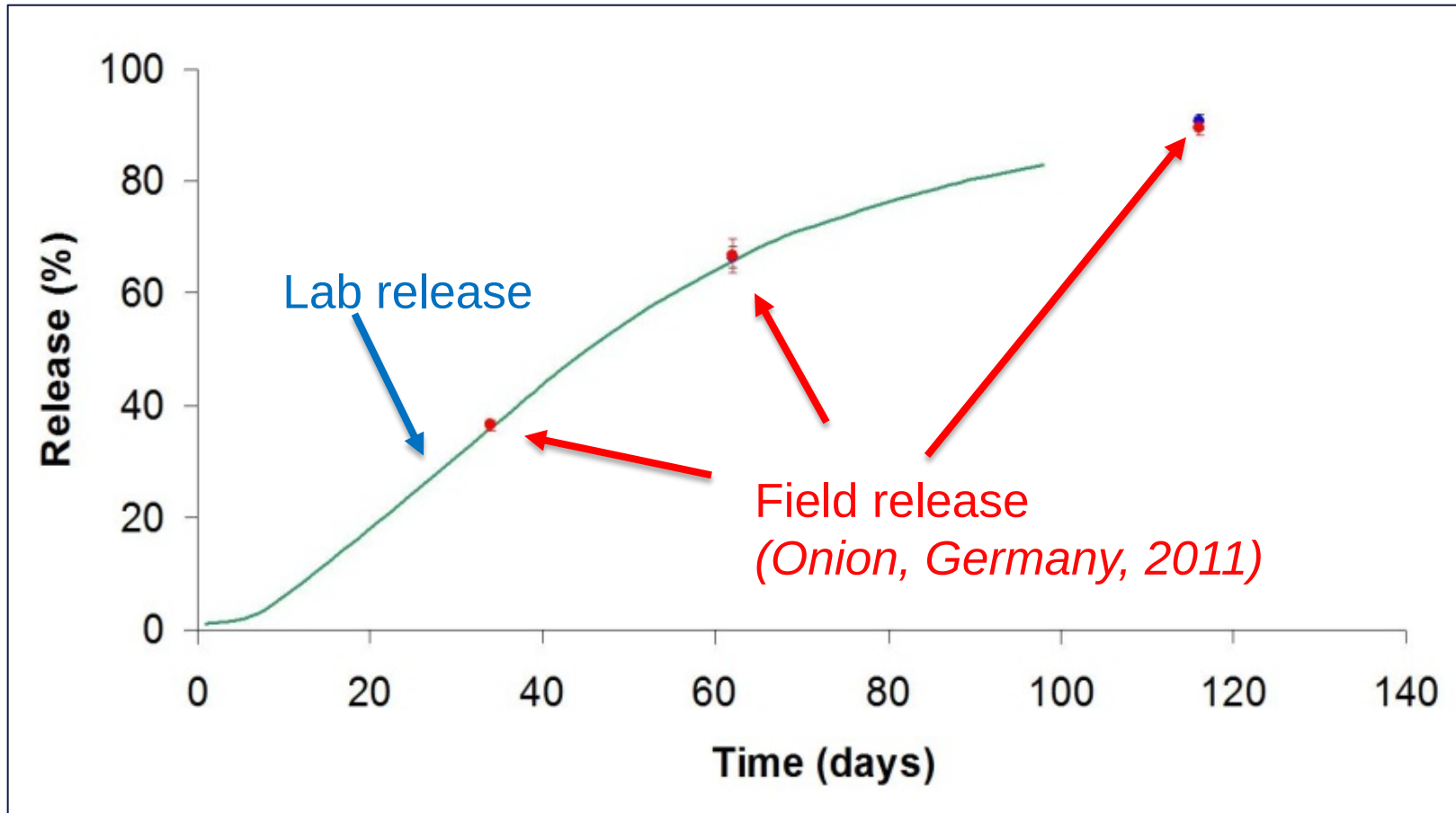


CEN Method 13266: 10 g in 500 ml water at 25 °C

Top view



Release profile: field conditions



Comparison of polyurethane coated urea (Agrocote Max) (lab versus field)

Macro elements

Urea, Ammonium sulfate
 $\text{NH}_4\cdot\text{H}_2\text{PO}_4$, $(\text{NH}_4)_2\cdot\text{HPO}_4$
 KCl , K_2SO_4 , KNO_3
 NP, NK, NPK

Complex
 fertilisers
 NPK+Mg+S+
 micro's

Secondary elements

MgSO_4
 Calcium ammonium nitrate

Micro elements

Few coated trace
 elements, e.g. $\text{Fe}_2(\text{SO}_4)_3$

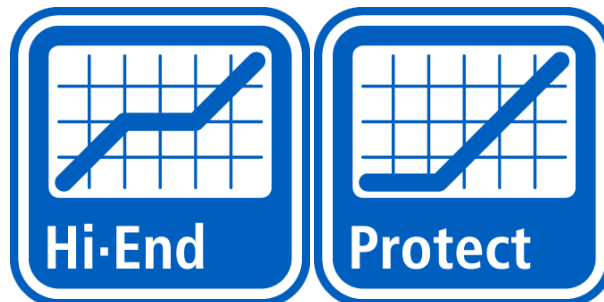
'Specials'

$\text{Al}_2(\text{SO}_4)_3$



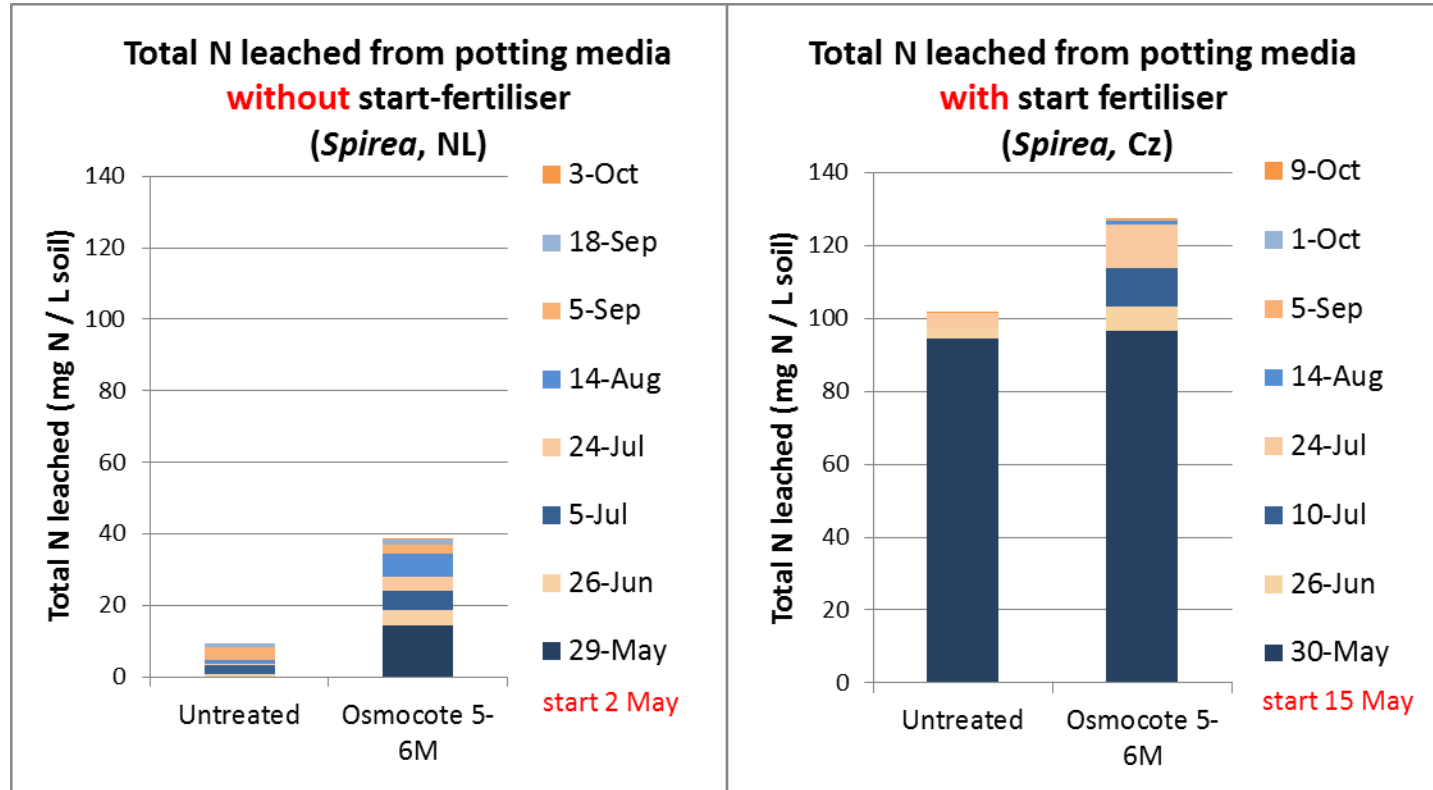
Ornamental use:

- Mixed through growing media (e.g. peat or bark mixtures with lime for pH control)
- CRF has to provide full nutrition for the plant. Use of coated NPK+Mg+S+micro elements
- Advanced release profiles:



Reduced leaching by use of CRF

Leaching of only a small fraction (5%) of applied nutrient rate of CRF



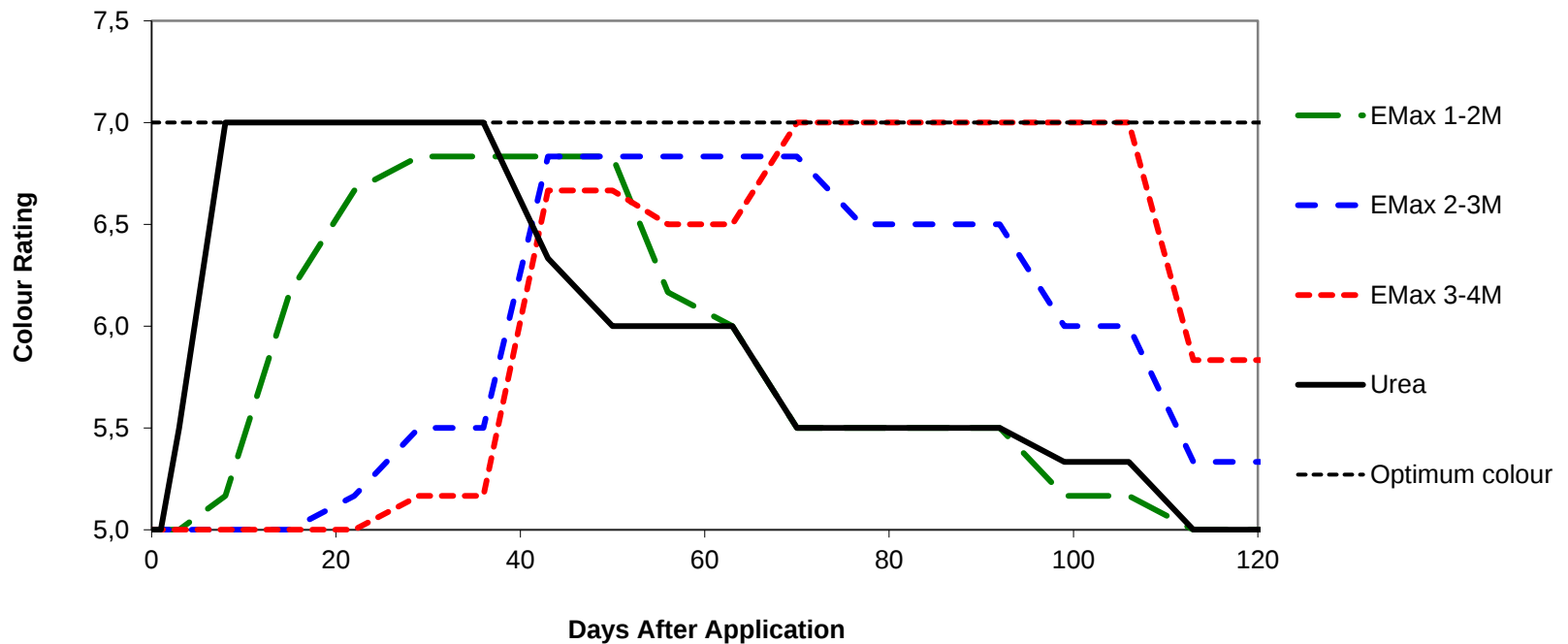
CRF: 632 mg N/L potting soil applied

Starter fertiliser: 140-210 mg N/L
CRF: 632 mg N/L potting soil applied

- Sports and golf courses
- Limited applications
- Control the growth
- Good sward colour, strength and health



Colour over time in sports grass Spain 2012:
EMax different longevities at 64 kg N/ha



Extended use of nitrogen by the grass

Use of Agriculture & Forestry:
More complex because of
variability:

- Growing period
- Part of plant harvested
- Soil characteristics



- CRF to prevent high nutrient losses -> **reduced rates possible**
- CRF to reduce soil fixation of nutrients
- CRF to reduce labour
- CRF if crop architecture limits split applications.
- CRF for plant hole applications.

Goal of the trial:

To quantify the reduction of possible Nitrogen losses in a tomato crop (grown in a sandy soil), comparing traditional N fertilizers to N-coated (Agrocode Max) or N-fertilizers containing N-inhibitors

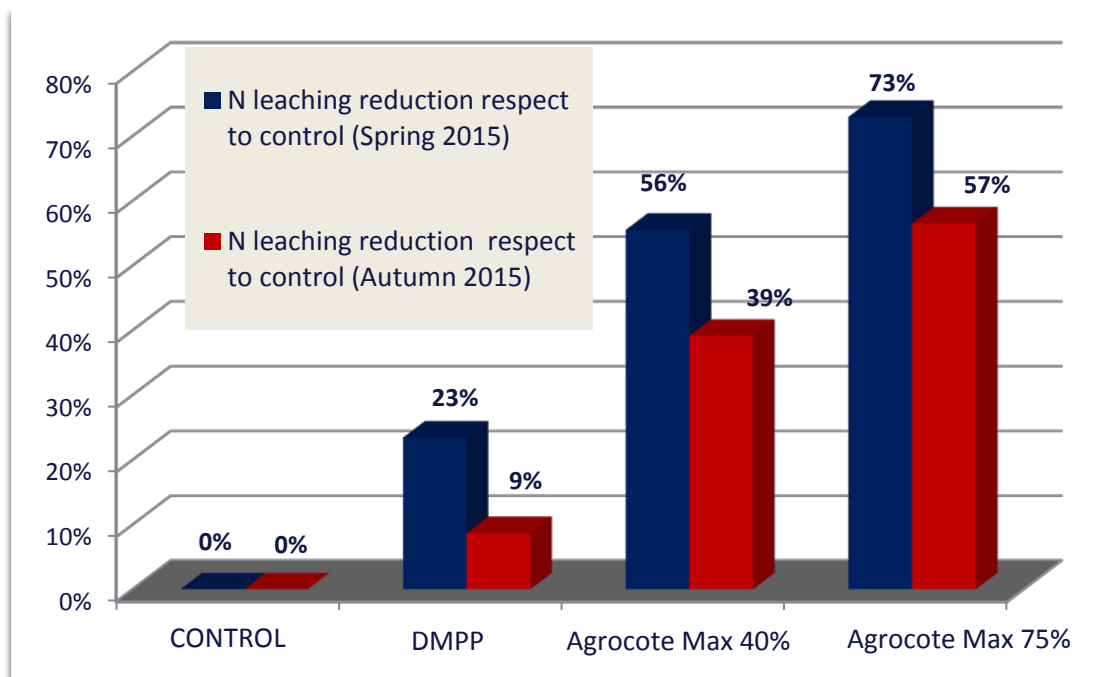


Research executed by University of Pisa



Leaching study Tomato shows on average 65% less leaching with Agrocote Max compared to control

% N leaching reduction



CONTROL Nitrogen leaching was 127 kg/ha for spring and 46 kg/ha for autumn

Research executed by University of Pisa

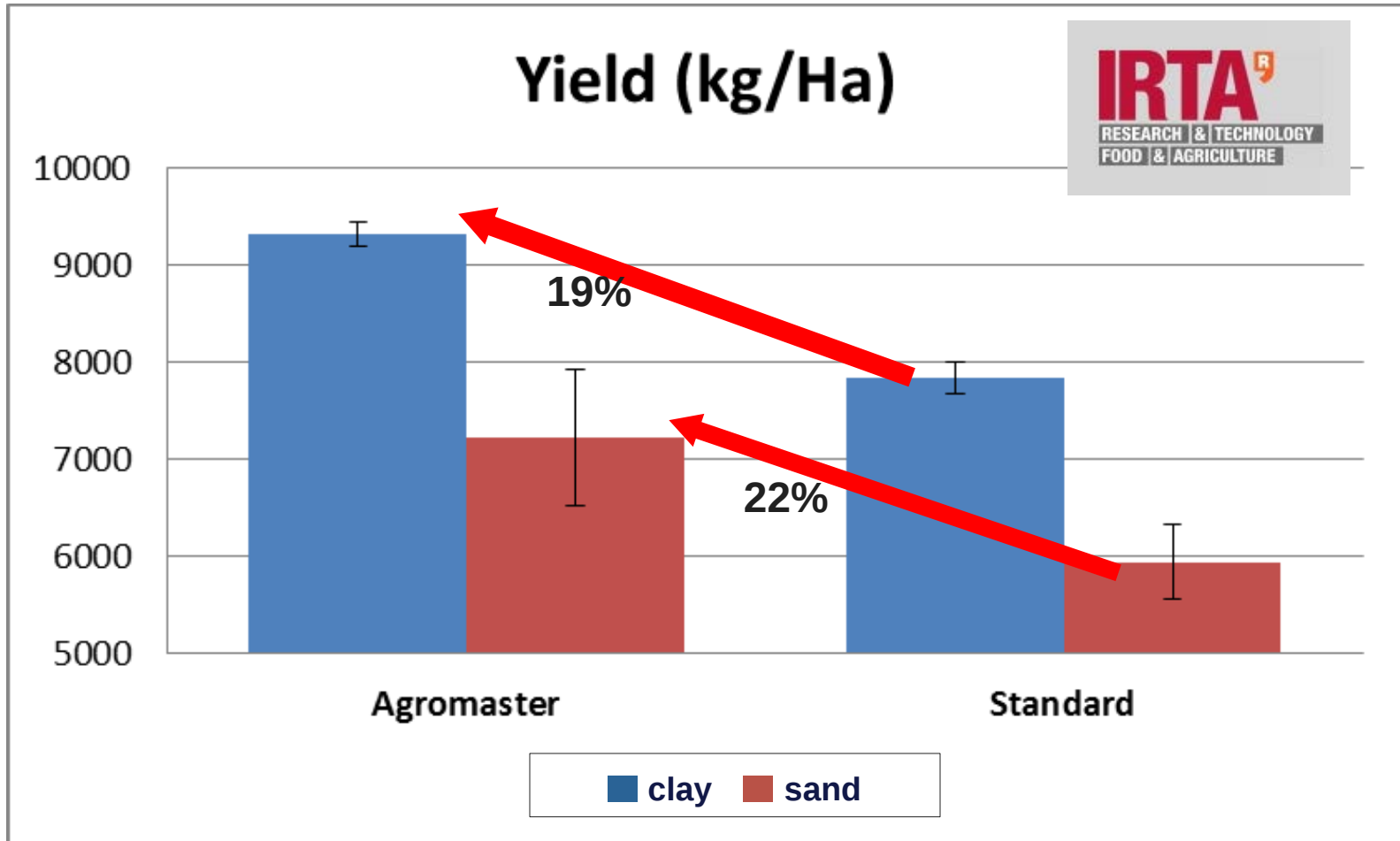


Duration of trail 3-4 months, 360 kg N/hectare in spring trial, autumn trial 300 kg N/hectare

Agromaster improves N efficiency and yield in rice in Spain

Strategy	Product	Basal	Early tillering	Panicle initiation	Total Kg/ha
ICL SF Program	Agromaster 30-8-11 4-5M (75% coated)	160 kg N/Ha	-	-	160
		42 kg P2O5/Ha			42
		58 kg K2O/Ha			58
Grower's practice	Urea/ Ammonium sulfate (AS)	53 kg N/ha as Urea	53 kg N/ha as AS	53 kg N/ha as AS	160
	Superphosphate	42 kg P2O5/Ha			42
	Potassium Sulphate	58 kg K2O/Ha			58

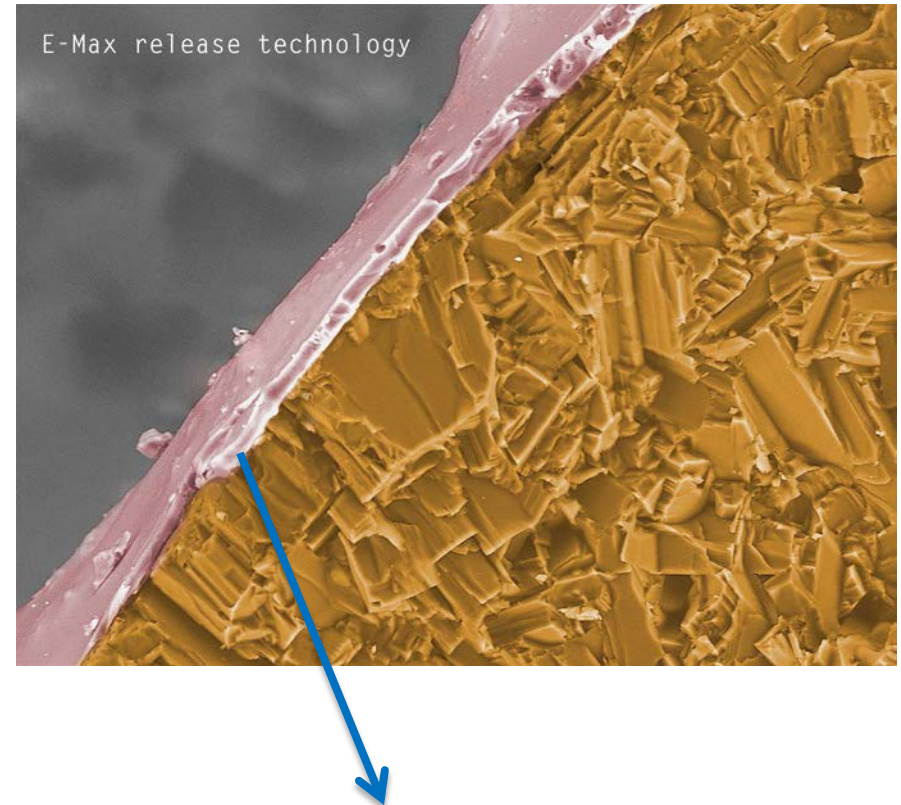




Locations: Trial 1: IRTA, Amposta, Catalunya, Spain Trial 2: Illa de Riu, St. Jaume, Catalunya, Spain

Material requirements for coating:

- Low water (vapor) permeability
- Coatings as thin as possible
 - ‘Diluting’ the nutrient content
 - Lowest cost
 - Environmental considerations



Typically 50 micrometer=thickness human hair

Degradation of CRF coatings

Composting test of major CRF coatings on market:

- 0-15% degradation of C in coating to CO₂ at 58 °C in 3-4 months

Current systems degrade slowly because of high requirements of functional properties.

Fast degradation as proposed by the EU Commission in the draft EU Fertilizer legislation is not possible for CRF.

Industry will need to develop new technology and testing method for biodegradation.

CRF are designed to control the nutrient release over time to match the nutrient needs of plants.

CRF use can lead to higher nutrient use efficiency and reduced losses to the environment

New developments towards:

- More nutrients are available as CRF
- Fine tuning release profile/use for (Ag) crops
- Advanced release profiles
- Faster mineralization of coatings





The background features several thick, curved lines in various colors including red, green, purple, orange, teal, and brown, which sweep across the frame. A solid dark blue horizontal band cuts across the middle of the image, serving as a backdrop for the text. The overall aesthetic is modern and graphic.

THANK YOU