CONTROLLED RELEASE FERTILIZERS AND THEIR NUTRIENT RELEASE

J. B. SARTAIN
FERTILIZER INDUSTRY HISTORY

CONTROLLED-RELEASE MATERIALS ACCOUNTED FOR 1.7% OF THE US FERTILIZER MARKET IN 1993

ANNUAL GROWTH IN US CONSUMPTION IN CONTROLLED-RELEASE MATERIALS HAS BEEN APPROXIMATELY 4% FOR PAST 6 YRS

MOST OF THE DEVELOPMENT AND USE OF CONTROLLED-RELEASE HAS INVOLVED NITROGEN BASED MATERIALS
FERTILIZER INDUSTRY HISTORY

CONTROLLED-RELEASE PRODUCTS ARE USED MOSTLY IN THE NON-FARM OR SPECIALITY MARKET.

NURSERIES, HOME LAWNS, RECREATIONAL AREAS AND GOLF COURSES

SOME USED IN HIGH CASH VALUE VEGETABLES, AND CITRUS

IN JAPAN SOME ARE USED IN RICE PRODUCTION.
SELECTED CONTROLLED RELEASE MATERIALS AND THEIR PROPERTIES
Nitroform

- Urea formaldehyde
- Insoluble organic
- 38% N; 65-71% WIN
- Biological N release
  - rate influenced by soil temperature
Nutralene

- Methylene Urea
- 40% N - 36% WIN
- Biological N release
- More rapidly available than UF
- Not as adversely influenced by cool temperatures
Sulfur Coated Urea

- 32-38% N
- Release depends upon
  - thickness of sulfur coating
  - biological
  - soil environment
    - temperature
    - pH
- Cool season response - erratic
- Coating fragile
Polymer/Sulfur-Coated Urea

- Hybrid between
  - Sulfur (first and main coat material)
  - Polymer (Secondary coat)
- Controlled release fertilizer produced at a lower cost
- Release mechanism is a combination of:
  - Diffusion, dominated by the polymer coating
  - Capillary, once in contact with the sulfur coat.
Polyon

- 40 - 44% N
- Polyurethane coated urea
- N release influenced by
  - coating thickness
  - diffusion rate
  - soil temperature
- good for both warm and cool season
- Coating is abrasive resistant
Trikote

- 42% N
- Urea coated with a polymer
- N release by diffusion
- Coating thickness important
- Release faster than Polyon
IBDU

- 31-90% WIN
- N released by hydrolysis
- Relatively unaffected by
  - temperature
  - pH
- Particle size important
- Excellent cool season response
CoRon

- 28% N Solution
- Polymethylene ureas and amine modified polymethylene ureas
- N release dependent upon microbial action
N-Sure

- 30% N
- Ring structured Triazones may contain methylene diurea
- N release by microbial action
- Response very similar to CoRon
NITRO 30 (LIQUID)

TOTAL - N 30%

SOLUBILITY 100%

METHYLENE UREA
NITAMIN

SOLUTION/SOLID CONTAINING 30% N
A MIXTURE OF TRIAZONE, METHYLENE UREAS AND UREA

CONTAINS 30% UREA – READILY AVAIL
RELEASE BIOLOGICALLY
Nitrification Inhibitors

Nitrate is leached easier than ammonium-N
Fall application for plant uptake in the next growing season (mid-western)
Some nitrification inhibitors include:
- Nitrapyrin (N-Serve)
- Dicyandiamide (DCD)
- NBPT((N(N-butyl)-triphosphoric triamide)
N- Serve

- Inhibits action of nitrosomonas
- Applied with NH3 extending NH4+ life time in soil
- Not beneficial in Florida turfgrass
- Affected at high vapor pressure and high temperature.

DCD

- 66 % N
- Used as nitrification inhibitor and N source
- More used in Europe
- Inconsistent results in Florida’s potato production area
- General class inhibitor – kills everything
NITROGEN STABILIZED MATERIALS

UFLEXX - UREA + AGROTAIN

UMAXX - UREA + 2 X AGROTAIN

BOTH PRODUCTS CONTAIN 46% N

AGROTAIN = NBPT + DCD
UFLEXX 46% N
UREA + AGROTOAIN
SOME REASONS FOR USING CONTROLLED RELEASE NITROGEN PRODUCTS

GREATER EFFICIENCY OF APPLIED N
MORE UNIFORM LONG TERM GROWTH
LESS LOSS OF N DUE TO LEACHING
EFFECT OF N SOURCE ON GROWTH OF RYEGRASS

GROWTH RATE (kg/ha/d)

NITROGEN SOURCES

- UF
- SCU
- NUT
- IBDU
- AS

9
15
12
30
13
EFFECT OF N SOURCE ON GROWTH OF TIFWAY BERMUDA

![Bar chart showing the growth rate (kg/ha/d) for different nitrogen sources: CAS, SCU, NUT, IBDU, NIT, AS. The growth rates are as follows: CAS 8 kg/ha/d, SCU 13 kg/ha/d, NUT 4.4 kg/ha/d, IBDU 5.1 kg/ha/d, NIT 6.7 kg/ha/d, AS 10.1 kg/ha/d.](chart.png)
LEACHING N LOSS FROM SLOW-RELEASE N SOURCES

% N LEACHED

AS  CAS  NUT  SCU  NIT  IBDU

NITROGEN SOURCES

80  62  58  50  28  17
EFFECT OF N SOURCE ON TOTAL N LEACHED

<table>
<thead>
<tr>
<th>Nitrogen Source</th>
<th>Total N Leached (mg)</th>
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<tr>
<td>NITROFORM</td>
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<tr>
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<td>UREA</td>
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<td>AS</td>
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ESTIMATING RELEASE PROPERTIES OF SLOW-RELEASE FERTILIZER MATERIALS
OBJECTIVES

1. ESTABLISH N RELEASE CURVES FOR CRN SOURCES

2. DEVELOP LABORATORY PROCEDURES FOR EXTRACTING N FROM CRN SOURCES

3. ESTABLISH A RELATIONSHIP BETWEEN RELEASE CURVES AND EXTRACTION PROCEDURES

4. PREDICT N RELEASE BASED ON EXTRACTION
Figure 5. Percentage of applied N released from selected nitrogen sources over 189 day soil incubation.
TOTAL N RELEASED FROM POLYON BY FORM OVER TIME

CUMMULATIVE N RELEASED (mg)

DAYS

7 14 28 42 56 84 112 140 180

0 50 100 150 200 250 300 350

CUMMULATIVE N RELEASED (mg) NO3-N NH4-N UREA
Mean % N released from selected N sources over 182 day incubation period

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SUMMARY

NUTRIENT RELEASE IS INFLUENCED BY ENVIRONMENTAL CONDITIONS

CONTROLLED RELEASE MATERIALS RELEASE N AT DIFFERENT RATES

INITIAL AND LONG TERM RELEASE OF N SIGNIFICANTLY DIFFERENT BASED ON CONTROLLED RELEASE SOURCE