Controlled Release Nutrition for Agriculture
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- Hot does it work - Multicote® Technology
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Overview

- Haifa’s controlled release fertilizers for agriculture
  - Multicote® Agri / Multigro – for agriculture & horticulture
  - CoteN™ – for arable crops
- Designed to feed plants continuously over months
- Based on polymer coating technology for best performance
- A variety of formulas is available, to suit the needs of different plants
The benefits of Controlled Release Nutrition
The benefits of controlled release nutrition

**Optimal Plant Development** - Nutrients are precisely supplied in accordance with specific plant needs

**Controlled release:** optimal nutrition throughout the growth season

**Granular soluble fertilizer:** hazardous excess at the beginning followed by deficiency towards the end of the growth season
The benefits of controlled release nutrition

- Single Application per Season
  - Labor saving
  - Reduced application costs
  - Fewer tractor operations = less soil compaction
The benefits of controlled release nutrition

- **Minimized Losses**
  Through leaching, volatilization or fixation in the soil
  - Availability of nutrients throughout the growth cycle is ensured
  - Optimized use of fertilizers without wastage
  - No surplus fertilization is required – reduced application rates
  - Ecologically superior (no soil, ground-water or air pollution)
The benefits of controlled release nutrition

- **Fertilization totally independent of irrigation**
  - No need for sophisticated dosing and injection systems
  - In rainy season – no need for technical irrigations
  - No fertilizer losses where irrigation is applied in excess to prevent salinity build-up
Multicote® Products for Agriculture
Multicote® Agri / Multigro

- Combine polymer-coated granules of N, P, K and Mg, and non-coated, readily available nutrients
- Release longevities: 4, 6, 8 and 12 months
- Choice of formulas enable perfect match to crop requirements and growth conditions
- Ideal for: vegetables (open field and protected), herbs, strawberries, fruit trees, bananas, and forest planting
Multicote® Agri “Stages”

Formulas with N-P-K ratio that adapts during the season to best match with crop’s growth requirements.
CoteN™

- Polymer coated urea for arable crops
- Improves nitrogen-use efficiency
- Recommended where N application rates should be reduced or limited
- Ideal for corn and wheat
- May be blended with non-coated N, P, or K (CoteN™ Mix)
Multicote® Technology
Multicote® technology

- Core: Soluble nutrients
- Shell: Polymer coating
Multicote® technology

Scanning Electron Microscope image of coated NPK granule
Multicote® technology

After application in the soil:

- Water penetration
- Gradual dissolution of the nutrients

This stage takes 7-10 days, depending on the longevity.
Multicote® technology

Water penetration
Diffusion of nutrients through the coating to the soil
Further dissolution of nutrients
Multicote® technology

Water penetration

Diffusion of nutrients through the coating to the soil

Complete dissolution of nutrients

At this stage the release rate decays, according to Fick’s 2nd law of diffusion.
Fick’s 2nd law of diffusion:

\[
\frac{dC}{dt} = D \frac{d^2C}{dX^2}
\]

C = concentration
t = time
D = diffusion coefficient
Multicote® technology

After the release is complete, the coating will degrade gradually, leaving no residues in the soil.
Multicote® technology

Typical release curve:

% release

Lag  Linear release  Decay

Time
**Multicote® technology**

**Release rate, longevity & temperature**

- The rate of nutrient release from Multicote increases with temperature:

  \[
  \frac{dC}{dt} = D \frac{d^2C}{dX^2} \quad \text{and} \quad D = D_0 e^{-\frac{Q}{RT}}
  \]

  - $C$ = concentration, $t$ = time
  - $D$ = diffusion coefficient
  - $Q$ = activation energy, $R$ = gas constant
  - $T$ = temperature

- Note: plant uptake rates also increase with temperature

- The longevity decreases as release rate increases
**Multicote® technology**

The rate of nutrient release from Multicote® increases with temperature, and the longevity is decreased accordingly.

<table>
<thead>
<tr>
<th>temperature</th>
<th>Release rate</th>
<th>longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Arrow Up" /></td>
<td><img src="image2" alt="Arrow Up" /></td>
<td><img src="image3" alt="Arrow Down" /></td>
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<tr>
<td><img src="image4" alt="Arrow Down" /></td>
<td><img src="image5" alt="Arrow Down" /></td>
<td><img src="image6" alt="Arrow Up" /></td>
</tr>
</tbody>
</table>
When to Use?
Multicote® Agri & CoteN™ are recommended

On light soils
where nutrients are easily leached
Multicote® Agri & CoteN™ are recommended as base fertilizers for rainy season crops. Rainfall accelerates nutrient leaching...
Multicote® Agri & CoteN™ are recommended

.... when the mud makes side-dressing application troublesome.
Multicote® Agri & CoteN™ are recommended

Where nitrogen application rates are limited by local regulations, so high efficiency of nutrient use is desired
Multicote® Agri & CoteN™ are recommended for crops with a shallow root system.
The Art of Blending
The agronomist’s recommendation: “the Art of blending”

- The right formula (N-P-K)
- The right longevity (consider temp., crop cycle)
- Crop nutritional requirements at different growth stages
- The rate applied compared to farmer practice
- The % of the coated component (blend)
## Setting percentage of coated N

<table>
<thead>
<tr>
<th>Soil texture</th>
<th>Water regime</th>
<th>Sand&gt;70% (Sand, loamy sand)</th>
<th>50%&lt;sand&lt;70% (medium sandy)</th>
<th>Silt&gt;40% (silt, silty loam, silty clay)</th>
<th>Clay&gt;60% (clay loam, clay)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arid/semi arid or protected crops</td>
<td>No water excess</td>
<td>75%</td>
<td>75%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Arid/sub Mediterranean</td>
<td>25% above ETKc</td>
<td>100%</td>
<td>75%</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>Rainy sub continental, humid tropical</td>
<td>50% above ETKc</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>75%</td>
</tr>
<tr>
<td>Humid tropical</td>
<td>ETKc X2 or more</td>
<td>100%</td>
<td>100%</td>
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<td>100%</td>
</tr>
</tbody>
</table>
## Setting percentage of coated P

<table>
<thead>
<tr>
<th>Soil texture</th>
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<th>Sand&gt;70% (Sand, loamy sand)</th>
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</thead>
<tbody>
<tr>
<td>Arid/semi arid or protected crops</td>
<td>No water excess</td>
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<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Arid/sub Mediterranean</td>
<td>25% above ETKc</td>
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<td>10%</td>
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</tbody>
</table>
## Setting percentage of coated K

<table>
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<tr>
<th>Soil texture</th>
<th>Water regime</th>
<th>Sand &gt; 70% (Sand, loamy sand)</th>
<th>50% &lt; sand &lt; 70% (medium sandy)</th>
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<th>Clay &gt; 60% (clay loam, clay)</th>
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Guideline for setting application rates, longevity and % coating

- More rain / irrigation → more coating
- Lighter soil → more coating
- Coated portion of components N > K > P
- Longer crop cycle → more coating, extended longevity
- Warmer soils during growth cycle → more coating, extended longevity
- Higher expected yield requires higher nutrition rates
- Application method should be considered (top dressing, incorporation, banding).
- Economical analysis compared to available alternatives!
Summary

- A range of controlled release fertilizers for agricultural applications
- Based on polymer-coating technology
- Provide efficient nutrition
  - For optimal growth
  - For minimized losses
- Require single application per season
- Products address specific requirements of the crop
Controlled Release Nutrition

- Continuous plant nutrition over months
- Enhanced nutrient use efficiency
- Labor saving
Thank You

Join-up our knowledge community
www.haifa-group.com/community