Uncommon Formulations for Tailor-made Applications

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Reiner Kober (BASF SE) et al. on behalf of ECPA, Specifications Expert Group
## Uncommon Formulations - Agenda -

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<td><strong>(4) Forest Protection System</strong></td>
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<tr>
<th><strong>CropLife 2-letter-code</strong></th>
<th><strong>Author(s)</strong></th>
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<tr>
<td><strong>RB</strong></td>
<td>Yumiko Kozuki (Sumitomo Chem.)</td>
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<tr>
<td><strong>FU</strong></td>
<td>Bart Roose (Monsanto)</td>
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<tr>
<td><strong>AL</strong></td>
<td>Peter Wyss &amp; Peter Kundel (Syngenta)</td>
</tr>
<tr>
<td><strong>LN</strong></td>
<td>Amy Dugger-Webster &amp; Alberto Gasser (BASF)</td>
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</table>
Common Formulation Types

**Liquid Formulations**
- EC  Emulsifiable concentrate
- SL  Soluble concentrate
- SC  Suspension concentrate
- ME  Micro-emulsion
- DC  Dispersible concentrate
- SE  Suspo-emulsion
- EW  Emulsion, oil in water
- OD  Oil dispersion
- CS  Capsule suspension

**Solid Formulations**
- WG  Water dispersible granule
- WP  Wettable powder
- SG  Water soluble granules

**Formulations for Seed Treatment**
- FS  Flowable concentrate f.S.T.
- ES/LS  Emulsion/Solution f.S.T.
- DS  Powder for dry S.T.

Examples:

for tankmixes
## Crude Definitions

<table>
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<th>Common Formulations</th>
<th>Uncommon Formulations</th>
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<tr>
<td><strong>Standardized applications:</strong></td>
<td><strong>Specific &amp; tailor-made application systems:</strong></td>
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<tr>
<td>- by Knapsack Sprayer to high-tech / high-speed / bulk / machine-based</td>
<td>often manual, but highly specific devices</td>
</tr>
<tr>
<td>Widely used</td>
<td>Niche markets</td>
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<tr>
<td>Farming / Field Crops</td>
<td>Home &amp; Garden / Specialty Crops / Personal Care / Forestry</td>
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Example 1

Matrix Formulations for Vector Control (MR)
Vector-borne Diseases

- Vector-borne diseases / diseases with intermediate hosts among the major causes of illness and death in many tropical / subtropical countries.
- Malaria, the most deadly vector-borne disease, kills over 0.5 million people annually - mostly African children under the age of five — and significantly impedes economic and social development.
- Dengue fever and dengue hemorrhagic fever (DHF) are the world's fastest growing vector-borne disease.

Key solution for vector control: AI-coated or incorporated LNs
## Vector / Mosquito Control

<table>
<thead>
<tr>
<th>Code</th>
<th>Term</th>
<th>Definition / Formulation</th>
<th>Important Phys/Chem properties</th>
</tr>
</thead>
</table>
| LN   | Long-lasting insecticidal net | ▪ Slow- / controlled-release on netting  
▪ Physical and chemical barrier  
▪ ‘LN’ refers to bulk netting and ready-to-use products (e.g., mosquito nets) | Wash resistance index          |
| MR   | Matrix release formulation  | ▪ Matrix release for controlled release of active ingredients (AIs)  
▪ One or more AIs incorporated into polymer resin and/or coated onto surfaces  
▪ Intended for **direct application into bodies of water** without further preparation | Release/retention rate         |
Application of MR Formulations

- **Used in water bodies** because *Aedes* mosquitos, which transmit dengue fever, only lay their eggs in **clean water**

![Diagram showing the application of MR Formulations.](image-url)
AI(s) in the MR Formulations

- MR consists of:
  - One or more AIs
  - Polymer resin
  - Necessary other formulants
- AI(s) incorporated into polymer resin and/or coated on surfaces (e.g., LNs)
- AI(s) released slowly, providing long-lasting effectiveness

Diagram:
- **External trigger** (e.g., temperature, pH)
- **Internal triggers**
- Only a small amount of AI on the surface
- Most AI is within the polymer resin
- AI migrates to surface
- Retention Rate Test for release profile
Sumitomo will present the result of the small scale collaboration study in the CIPAC TC meeting this year.

Retention Rate Test Method

1. MR transferred to glass bottle, and an ethanol-water mixture is added
2. Bottle placed upright in constant temperature
3. Following static extraction at three specified intervals, AI concentration determined and retention rate calculated

Extraction at 25°C in ethanol/water mixture

Initial 1 hr 2 hr 4 hr

Determination of AI content
Example 2

Gel for Direct Application (GD)
Gel for Direct Application (GD)

- Gel-like formulation:
  - At least one AI
  - Structuring agent
- Applied undiluted

A touch is all it takes
Formulation Benefits

- Longer contact time
  - Reduced surfactant content
- Localized & accurate application
  - Gel sticks to the leaves
  - No dripping/run off

How to use:

- Just one click
- Delivers precise amount of gel
- Touch the leaf
- Gel sticks to leaf
Specifications and Formulation Properties

- **Specification guideline pending**
- **Relevant phys/chem properties:**
  - **Appearance:** homogeneous formulation, no phase separation observed
  - **Acidity/Alkalinity or pH range**
Example 3

Tree Micro Injection – TMI
(AL – Any other Liquid - to be applied undiluted)
Tree Micro Injection

Background / Starting point: Increasing Problems with Tree Pests and Diseases

Processionary Moth
Tree Micro Injection
Examples of Tree Pests and Diseases

Pine Wilt Nematode
...vectored by pine sawyer beetles

Emerald Ash Borer
Tree Micro Injection
Examples of Tree Pests and Diseases

Horse Chestnut Leaf-Miner
Tree Micro Injection

Typical Spray Application on Trees:
Tree Micro Injection
Treatment of Trees - Injection Application
Tree Micro Injection
Treatment of Trees: **Injection Equipment**
Tree Micro Injection
The Formulation

- **Type:** **AL-formulation** (any other liquid); applied undiluted
- **AI:** Emamectin benzoate (e.g., 4% solution)
- **Application:**
  - Direct injection into the stem
  - 1 injection point per 5 cm DBH*
  - at approx. 1 – 3 ml per cm DBH*
- **Control:** 2 – 4 years

* DBH = Diameter at Breast Height [cm], typical values: 15–50 cm
Example 4

Forest Protection Nets (LN)
Storanet®
LN in Forestry for Log Piles Protection

- Benefits
  - User- and eco-friendly
  - Minimal AI directly available on net surface
  - Reusable & resistant to rain and UV for up to six months
  - Packaged individually; easy to combine for large log piles

- efficient bark beetle control -
Storanet®
The Net

- Combats bark- & wood-breeding beetles in deciduous and coniferous wood

**Specification:**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>Net material</td>
<td>100-denier multifilament polyester filament, knitted</td>
</tr>
<tr>
<td>Mesh size</td>
<td>At least 45 holes/square cm</td>
</tr>
<tr>
<td>Weight</td>
<td>63 g/m² ± 10%</td>
</tr>
<tr>
<td>Bursting strength</td>
<td>&gt; 450 kPa</td>
</tr>
<tr>
<td>Dimensional stability</td>
<td>± 5%</td>
</tr>
<tr>
<td>Active ingredient (AI)</td>
<td>100 mg alpha-cypermethrin / m²</td>
</tr>
<tr>
<td>Duration of effectiveness</td>
<td>24 weeks</td>
</tr>
<tr>
<td>Color</td>
<td>Olive-green</td>
</tr>
</tbody>
</table>
### Storanet® Active Ingredient Calculation

The table below shows the active ingredient (AI) calculation for 3 applications on 30 m³ of logs:

<table>
<thead>
<tr>
<th>Product</th>
<th>Formulation Type</th>
<th>Grams AI per 90 m³ (grams AI per m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karate® Forst</td>
<td>CS</td>
<td>150 (1.66)</td>
</tr>
<tr>
<td>Fastac® Forst</td>
<td>SC (oil-enhanced)</td>
<td>80 (0.9)</td>
</tr>
<tr>
<td>Storanet®</td>
<td>LN</td>
<td>10 (0.11)</td>
</tr>
</tbody>
</table>

**RESULT:** Storanet® uses approx. 10x less AI compared to common spray applications
**Trials on Mortality Rate of Beetles Placed on Net**

- **Studied by Göttingen Forestry Research Institute**
  - 20 European spruce bark beetles placed on net
  - **Parameters studied:**
    - Contact times: 30 and 60 seconds
    - Duration of use: new net vs. use in 17th week

**Fig.: Beetles being placed on a net**

<table>
<thead>
<tr>
<th>Duration of contact</th>
<th>New net</th>
<th>Net in 17th week of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 seconds</td>
<td>100%</td>
<td>90%</td>
</tr>
<tr>
<td>60 seconds</td>
<td>100%</td>
<td>95%</td>
</tr>
</tbody>
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**Storanet®**

**Efficacy of Net Technology**
Storanet®
Biological Efficacy

Fig. 1: Number of boreholes in previously uninfested log piles:

- **Untreated**: 142 boreholes
- **Fastac® Forst (2%)**: 4 boreholes
- **Storanet®**: 0 boreholes

- Efficacy Storanet®: 100%
- Efficacy Fastac® Forst (2%): 97%

...beyond Storanet®: Additional LN applications
- **Trinet®**: *attract & kill* net with pheromones
- **Carifend®**: stored good protection, including tobacco
Uncommon Formulations

- Summary -

• Special applications – not covered by classical formulation types – esp. for niche markets
• Many benefits, esp. due to safe applications for operators & users and lower impact to environment.
• Regulatory requirements should be appropriate – e.g. similar to emergency uses.

Reasonable balancing of benefits, costs and regulatory requirements.
Thank you for your attention
Back-ups
Two types of LN formulation

AI is existing in the polymer resin homogeneously.

- Active ingredient
- Raw material

Incorporated

AI is existing on the surface of the polymer resin.

- Raw material
- Active ingredient

Coated

Mixing → Spinning → Knitting → Cutting → Stitching → Product

or

or