Environmental and Farmer Friendly Biodegradable Rubber Spray Oil for Controlling Abnormal Leaf Fall Disease

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Rubber Research Institute of India, Rubber Board, Kottayam

Contributions
Introduction
- Agrospray Oils and Indian Scenario

Rubber Leaf Diseases

Rubber Spray Oils

Environmental Friendly Rubber Spray Oil Development and Trials

Conclusions

Agrospray Oils

- Oils have been used for controlling insects and pests since late 1800
- In 1880, use of kerosene-soap emulsions reported for controlling aphids and other insects
- In 1923, 2% light lubricating oil was used for controlling San Jose scale in Apple Orchards
- Since then petroleum oils have been used extensively for control of pests/insects
- Today, highly refined petroleum based oils are being used as spray oils for agricultural application
Agrospray Oils
International Trends

- Quite popular in USA and European countries
- Mainly used for protection of fruit trees/crops/gardens/floriculture etc.
- Marketed by various reputed oil companies
- Recommended under IPM program and as adjuvant
  - More efficient use of synthetic pesticides i.e. reduced cost and load on environment
- Used for organic farming because of their non-toxic nature

Indian Oil Products as Agricultural Oils

- Two Products Series
  - Servo Agrospray Oils – a patented technology for a series of crops: used in emulsion form
  - Servo Rubber Spray oils - for exclusively rubber plantation: used as such with COC
- Servo Agrospray Oil
  - Innovative products developed for agricultural use
  - A variety of products for different applications viz. orchards, horticulture, tea, fruits etc.
  - Optimized mixture of premium quality, biodegradable ingredients suitable for controlling the pests/insects/diseases in the plants
  - Approved for Organic Farming by USOCA
### Servo Agrospray Oil
#### Physico-chemical Properties

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<td>&lt; -24</td>
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<td>8.</td>
<td>Thermal Stability at 0°C and 50°C</td>
<td>Pass</td>
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<td>9.</td>
<td>Self Emulsifiability</td>
<td>Good</td>
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<td>Appearance of the Emulsion</td>
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<td>11.</td>
<td>Stability of 3% v/v Emulsion in 200 ppm hardness water</td>
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**MEETS ECO MARK REQUIREMENT AS PER 1992/95 NOTIFICATION OF MINISTRY OF ENVIRONMENT AND FOREST**

### Agrospray Oils: Pests Controlled
- San Jose Scale
- Powder Mildew
- Mealy Bug
- Pear Psylla
- Leaf Roller
- Leaf hopper
- Mustard Aphid
- European red mite
- Thrips
- Helopeltis
Servo Agrospray oil

……..certified for organic farming

The innovative development of the environment friendly, non-toxic, pesticide free, Servo Agrospray Oils was duly acclaimed as it won the following awards

- Golden Peacock Award in Innovative Product Category - 2008
- Green Tech Award for Environment Excellence – 2009
- CSIR S&T Innovation for Rural Development – 2009 having cash prize of Rs. 10.0 Lakhs

Patented Technology
Indian and Russian Patent Granted
Development of Servo Rubber Spray Oils

Fungal Diseases in Rubber Plantation

- Crops loss due to ravages of disease causing agencies in rubber plantations substantial

- Timely plant protection operations ensure healthy growth and economic production of latex.

- Fungal diseases endemic to rubber plant trees
  - Reduced photosynthesis, Slow bark renewal, Reduced DRC, More weed growth

- Rubber latex yield loss in the range of 9-25%:
Abnormal Leaf Fall

Total defoliation and weed growth

Control measures adopted

- Prophylactic spraying of the foliage prior to the onset of south west monsoon with the following:
  - Bordeaux mixture using high volume sprayers
  - Oil soluble copper oxy chloride dispersed in diluent spray oil employing either low volume air blast sprayers from the ground or through aerial application (1:5)
  - IndianOil has been supplying Servorubberspray Oil for this purpose
Rubber Spray Oil Characteristics

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Property</th>
<th>Servo Rubber Spray Oil (Conventional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Appearance at 30 °C</td>
<td>Clear liquid</td>
</tr>
<tr>
<td>2.</td>
<td>Density @ 29.5 °C, g/ml</td>
<td>0.8 - 0.85</td>
</tr>
<tr>
<td>3.</td>
<td>Flash point COC, °C</td>
<td>85 min</td>
</tr>
<tr>
<td>4.</td>
<td>Pour point, °C</td>
<td>0 - 15</td>
</tr>
<tr>
<td>5.</td>
<td>Kinematic viscosity @ 40 °C, cSt</td>
<td>2.5 - 4.0</td>
</tr>
<tr>
<td>6.</td>
<td>USR value</td>
<td>75 min</td>
</tr>
<tr>
<td>7.</td>
<td>Phytotoxicity to rubber plant</td>
<td>Negative</td>
</tr>
<tr>
<td>8.</td>
<td>Biodegradability, %</td>
<td>Not specified (52% typical value)</td>
</tr>
</tbody>
</table>

Increasing environmental awareness led to the thought of reducing the carrier oil residue in the environment. Joint study was initiated by R&D Centre of Indian Oil Corporation Ltd. and Rubber Research Institute for developing biodegradable rubber spray oil.

New generation Rubber Spray Oil B developed using highly refined and biodegradable base oils.

- **Extension of the widely awarded Servoagrospray Oil technology for the rubber plantation protection**

Field studies conducted for three seasons (2007, 2008 & 2009) by RRII, Kottayam have proved its efficacy for controlling abnormal leaf fall disease.
**Biodegradable Rubber Spray Oil Characteristics**

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<tr>
<th>S.No.</th>
<th>Property</th>
<th>Biodegradable rubber spray oil</th>
<th>Conventional Rubber Spray Oil</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Appearance at 30 °C</td>
<td>Clear Liquid</td>
<td>Clear liquid</td>
</tr>
<tr>
<td>2.</td>
<td>Density @ 29.5 °C, g/ml</td>
<td>0.842</td>
<td>0.8 - 0.85</td>
</tr>
<tr>
<td>3.</td>
<td>Flash point COC, °C</td>
<td>100 min</td>
<td>85 min</td>
</tr>
<tr>
<td>4.</td>
<td>Pour point, °C</td>
<td>(+) 9 max</td>
<td>0 - 15</td>
</tr>
<tr>
<td>5.</td>
<td>Kinematic viscosity @ 40 °C, cSt</td>
<td>2.96</td>
<td>2.5 - 4.0</td>
</tr>
<tr>
<td>6.</td>
<td>USR value</td>
<td>84</td>
<td>75 min.</td>
</tr>
<tr>
<td>7.</td>
<td>Phytotoxicity to rubber plant</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>8.</td>
<td>Biodegradability, %</td>
<td>85</td>
<td>No requirement (52% typical value)</td>
</tr>
</tbody>
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**Specialities of Biodegradable Spray Oil**

- Environmental friendly carrier oil for fungicides particularly copper oxy chloride on rubber plantations and other crops
- Better retention and even spread of copper oxy chloride on the leaves of rubber plants
- Salient features
  - High bio-degradability and non-toxicity
  - Non-phytotoxic to rubber plants
  - High wettability
  - Easy applicability
    - Effective control of abnormal leaf fall diseases
Evaluation of Servo Rubber Spray Oil B At RRII and IOC R&D Center

Studies Conducted by RRII- 2007

- Field studies conducted at plantations at two different locations – Mature plantations of susceptible clone RRIM 600

- Oil dispersible copper oxychloride (COC) @ 8 kg/ha was dispersed in 40 litres of bio-degradable oil

- The mixture used for prophylactic spray on selected locations

- Leaf retention was monitored and compared with locations sprayed with normal spray oil

<table>
<thead>
<tr>
<th>Type of oil</th>
<th>Leaf retention(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spray oil (1:5)-Recommended</td>
<td>Location 1 (RRIM 600)</td>
</tr>
<tr>
<td></td>
<td>37.1</td>
</tr>
<tr>
<td>Bio-degradable spray oil (1:5)</td>
<td>43.3</td>
</tr>
</tbody>
</table>

Efficacy of bio-degradable spray oil established
**Evaluation Report of 2008**

**Evaluation Studies Conducted by RRII-2008**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Location</th>
<th>Clone</th>
<th>Type of spraying</th>
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<tr>
<td>1</td>
<td>Location 1</td>
<td>RRIM 600</td>
<td>Micron spraying</td>
</tr>
<tr>
<td>2</td>
<td>Location 2</td>
<td>PB 260</td>
<td>Tractor mounted spraying</td>
</tr>
<tr>
<td>3</td>
<td>Location 3</td>
<td>PB 260</td>
<td>Micron spraying</td>
</tr>
<tr>
<td>4</td>
<td>Location 4</td>
<td>RRIM 600</td>
<td>Micron spraying</td>
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Oil dispersible copper oxychloride (COC) @ 8 kg/ha was dispersed in 40 litres of biodegradable oil.

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<td>Bio-degradable spray oil (1:5) Location 1 (RRIM 600)</td>
<td>65.6</td>
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<tr>
<td>Bio-degradable spray oil (1:5) Location 3 (PB 260)</td>
<td>84.5</td>
</tr>
<tr>
<td>Spray oil (1:5)-Recommended</td>
<td>43.1</td>
</tr>
<tr>
<td></td>
<td>80.5</td>
</tr>
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Efficacy of bio-degradable spray oil was comparable to the recommended practice.

**Retention Of Copper Content in Dried Rubber Plant Leaves**

- More copper retention observed in Biodegradable Spray Oil in PB260
- More copper retention observed in Biodegradable Spray Oil in RRIM600 also

More copper retention observed in Biodegradable Spray Oil.
IOC has developed and extensively marketing new generation Agricultural Spray Oils

Also bio-degradable rubber spray oil “Servo Rubber Spray Oil B” newly developed

Field studies conducted for three seasons (2007, 2008 & 2009) by RRII, Kottayam. Its efficacy for controlling abnormal leaf fall disease proved in field trials

Copper retention property of “Servo Rubber Spray Oil B” found superior as compared to conventional oil

New oil will be safer to use and leaves lesser load on environment
Evaluation Methodology

- **Samples**
  - Dry leaves collected before spraying will be used as blank and after spraying as sample
  - Bi-monthly leaves collection by RRII for analysis

- **Area Calculation**
  - The approximate area of the leaves calculated by drawing the outline of leaf on a graph paper and number of squares were measured

- **Method**
  - **Blank Determination**
    - Known amount (area and weight) of leaves (BLANK) is burnt in platinum crucible and converted into ash. The residue dissolved in hydrochloric acid of known volume. The solution is then analyzed for copper by PLASMA technique
  - **Sample Determination**
    - Known The same procedure is adopted on leaves collected after spraying oil. The copper is estimated by plasma in the solution

- **Calculation and Reporting**
  - The results of “BLANK” is subtracted from the “SAMPLE” and copper content in leaves is calculated as gm/cm²

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**Agrospray Oils**

In Different Crop Applications
**AGROSPRAY OILS ON DIFFERENT PESTS**

- San Jose Scale
- Leaf Roller
- Woolly apple aphid
- Pear Psylla
- European red mite
- Two spotted mite
- Leaf hoper
- Leaf miner
- Green apple aphid
- Apple rust mite
- Cherry fruit fly
- Mustard Aphid
- Helopeltis etc.

- Quite useful against soft bodied pests
- Most effective in early stage of life cycle of pest
- To be sprayed immediately after first incidence of pest

**Mode of Action of Servo Agrospray Oils on Pests**

- The emulsion of Servo Agrospray oil sprayed on the plants
- Water evaporates and leaves a thin film of oil on the pests
- This oil film creates a PHYSICAL BARRIER and SUFFOCATES the pests and kills the harmful pests
- It has ability to get into cracks and crevices, where eggs of pests /insects are laid and dissolve the outer shell of the eggs thereby killing the insect/pest at nascent stage itself
- Pests do not develop resistance against Servo Agrospray Oil, as it acts physically for controlling the pests
AGROSPRAY OIL

Key Features

- Water like product
  - No added colour
  - To retain environmental friendly benefits
- Odour less
- High USR value
- High biodegradable
- Non-toxic
- Non-phytotoxic

Servo Agrospray Oil

Physico-chemical Properties

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### Servo Agrospray Oil

#### Toxicological Properties

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<th>Property</th>
<th>Servo Agrospray</th>
<th>Significance</th>
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<tr>
<td>1.</td>
<td>Acute Oral LD50 in Rats</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Male, mg/Kg. B. Wt</td>
<td>&gt;5000</td>
<td>Product is green label type</td>
</tr>
<tr>
<td></td>
<td>b) Female, mg/Kg. B. Wt</td>
<td>&gt;5000</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Acute Dermal LD50 in Rabbits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Male, mg/Kg. B. Wt</td>
<td>&gt;2000</td>
<td>Non-toxic as per current international norms.</td>
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<td>b) Female, mg/Kg. B. Wt</td>
<td>&gt;2000</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Toxicity to fresh water fish, a) LC50 (96 hrs), mg/lt of water</td>
<td>537.0</td>
<td>Practically non-toxic as limit is 270.9 – 803.1 mg/lt</td>
</tr>
<tr>
<td>4.</td>
<td>Toxicity to Honey Bee (LD50), microgram/bee</td>
<td>188.36</td>
<td>Non-toxic</td>
</tr>
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<td>5.</td>
<td>Skin irritation to Rabbit</td>
<td>Non-irritant</td>
<td>Safe to use</td>
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<td>6.</td>
<td>Toxicity to Chickens &amp; Pigeons (LD50), mg / Kg B. Wt.</td>
<td>&gt;5000</td>
<td>Non-toxic as per current international norms.</td>
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Servo Agrospray Oil is Eco-friendly, Non-toxic, Non-phytotoxic and Biodegradable Oil

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#### Servo Agrospray Oil

**Organic Farming Certifications**

- **USOCA certified** Servo Agrospray Oil under National Program for Organic Production (NPOP) as suitable for organic farming products in India under the aegis of Agricultural & Processed

- **Food Products Export Development Authority (APEDA)** (A part of Ministry of Commerce & Industry, Govt. of India and initiated).
**Agrospray Oils Indian Scenario**

- Not much popular in India
- Only limited use till now
  - Apple orchards
  - Tea Gardens
  - Organic Farming
  - Rubber Plantations etc.

IndianOil the leading supplier of agricultural spray oils in the brand name “Servoagrospray Oil” and “Servorubberspray Oil”

**DIFFERENT LEAF DISEASES OF RUBBER PLANTS**

- Abnormal leaf fall – Phytophthora palmivora
  Butl. P. meadii McRae. & P.nicotianae var parasitica and P. botryosa (Chee).
- Secondary leaf fall – Glomerella cingulata
- Birds eye spot – Drechslera heveae
  (Helminthosporium heveae)
- Corynespora leaf spot – Corynespora cossicola
ABNORMAL LEAF FALL

- **Symptoms:**
  - It occurs during June – August, while general leaf fall occurs during December.
  - On leaves dull grey, circular spots appear which enlarge and become irregular.
  - The petiole exhibit sunken spot. Affected fruits rot. Leaves shed prematurely either green or after turning coppery red.
  - The affected leaf form a thick carpet of rotting foliage which emits bad smell.

SPRAY OIL FOR RUBBER PLANTATIONS

- Traditionally, kerosene type petroleum fractions being used
- Residue of carrier oil washed away with rain water reaching soil / water
- Carrier oil decompose by soil or water micro organisms
- Toxicity of the carrier oil to micro organism determines the degradation rate.
- Conventional carrier oils : low biodegradability leaving more than 50% residue
- IOC-RII work introduced high unsulphonated residue(USR) oil during 90s
Micron spraying
- Based on the tree spread, foliage intensity, planting material and age, two rounds of spray using about 17 to 22 litres of fungicide oil mixture per hectare per round (1:6 proportion) with a gap of 10 to 15 days or a single round of spray with about 30-40 litres of fungicide oil mixture per hectare (1:5 proportion) applied.

Aerial spraying
- Spraying 6.2 litres of 40% oil based copper oxy chloride paste in 37 litres of diluent oil or 8 kg oil dispersible copper oxy chloride powder 56% in 40 litres of oil is used per hectare.

Spraying should be done as close to the monsoon as possible.

Evolution of Agrospray Oils

Generation I
Solvent refined oils (~60% saturates, higher aromatics and low sulphur concentrations)

Generation II
Highly refined oils (70-80% saturates, moderate aromatic and low sulphur concentrations)

Generation III
Severely hydro treated oils (>95% saturates, Very very low aromatic and sulphur content)