PYMETROZINE MARKET ANALYSIS

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CHEMICAL FORMULA	$C_{10}H_{11}N_5O$
CHEMICAL NAME	Pymetrozine

Use Case:

a) What is the use of this compound?

1) Control of Sap-Feeding Insects (Homopteran Pests)

- Aphid Control: Pymetrozine effectively controls aphids in various crops by disrupting their feeding behavior. It inhibits their ability to penetrate plant tissues, leading to starvation and death. This is critical in crops like potatoes and vegetables.

- Whitefly Management: It is also used to manage whiteflies, another sap-feeding pest, in crops such as tomatoes and cotton. The insecticide prevents them from feeding, reducing the spread of viral diseases they often transmit.

- Leafhopper and Planthopper Control: Pymetrozine is employed to control leafhoppers and planthoppers in rice and other cereal crops, preventing damage that can lead to significant yield losses. It prevents egg-laying and hopper resurgence.

2) Integrated Pest Management (IPM) Compatibility

- ·Selective Action: Pymetrozine's selective action targets specific pests while minimizing harm to beneficial insects, making it suitable for IPM programs aimed at reducing broad-spectrum insecticide use.

- Low Environmental Impact: Due to its low toxicity to non-target organisms like bees and birds, it aligns with sustainable agricultural practices, enhancing environmental safety.

- Resistance Management: Its unique mode of action, affecting chordotonal mechanoreceptors, offers an alternative to insecticides with more common resistance mechanisms, helping to manage and prevent resistance development in pest populations.

b) Are there any alternatives for this compound? Name a few.

- Based on the use cases of Pymetrozine, here are a few alternative compounds that can be used for similar applications: Neonicotinoids (e.g., Imidacloprid, Thiamethoxam) , Pyrethroids (e.g., Deltamethrin, Cypermethrin), Buprofezin.

c) Why is this compound superior to its alternatives?

Pymetrozine's superiority over many alternatives lies primarily in its selective toxicity and unique mode of action.

- Selective Toxicity: Unlike broad-spectrum insecticides like pyrethroids, pymetrozine targets specific sap-feeding pests, minimizing harm to beneficial insects and pollinators. This is crucial for integrated pest management (IPM) strategies.
- Unique Mode of Action: Pymetrozine affects the chordotonal mechanoreceptors in insects, a mode of action different from that of neonicotinoids and other common insecticides. This reduces the risk of cross-resistance and provides effective control even when pests have developed resistance to other chemicals.

d) Is this compound imported in India? What is the magnitude of imports?

- Pymetrozine worth $32,289,309 have been imported
- Average import price for pymetrozine was $52.61
- Pymetrozine were imported from 11 countries
- South Korea was the largest exporter of pymetrozine accounting for 99.97% of the total imports of pymetrozin
- Switzerland was the second largest exporter of pymetrozine accounting for 0.01% of the total imports of pymetrozine
- The month of Jun 2015 accounted for highest number of import shipments
- Most frequently used pymetrozine HS Code is 38089199

Economic Feasibility :

a) What input raw materials are needed for its synthesis (same as reported in the Patent application)?

a. Hydrazidation:
   - Materials: Dialkyl carbonate (1 mol) + hydrazine hydrate (2.2–3.0 mol)
   - Solvent: Water or methanol.

b. Condensation:
   - Materials: Carbodihydrazide (1 mol) + 3-formylpyridine (1 mol)
   - Solvent: Ethanol or THF

c. Cyclization:
   - Materials: Compound IV (1 mol) + monochloroacetone (1.05 mol)
   - Solvent: Ethanol or THF

b) Provide preliminary economic feasibility based on cost of raw materials, solvents and product selling price.

Dialkyl carbonate (ROCOOR) + Hydrazine hydrate + 3-formylpyridine + Monochloroacetone → Pymetrozine ($C_{10}H_{11}N_5O$)

Compound	Molecular Weight (g/mol)	Rate (INR /kg)	Rate (INR/k mol)	Quantity (kmol)	Amount (INR)
Dialkyl Carbonate	118.3	150	1,77,195	1	1,77,195
3-Formylpyridine	32.0	50	16,025	2.2	35,555
Monochloro-acetone	107.11	500	53,555	1	53,555

Potassium Carbonate	138.21	60	8292.6	0.5	4,146
Ethanol (Solvent)	46.07	50	2303.5	Solvent	-
Water (Solvent)	18.02	1	18.02	Solvent	-
Pymetrozine (Product)	217.23	2,500	5,43,075	1	5,43,075
Total Input Costs					1,84,747
Pymetrozine (1kmol) Revenue					5,43,075

Calculations:

- Total Input Costs (for Raw Materials): Rs 18,4747 per kmol of Pymetrozine
- Revenue from 1 kmol Pymetrozine: Rs 543,075
- ·Net Profit: Rs 543,075 - Rs 18,4747 = Rs 358,328
- Profit Percentage: (Rs 358,328 / Rs 543,075) * 100 = 65.98%

References:

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List of Contribution of Author:

Divya Mhetre(230649) :

Carried out the market research for chemical trade data, prepared the use case and looked at economic feasibility.

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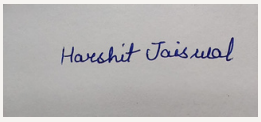
HARSHITJAISWAL	230460	
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