

# **New Chemistries and their potential in Resistance Management**

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# CONVENTIONAL INSECTICIDES

**Neuro-toxicants acting on**

**Voltage gated sodium channels**

**(DDT and pyrethroid)**

**GABA-gated chloride channels**

**(endosulfan)**

**Acetylcholinesterase inhibition**

**(organophosphates and carbamates)**

**Octamine receptors**

**(amitraz)**

# NEW INSECTICIDES I

## Neuro- toxicants

Acting on ACh receptors

(imidacloprid, acetamiprid, thiamethoxam),  
(spinosad)

Acting on GABA and Glutamate Receptors

(abamectin, emamectin, milbemectin),  
(fipronil)

Inhibiting sodium ion entry into nerve cells  
(indoxacarb)

# NEW INSECTICIDES II

**IGRs**

**Chitin Synthesis Inhibitors**

**(benzoylphenyl ureas and buprofezin)**

**Juvenile Hormone Mimics**

**(fenoxycarb and pyriproxyfen)**

**Ecdysone Agonists**

**(tebufenozide, methoxyfenozide, halofenozide)**

# NEW INSECTICIDES III

**Others**

**Inhibiting mitochondrial respiration**  
**(diafenthiuron, pyrroles)**

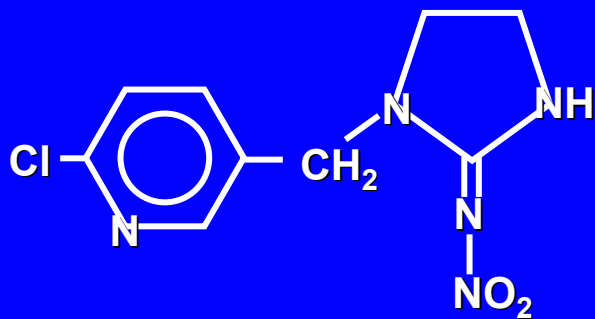
**pymetrozine, azadirachtin**

**Bio-  
insecticides**

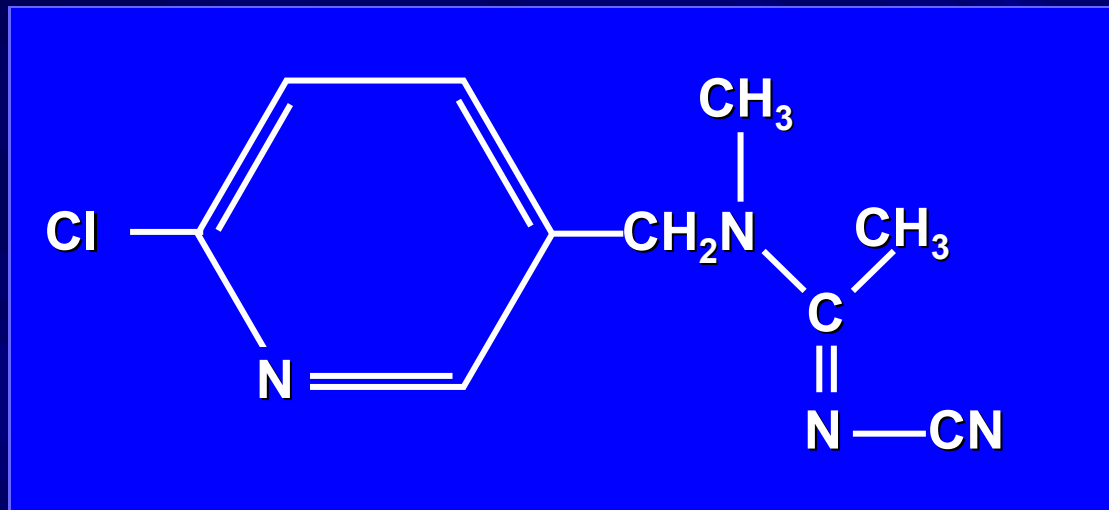
**Bacteria (Bt), Fungi (*Paecilomyces*),  
Viruses (NPV)**

# NEONICOTINOIDS

- ❖ **Imidacloprid**
- ❖ **Acetamiprid**
- ❖ **Thiamethoxam**



**Imidacloprid**

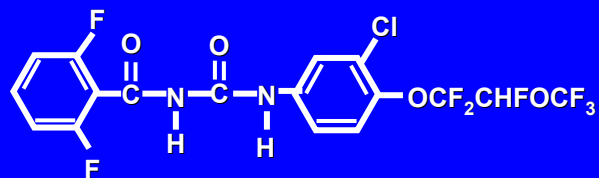
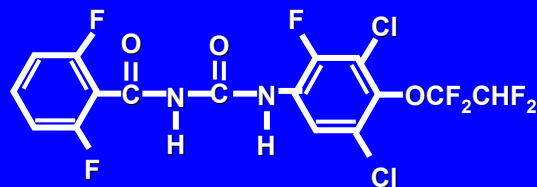
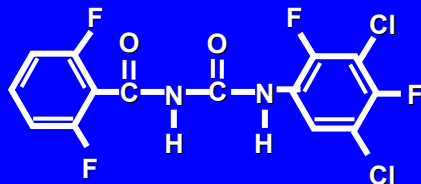
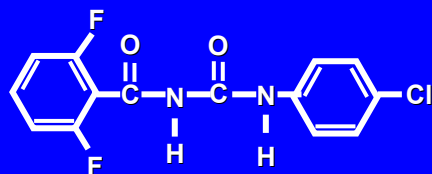


**Acetamiprid**



# **NEONICOTINOIDS**

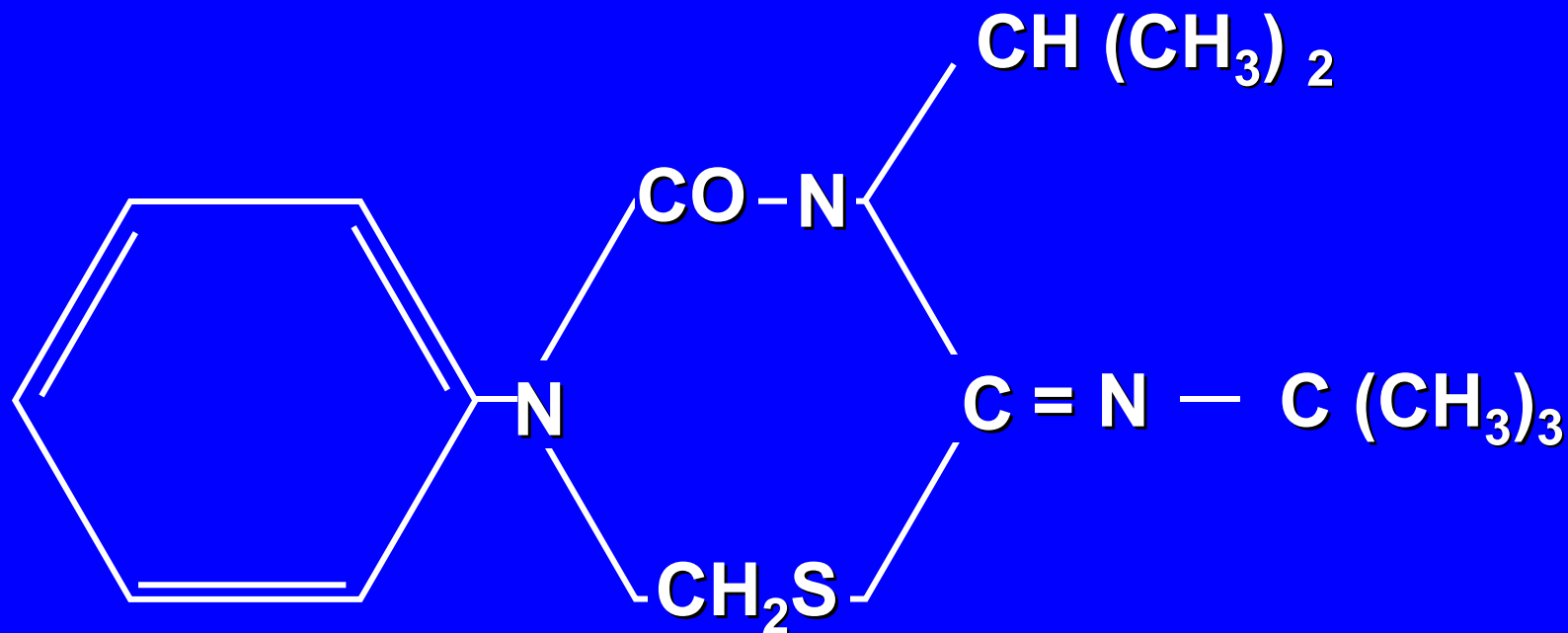
- ❖ **Exhibit systemic and translaminar properties**
- ❖ **Act as contact and stomach poisons**
- ❖ **Used as foliar, drench or seed treatments**
- ❖ **Long residual activity**
- ❖ **Mild effect on beneficials**
- ❖ **Used against whiteflies, leafhoppers, aphids, thrips and coleopteran pests**



**Structure of chitin synthesis inhibitors – five benzoylphenyl ureas. From top: diflubenzuron, chlorfluazuron, teflubenzuron, hexaflumuron, novaluron.**

# **Chitin Synthesis Inhibitors**

- ❖ **Benzoylphenyl ureas (BPUs), include diflubenzuron, teflubenzuron, lufenuron, chlorfluazuron, novaluron, hexaflumuron**
- ❖ **Mainly stomach poisons**
- ❖ **Effective against lepidopteran larvae, particularly Spodoptera, Heliothine spp.**



**Bupropion**

# **BUPROFEZIN**

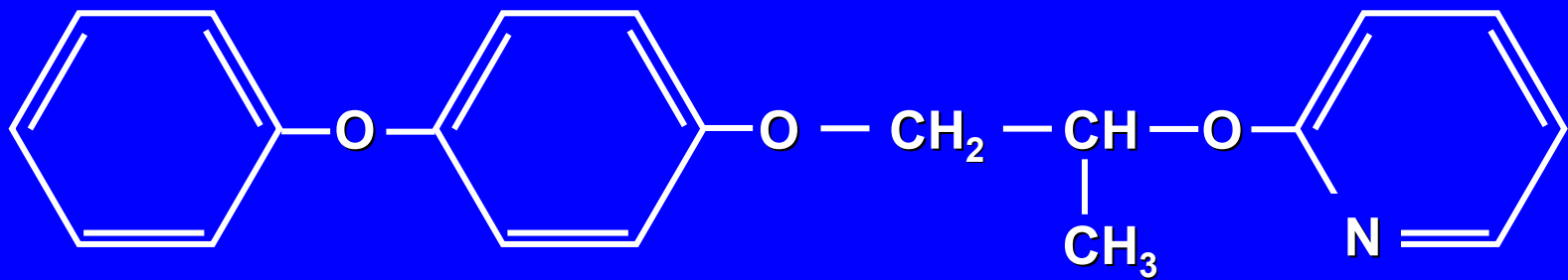
- ❖ **Thiadizine-like compound with long residual activity**
- ❖ **Inhibits incorporation of 3H-glucose and N-acetyl-D-3H-glucosamine into chitin**
- ❖ **Acts on nymphal stages of sucking pests such as WFs, scales, leaf and plant hoppers**
- ❖ **Contact and vapour activity**
- ❖ **Mild effect on beneficials**

# **Ecdysone Agonists (tebufenozide, methoxyfenozide)**

- ❖ **Substitutes for dibenzoyl hydrazines (diacylhydrazines)**
- ❖ **Bind to ecdysteroid receptors, accelerate molting process**
- ❖ **Effective against lepidopteran pests such as bollworms, diamondback moth**
- ❖ **No harm to natural enemies**

# **Juvenile Hormone Mimics (fenoxycarb, pyriproxyfen)**

- ❖ **Pyriproxyfen is a fenoxycarb derivative in which a part of aliphatic chain was replaced by pyridyl oxyethylene**
- ❖ **Least harmful to beneficials**



**Pyriproxyfen**



# **PYRIPROXYFEN**

- ❖ **A potent JH mimic affecting hormonal balance in insects, thereby resulting in strong suppression of embryogenesis, metamorphosis and adult formation**
- ❖ **Controls whiteflies and scales**
- ❖ **Least effect on beneficials**

# **AVERMECTINS**

## **(abamectin, emamectin benzoate)**

- ❖ **Isolated from soil actinomycete microorganism, *Streptomyces avermitilis***
- ❖ **Affect nervous system of arthropods by increasing chloride ion influx at the neuromuscular junction, resulting in cessation of feeding and irreversible paralysis**
- ❖ **Their direct activity is toxic to non-target organisms but their translaminar activity and rapid photodecomposition renders them important agents in IPM**

# **ABAMECTIN**

- ❖ **Highly toxic to many arthropods, including spider mites, agromizid leafminers, ants, cockroaches, and some lepidopterans**
- ❖ **Residual activity due to its translaminar action**
- ❖ **A selective pesticide with low toxicity to many non-target arthropods**

# EMAMECTIN BENZOATE

- ❖ **A derivative of abamectin**
- ❖ **Excellent activity against lepidopterans, particularly *Spodoptera* and heliothines**
- ❖ **Also effective against thrips**

# SPINOSAD

- ❖ Derived from soil *actinomycete*, *Saccharopolyspora spinosa*
- ❖ Spinosyns initially cause spontaneous muscle contractions and tremors by exciting neurons in the CNS
- ❖ The site of action on acetylcholine receptors differs from that of neonicotinoids
- ❖ Acts via ingestion, but also some contact activity
- ❖ Has translaminar activity
- ❖ Low mammalian toxicity, favourable environmental profile, toxic to some beneficials
- ❖ Effective against lepidopterans, dipterans, thrips

# **PYRROLE (chlorfenapyr)**

- ❖ **Derived from dioxapyrrolomycin, isolated from Streptomyces**
- ❖ **Pro-insecticide, activated by MFOs**
- ❖ **Acts on mitochondria by uncoupling oxidative phosphorylation**
- ❖ **A stomach poison, some contact activity**
- ❖ **Effective against Coleoptera, Lepidoptera, Acarina, Thysanoptera**
- ❖ **Harmful to many beneficials, but safe to bumble bees and various predatory mites**

# **DIAFENTHIURON**

- ❖ **A thiourea derivative**
- ❖ **Pro-insecticide, converted to an insecticide (carbodiimide) by light**
- ❖ **Inhibits mitochondrial respiration**
- ❖ **Shows translaminar and vapour action**
- ❖ **Controls sucking pests such as WFs, aphids, jassids, mites**
- ❖ **Moderate mammalian toxicity**
- ❖ **Selective on beneficial insects and predatory mites**
- ❖ **Non-toxic to birds but toxic to bees and fish**

# INDOXACARB

- ❖ **An oxadiazine pro-insecticide that is bioactivated by esterases into DCJW inside insects following ingestion**
- ❖ **Inhibits sodium ion entry into nerve cells, resulting in paralysis and death**
- ❖ **Effective against lepidopteran (heliathines, diamondback moth), certain coleopteran (CPB) and homopteran (*Lygus*) pests**
- ❖ **Considered safe to beneficials**



# FIPRONIL

- ❖ A phenylpyrazole, active at the neuro-inhibitory GABA-gated chloride channels
- ❖ Broad-spectrum insecticidal activity such as *Spodoptera*, heliothines, thrips, CPB, Lygus
- ❖ Controls soil insects but non-toxic to earthworm and various microorganisms
- ❖ Activity against household pests, used in baits
- ❖ Not effective against WFs and aphids
- ❖ Very toxic to bees and some predators of cotton pests

# **PYMETROZINE**

- ❖ **A novel azomethine pyridine insecticide**
- ❖ **Affects nerves controlling salivary pump and causes immediate and irreversible cessation of feeding, followed by starvation and insect death**
- ❖ **Highly specific against sucking insect pests like aphids, WFs and plant hoppers**
- ❖ **Has systemic and translaminar activities, can be used as drench or foliar application**
- ❖ **Low mammalian toxicity**
- ❖ **No appreciable effect on non-targets and beneficials especially coleopteran, heteropteran and neuropteran species**

# CONCLUSIONS

- **Acetylcholine receptor agonists such as neonicotinoids are efficient control agents against sucking pests such as aphids, leafhoppers and whiteflies and spinosad against heliothines, spotted bollworm, thrips and diversity of insect pests.**
- **GABA receptor agonists: abamectin acts against mites, emamectin on lepidopterans and thrips, and milbemectin on diversity of insect pests.**
- **All the above compounds are considered mild insecticides and suit well in IPM programs.**
- **No appreciable cross-resistance was found between BPU, neonicotinoids, and juvenile hormone mimics. Hence these compounds can be used as components in IRM programs.**

# CONCLUSIONS

- **IGRs such as chitin synthesis inhibitors (benzoylphenyl ureas and buprofezin), juvenile hormone mimics (fenoxycarb and pyriproxyfen), and ecdysone agonists (tebufenozide and methoxyfenozide) are considered leading compounds for controlling agricultural pests.**
- **BPU's such as novaluron, lufenuron, hexaflumuron, and chlorfluazuron act efficiently on lepidopterans, while buprofezin acts specifically on whiteflies and scale insects.**
- **Ecdysone agonists such as tebufenozide and methoxyfenozide act specifically on lepidopterans while halofenozide acts on coleopterans.**

**Thank you for your  
patience**