



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 10, October 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 8.524**

9940 572 462

6381 907 438

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# Novel Insecticides: A Sustainable Approach for Insect Pest Management

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**ABSTRACT:** Insect pest management in agriculture has been greatly aided by conventional insecticides over the past 50 years. Numerous issues, including resistance, residue, resurgence, and environmental safety, have been brought about by their careless use. In the context of managing pest resistance and controlling pest populations, the focus of insecticide research has switched to the creation of new green chemicals with unique biochemical targets. Chemical and biological methods of controlling pests while maintaining human safety are currently experiencing a rebirth. New insecticide groups with novel chemistries, such as IGR, oxadiazines, ketoenols, phenylpyrazoles, and mitochondrial electron transport inhibitors (METI), have been developed and brought to market for use in contemporary crop protection in recent years. As a result of their high target specificity, adaptability in application techniques, and relatively low risk to non-target organisms and the environment, these significant classes of new insecticides are increasingly important in the current context of environmental safety and their applications in integrated pest management and insect resistance management programs.

**KEYWORDS:** Insecticide, Natural enemies, Novel, Pest management, Resistance

## I. INTRODUCTION

Traditional neuroactive pesticides have a significant role in controlling the population of pest insects because of their broad spectrum effects. Recurrent application of neuroactive pesticides can lead to issues with controlling insect populations, such as pesticide resistance, pest resurgence, secondary pest outbreaks, residue-related issues, and hazardous effects on humans. Managing the population of insect pests has made the replacement of traditionally applied neuroactive pesticides necessary. Searching for insecticides with a distinct mode of action that uses green chemistry is emphasized. Having distinct qualities from conventional insecticides, recently identified compounds that are pest-specific to insects have an impact on the specific biochemical locations found in those bug families. Since they work in different ways, they don't affect insect pests that have evolved resistance mechanisms. They also serve as rotational alternatives, offer special selective chemicals that control pest insects, and provide more desirable control in insect pest management. Because of their green chemical origin and low application doses, these recently discovered insecticides have relatively little adverse effects on non-target pests, natural enemies, mammals, and the environment.

## II. NEONICOTINOIDS OR CHLORONICOTINYL INSECTICIDES (CNIS)

Impressive chemical and biological features characterize the new and unique class of insecticides known as neonicotinoids. According to Elbert et al., 1998, this group has grown at the fastest rate over the past 20 years due to its broad insecticidal spectrum, systemic and translaminar features, strong residual activity, and distinct mode of action. According to Bai et al., 1991, the nicotinic acetylcholine receptor (nAChR) in insect nervous systems is the biochemical target site of CNIs, which function in a manner similar to that of nicotine. Neonicotinoid group includes Imidacloprid, Thiamethoxam, Thiacloprid, Clothianidin.

- **Imidacloprid**

It is the first commercially available neonicotinoid and is used on more than 140 crops in more than 120 countries. Due to its adaptability, it can be used anywhere in the world to combat chewing and sucking pests of various vegetable crops (Mandal et al., 2007). Additionally, it is said to have no effect on nematodes and spider mites but to be effective against soil insects like termites and white grubs. It comes in the following formulations: WG, FS, WS, and SL. When combined with polymer at 40 ml/kg, imidacloprid at 3 g/kg of seed offered effective control over okra jassids and fruit borer.

- **Thiamethoxam**

Marketed as actara for foliar spray and as a cruiser for seed treatment, it is the second neonicotinoid insecticide now in use (Maienfisch et al., 2001). This pesticide, which is used against sucking pests as well as certain chewing and soil-dwelling insects, is very systemic and broad spectrum. It is used on a variety of vegetable crops. For honeybees, it is extremely poisonous. 200 g a.i./kg of seed is the usage rate for seed treatment, and 25–50 g ai/ha for foliar spraying.

- **Thiacloprid**

According to Erdelen, 2001, it is a systemic insecticide with a broad range that has been specifically designed for foliar spray application. It has a long-lasting action against sucking pests like aphids, leafhoppers, thrips, whiteflies, psylla, leafminers, and weevils on crops. Its inertness to pollinating insects, including bumblebees, honey bees, and parasitic wasps, makes it possible to apply it both before and after the crop flowers. It recommended dosage is 54–72 g a.i/ha. This is just one of its many remarkable advantages.

- **Clothianidin**

Applied at very moderate usage rates as a foliar spray, soil application, and seed treatment, it is a broad range insecticide with contact, stomach, and strong systemic activity (Altmann, 2003). Aphids, leafhoppers, whiteflies, and thrips are just a few of the sucking insects that it actively combats. Clothianidin is highly effective against a wide range plant pests that feed on roots, stems, and leaves as well as soil-dwelling pests that infest and surround seeds because of its exceptional root systemicity. The suggested dosage is 15–25 g a.i/ha, and it comes as 50% WDG.

### III. OXADIAZINES

Oxadiazines are a group of broad-spectrum insecticides that work by blocking sodium channels in the nervous system of insects. This results in impaired nerve function, paralysis, cessation of feeding, and death. Oxadiazines group include Indoxacarb, Diamides, Cyantraniliprole, Flubendiamide.

- **Indoxacarb**

According to McCann et al., 2001, it is the oxadiazine group's first commercially available pesticide. By preventing sodium ions from entering nerve cells, it inhibits voltage-gated sodium channels (Lapied et al., 2001). This causes the target pest species to become paralyzed and die. Moreover, indoxacarb and pyrethroids have been found to have negative cross-resistance in *Helicoverpa armigera*. It comes in 14.5 and 15.8 SC forms, with a dosing recommendation of 30-75 g ai/ha.

- **Diamides**

Flubendiamide and chlorantraniliprole, which belong to the phthalic acid diamide and anthranilic diamide classes, respectively, are the two classes that have been produced within this category. Given that insects can quickly develop resistance and that safe and efficient pesticides that act at new biochemical target sites are needed, the recent introduction of flubendiamide and chlorantraniliprole (Rynaxypyr) is noteworthy in the field of crop protection. This class of insecticides specifically binds to the ryanodine receptors (RyRs) in insect muscle cells. This activation of RyRs causes an uncontrollable release of Ca<sup>2+</sup> ions from internal storage in the sarcoplasmic reticulum, which in turn causes muscular paralysis and death.

- **Cyantraniliprole**

With cross-spectrum efficacy against lepidopteran and hemipteran pests, it is a second-generation ryanodine receptor insecticide (Selby et al., 2008). Fruiting vegetables and cucurbits are the target crops. It manages fruit flies, whiteflies, foliage-feeding beetles, dipteran leafminers, and lepidopteran larvae. regulates weevils, psyllids, thrips, aphids, and leafhoppers as well. It can be applied to soil due to its translaminar action. For insects that chew and suck, the dosage is 10-100 g a.i./ha.

- **Flubendiamide**

By synthesizing and screening two thousand derivatives based on a pyrazine dicarboxamide derivative, it was found in 1998. It is quite active against numerous cucurbitaceous, cole, and solanaceous vegetable pests that are lepidopterans; however, no activity in other insect orders is apparent. It is used both through chemigation and foliar spraying. Indoxacarb and methoxyfenozide are thought to be good alternatives to it. A 48–60 g a.i/ha suggested dose is given, and it comes in 24 WG and 240 SC.



#### **IV. KETOENOL GROUP OR TETRAMIC AND TETRONIC ACID DERIVATIVES**

Among the insecticides in this group are spirodiclofen, spiromesifen. According to Bretschneider et al., 2003, the inhibition of the enzyme Acetyl CoA carboxylase characterizes the mode of action of ketoenols in lipid biosynthesis or metabolism. In particular, triglycerides and free fatty acids are inhibited in relation to biological activity. In many vegetable crops, ketoenols are a useful tool for managing sucking pests like mites and whiteflies due to their novel method of action and lack of cross resistance to existing commercial medicines.

- **Spirodiclofen**

Wachendorff et al., 2000 describe it as a selective, non-systemic acaricide with outstanding efficiency against mites, including Tetranychus, Panonychus, Phyllocoptruta, Brevipalpus, and Aculus. It also has broad-spectrum activity. Spirodiclofen's strong lipophilicity contributes to its good residual efficacy against spider mite species, with the acaricidal impact lasting up to 14 days. Higher temperatures cause spirodiclofen to become more active, which suggests a positive temperature coefficient. Even at the maximum concentration of 1000 ppm, it does not cause phytotoxicity in greenhouse conditions when applied to cucumber and tomato.

- **Spiromesifen**

It is a new insecticide and acaricide that is a derivative of tetroneic acid and was introduced recently (Bretschneider et al., 2003). It is highly effective against a variety of mites, including spider mites like Tetranychus spp., red spider mites (Panonychus spp.) and Oligonychus sp., Tarsonemid mites (Polyphagotarsonemus latus) and Eriophyid mites (Aculops lycopersici). It is also reported to suppress some species of thrips in vegetables, including Scirtothrips dorsalis, Thrips palmi, and Thrips tabaci.

#### **V. MET INHIBITORS/PYRIDAZINONES (MITOCHONDRIAL ELECTRON TRANSPORT INHIBITOR)**

Insect and mite population management is greatly aided by METI insecticides and acaricides. Insect mites, METI pesticides and acaricides impair mitochondrial electron transport (Tomar et al., 2017). When it comes to sucking pest populations and mite management, they work incredibly well.

- **Tetrazines**

The environment and predatory mites are not harmed by tetrazines, an acaricide that is very effective against phytophagous mites. Because of their translaminar characteristics, tetrazines, a type of contact acaricide, can enter the body by food in addition to their ovicidal effects (Hajimichael et al., 1996).

- **Thiazolidinones**

Because of its wide-ranging toxicity to egg, larva, and nymphal stages, it is used to reduce mites, thrips, and leafhopper populations. These can be given to plants at any stage of growth and are very successful in controlling the population of mites (Campos and Omoto, 2002).

- **Nereistoxin**

According to Sinha et al., 2009, this broad-spectrum pesticide works well to suppress sucking and chewing insect pests at every stage of development. It inhibits the function of insects' nicotinic acetylcholine receptors.

- **Formamidines**

Utilizing its acaricidal and insecticidal qualities to manage leaf miners, scale insects, red spider mites, two-spotted spider mites, and aphids (Bynum et al., 1997). Its effects include inhibition of the monoamine oxidase enzyme and agonists of adrenoreceptors.

#### **VI. PHENYL PYRAZOLE**

Because they specifically target the GABA gated chloride channel, phenylpyrazoles pesticides are very effective at controlling the population of mites and other insects. Insects and mites are eliminated when the GABA-gated chloride channel and ionotropic receptor are blocked.

- **Fipronil**

A new class of pesticides with insecticidal and acaricidal properties is represented by phenyl pyrazoles. Fipronil acts on chewing and sucking insects through touch. According to Bloomquist (2001), it functions by neuro inhibiting GABA-gated chloride channels. Fipronil has broad-spectrum efficacy against a wide range of insect pests, including soil insects, sucking pests like thrips and *Lygus* sp., and foliar feeding insect pests including diamondback moth (*Plutella xylostella*), and *Spodoptera* spp.

It comes in two forms: 0.3% as granules applied at 50–75 g a.i./ha to combat soil pests and 5% SC used as a foliar spray at 40–50 g a.i./ha against vegetable pests. Rats have an acute oral LD50 of 100 mg/kg and a cutaneous LD50 of more than 2000 mg/kg.

- **Ethiprole**

Aphids and hoppers are effectively combated by it. It inhibits GABA-mediated neuronal transmission. The central nervous system is affected by ethiprole's gamma-butyric acid-regulated chloride channel. Cross-resistance is unlikely due to its high level of selective toxicity. Silkworms are poisoned by it, although fish and birds are less affected.

## VII. INSECT GROWTH REGULATORS (IGRS): CHITIN BIOSYNTHESIS INHIBITORS

A novel strategy for managing insect pests involves utilizing analogs and antagonists of insect growth regulators (IGRs), including ecdysones, juvenile hormones (JH), chitin synthesis inhibitors, and related chemicals. They can play a significant part in the integrated pest management program due to their strong selective toxicity towards insect species, low toxicity to mammals, and environmental safety.

- **Novaluron**

A new insecticide, benzyl phenyl urea (BPU), exhibits greater contact and translaminar activity in comparison to existing CSI. *Spodoptera litura*, *S. exigua*, bollworms, caterpillars, and the diamondback moth are all effectively controlled by it. Moreover, it works well against coleopteran larvae and is a potent toxin against leafminers and developmental stages of whiteflies (*B. tabaci* and *Trialeurodes vaporariorum*) (Ishaaya et al., 1996). The suggested dosage for t is 33.5–75 g a.i./ha, and it is available in 10% EC.

- **Teflubenzuron**

This stomach-acting insect growth regulator is non-systemic. After contact or ingestion, it has an impact on female insects' fertility. On vegetables like cauliflower, potatoes, and cabbage, it is used to suppress the larvae of Lepidoptera, Coleoptera, Diptera, Aleyrodidae, Hymenoptera, Psyllidae, and Hemiptera. It is not included in India's registry.

- **Flufenoxuron**

Another IGR pesticide with acaricidal and insecticidal qualities is flufenoxuron. It acts on the stomach and has contact. widely employed to keep vegetable pests and insects under control. Together with these, it can also be used to manage pests that have developed a resistance to traditional insecticides. The suggested dosage is 40 g a.i./ha, and it is available as 10% DC.

## VIII. CONCLUSION

In conclusion, the application of innovative pesticides in crop pest management usually highlights the significance of integrated pest management (IPM) techniques. It draws attention to how cutting-edge insecticides might minimize their negative impacts on the natural world while lowering pest populations. This ought to promote environmentally friendly methods, such as the creation of focused pesticides that protect beneficial species and lessen resistance problems. It might also necessitate more study into alternate pest management strategies and training farmers on how to use these products safely and effectively. Finally, the middle-of-the-road strategy that protects ecosystems while increasing crop yields.

**REFERENCES**

1. Altmann, R. (2003). Poncho®: a new insecticidal seed treatment for the control of major maize pests in Europe.
2. Bai, D., Lummis, S. C., Leicht, W., Breer, H., & Sattelle, D. B. (1991). Actions of imidacloprid and a related nitromethylene on cholinergic receptors of an identified insect motor neurone. *Pesticide science*, 33(2), 197-204.
3. Bloomquist, J. R. (2001). GABA and glutamate receptors as biochemical sites for insecticide action. *Biochemical sites of insecticide action and resistance*, 17-41.
4. Bretschneider, T., Benet-Buchholz, J., Fischer, R., & Nauen, R. (2003). Spirodiclofen and spiromesifen—novel acaricidal and insecticidal tetrionic acid derivatives with a new mode of action. *Chimia*, 57(11), 697-697.
5. Bynum Jr, E. D., Archer, T. L., & Plapp Jr, F. W. (1997). Comparison of banks grass mite and twospotted spider mite (Acari: Tetranychidae): responses to insecticides alone and in synergistic combinations. *Journal of Economic Entomology*, 90(5), 1125-1130.
6. Campos, F. J., & Omoto, C. (2002). Resistance to hexythiazox in *Brevipalpus phoenicis* (Acari: Tenuipalpidae) from Brazilian citrus. *Experimental & applied acarology*, 26, 243-251.
7. Elbert, A., Nauen, R., & Leicht, W. (1998). Imidacloprid, a novel chloronicotinyl insecticide: biological activity and agricultural importance. In *Insecticides with novel modes of action: mechanisms and application* (pp. 50-73). Berlin, Heidelberg: Springer Berlin Heidelberg.
8. Erdelen, C. (2001). Field trials with Calypso®(thiacloprid) in fruit cultivation in Germany.
9. Hajmichael, J., Horváth, G., Pap, L., Botár, S., & Székely, I. (1996). Chemical evaluation of SZI-121, a tetrazine type miticide. *Journal of Environmental Science & Health Part B*, 31(3), 515-519.
10. Ishaaya, I., Yablonski, S., Mendelson, Z., Mansour, Y., & Horowitz, A. R. (1996). Novaluron (MCW-275), a novel benzoylphenyl urea, suppressing developing stages of lepidopteran, whitefly and leafminer pests
11. Lapiéd, B., Grolleau, F., & Sattelle, D. B. (2001). Indoxacarb, an oxadiazine insecticide, blocks insect neuronal sodium channels. *British journal of pharmacology*, 132(2), 587-595.
12. Maienfisch, P., Huerlimann, H., Rindlisbacher, A., Gsell, L., Dettwiler, H., Haettenschwiler, J., ... & Walti, M. (2001). The discovery of thiamethoxam: a second-generation neonicotinoid. *Pest Management Science: formerly Pesticide Science*, 57(2), 165-176.
13. Mandal, S. K., Sah, S. B., & Gupta, S. C. (2007). Management of insect pests on okra with biopesticides and chemicals. *Annals of Plant Protection Sciences*, 15(1), 87-91.
14. McCann, S. F., Annis, G. D., Shapiro, R., Piotrowski, D. W., Lahm, G. P., Long, J. K., ... & Wing, K. D. (2001). The discovery of indoxacarb: oxadiazines as a new class of pyrazoline-type insecticides. *Pest Management Science: formerly Pesticide Science*, 57(2), 153-164.
15. Selby, T. P., Lahm, G. P., Stevenson, T. M., Hughes, K. A., Annan, I., & Cordova, D. (2008). Selective ryanodine receptor activator. *Pesticide Chemistry, Crop Protection, Public Health, Environmental Safety*. Wiley-VCH, Weinheim, 111-120.
16. Sinha, S. R., Paul, A. V. N., & Singh, R. (2009). Bio-efficacy of insecticides against two major insect pests of brinjal. *Annals of Plant protection Sciences*, 17(1), 226-228.
17. Tomar, S., Sharma, S., & Malik, K. (2017). Diafenthiuron (a novel insecticide) for management of whitefly, *Bemisia tabaci*. *Indian Journal of Scientific Research*, 120-123.
18. Wachendorff, U., Brück, E., Elbert, A., Fischer, R., Nauen, R., Stumpf, N., & Ticmann, R. (2000). BAJ2740, a novel broad spectrum acaricide.



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