



Why Are Insect Pests Becoming More Resistant to Pesticides

*Raj Kumar¹, V. Manoj Kumar Reddy², Sudheer Kumar³,
Naval Kishore Meena⁴ and Ashish Kumar⁵

¹Ph.D. Scholar, Department of Entomology, Choudhary Charan Singh Haryana Agricultural University Hisar

²B.Sc. (Hons.) Agriculture, School of Agriculture, ITM University, Gwalior

³Programme Assistant (Computer Programmer), Dept. of Raja Dinesh Singh Krishi Vigyan Kendra, Awadheshpuram (Ainthu), Kalakankar, Pratapgarh, Uttar Pradesh

⁴Ph.D. Scholar, Department of Horticulture (Fruit Science), Rajasthan College of Agriculture, MPUAT, Udaipur-313001, Rajasthan

⁵Ph.D. Scholar, Department of Horticulture (Fruit Science), Rajasthan College of Agriculture, MPUAT, Udaipur-313001, Rajasthan

*Corresponding Author's email: veenja.raj879@gmail.com

For decades, pesticides have been the farmer's strongest weapon against insect pests. They helped increase crop production, protect food security, and reduce losses. But recently, many farmers are facing a frustrating problem: pesticides that once worked effectively are no longer killing pests. This happens because insects are becoming resistant meaning they survive pesticide applications and continue damaging crops. Resistance is now one of the biggest threats to sustainable agriculture worldwide. Resistance is defined as a heritable change in pest sensitivity, where pesticides fail to control pests even when used properly.

How Does Resistance Develop

Think of a pest population like a classroom of students. Not all students are equally strong. When a pesticide is sprayed:

- Most insects die
- But a few naturally strong insects survive
- These survivors reproduce
- Their offspring inherit resistance

Over time, the whole population becomes resistant.

This process happens due to natural selection and genetic inheritance.

Major Reasons Why Insect Pests Become Resistant

1. Overuse and Misuse of Pesticides

Repeated use of the same pesticide is the biggest cause.

- It kills susceptible insects
- Resistant insects survive and multiply
- Resistance spreads quickly

Overuse creates strong **selection pressure favoring resistant individuals.**

Example: Farmers spraying the same insecticide again and again on vegetables.

2. High Reproductive Capacity of Insects

Insects reproduce very fast.

- Many insects produce hundreds of offspring
- Short life cycles mean many generations per year
- Resistance spreads rapidly

High reproduction and genetic variability speed up resistance development.

Example: Aphids and whiteflies multiply quickly.

3. Genetic Mutations in Insects

Sometimes insects develop natural genetic changes.

These mutations may:

- Reduce pesticide effect
- Allow detoxification of poison
- Prevent pesticide binding

These resistant genes pass to future generations.

Example: Diamond back moth developed resistance to Bt toxins.

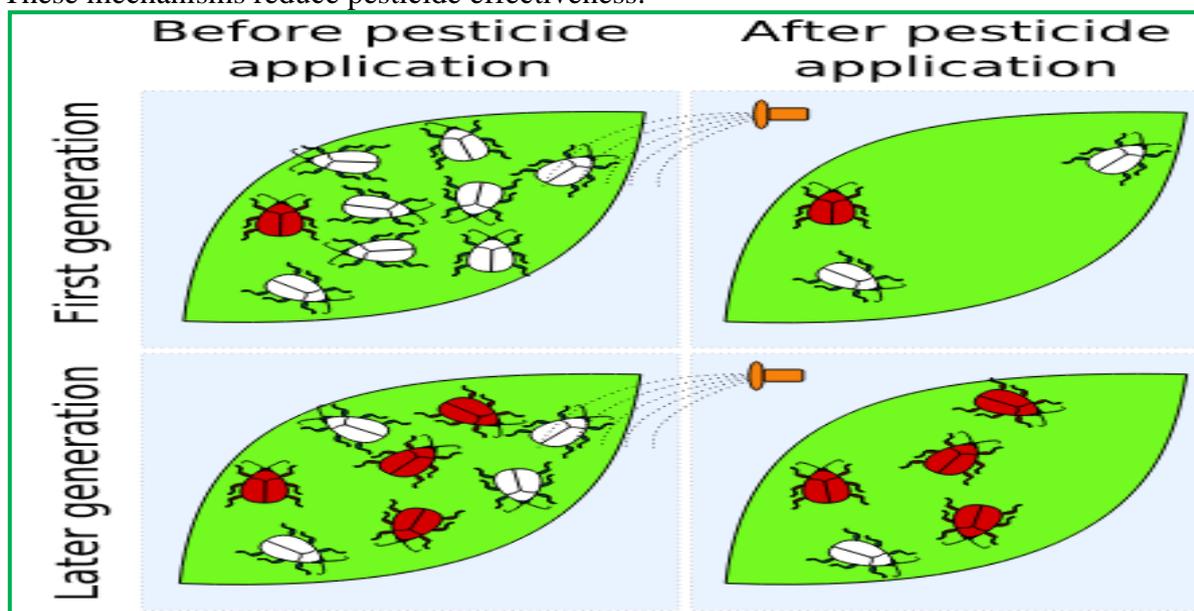


4. Insects Develop Special Defense Mechanisms

Insects can protect themselves using several mechanisms:

- Breaking down pesticides using enzymes
- Changing body structure to reduce absorption
- Altering behavior to avoid sprayed areas
- Modifying target sites inside the body

These mechanisms reduce pesticide effectiveness.



5. Continuous Use of Same Chemical Group

Using the same pesticide repeatedly causes **cross-resistance**.

This means:

- Resistance to one pesticide
- Resistance to similar pesticides

This makes control even harder.

Table 1: Major Causes of Insect Resistance

Cause	Explanation	Example
Overuse of pesticides	Same pesticide used repeatedly	Cotton pests resistant to pyrethroids
High reproductive rate	Rapid multiplication spreads resistance	Aphids, whiteflies
Genetic mutation	Natural changes increase survival	Diamondback moth
Misuse of pesticides	Wrong dose or frequent spraying	Vegetable crop pests
Lack of rotation	Same chemical group used continuously	Resistance to multiple insecticides

Table 2: Mechanisms Used by Insects to Resist Pesticides

Mechanism	How it Works	Result
Metabolic resistance	Insect breaks pesticide using enzymes	Pesticide becomes harmless
Target-site resistance	Pesticide cannot bind to insect body	No toxic effect
Penetration resistance	Reduced pesticide absorption	Less chemical enters body
Behavioral resistance	Insects avoid sprayed areas	Escape from pesticide
Cross resistance	Resistance to many pesticides	Control becomes difficult

Real-Life Example Farmers Experience

Many vegetable farmers report that:

- Earlier one spray controlled pests
- Now 3-4 sprays fail

This is due to resistance.

Why This Is a Serious Problem

Pesticide resistance leads to several serious problems in agriculture. When pesticides stop working effectively, insect pests continue to damage crops, resulting in significant crop losses and reduced yield. Farmers are forced to spray more frequently or buy stronger and more expensive pesticides, which increases the cost of cultivation. Excessive and repeated pesticide use also causes environmental pollution by contaminating soil, water, and beneficial organisms. In addition, pesticide residues can pose health risks to farmers and consumers. To control resistant pests, farmers often use higher doses than recommended, which further worsens the situation by accelerating resistance development, increasing costs, and causing greater harm to the environment and human health.

How Farmers Can Slow Resistance

Farmers should:

- Rotate pesticides
- Use recommended dose
- Adopt Integrated Pest Management (IPM)
- Use biological control
- Avoid unnecessary spraying

Conclusion

Insect resistance is a natural biological process, but it has increased rapidly due to human activities, especially the excessive and repeated use of pesticides. When pesticides are

sprayed, some insects survive because of their natural ability to tolerate the chemical. These surviving insects reproduce and pass their resistance traits to the next generation. Over time, the pesticide becomes less effective or even useless. If proper pest management practices are not followed, controlling pests will become more difficult and costly in the future. Therefore, it is important to adopt smart farming practices, use pesticides in a balanced and recommended manner, and follow Integrated Pest Management (IPM). These approaches help in managing pests effectively while delaying resistance development and protecting the environment.