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Identifying and Controlling Major Crop-Damaging Insects in Small-Scale Farms

Gurugubelli Sesil[1]*, Swapnil Kumar Pandey[2], Dhane A S[3], Chaman Kumar[4] and Renish G Roy[5]

[1]M.Sc. Scholar, Department of Entomology, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad
[2]Assistant Professor, Faculty of Agriculture, JNCT Professional University, Bhopal
[3]Assistant Professor, Department of Entomology, Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra
[4]Assistant Professor Cum. Jr. Scientist, Department of Entomology, R.N.T.A.C. Deoghar, Birsa Agricultural University, Ranchi
[5]M.Sc. Scholar, Department of Genetics and Plant Breeding, Faculty of Agriculture, Tantia University, Sri Ganganagar, Rajasthan

*Corresponding Author
Gurugubelli Sesil*

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INTRODUCTION

Small-scale farms are a vital pillar of agriculture worldwide, especially in developing regions. Even though they operate on relatively small land holdings and often rely on family labour, many of these farms supply a substantial portion of local food needs. However, the productivity and sustainability of small-scale farms face persistent threats from insect pests. Crops can suffer damage at multiple stages — from seedlings to harvest, and even in storage — when insects attack roots, stems, leaves, fruits, or grains. Such damage reduces both yield and quality of harvests. Globally, the impact of insect pests is substantial. For major staple crops such as rice, wheat, maize, potato, and soybean, studies estimate yield losses in the range of roughly 17% to 30%, depending on crop and region. In some analyses, overall pre-harvest losses due to pests (insects and others) can amount to about one-third of the potential yield worldwide. For smallholder and small-scale farmers, these losses are particularly critical. Because their resources, access to advanced technologies, and capacity for large-scale interventions are limited, pest outbreaks can severely erode food security and household income.

At the same time, small-scale farms often have structural advantages when it comes to resilience and ecological balance. Farms that maintain crop diversity — for example through mixed cropping, crop rotation, or intercropping — and preserve semi-natural habitat features like field margins or hedgerows tend to harbour beneficial insects (natural predators, parasitoids, pollinators). These beneficial organisms can help suppress pest populations naturally, reducing reliance on chemical controls.

Given this context, effectively identifying major crop-damaging insects and designing control strategies that are suitable for small-scale farms becomes essential. Rather than relying solely on high-input, high-chemical approaches — which are often unaffordable and environmentally harmful — there is a strong case for integrated, context-appropriate pest management. Such approaches may combine traditional practices, ecological principles, and careful monitoring, offering small-scale farmers a realistic path to protect their crops, sustain yields, and safeguard livelihoods.

Common Crop-Damaging Insects

Below is a summary of several major insect pests affecting crops (vegetables, cereals, pulses, root/tuber crops), their identifying characteristics, and the typical damage symptoms. This is not an exhaustive list, but it covers some of the most common and economically important pests encountered in small-scale agriculture.

Insect Pest / Pest Group	Type of Damage / Crop Stage Affected	Identification / Notes
Sap-sucking insects (e.g. aphids, whiteflies, thrips, scale insects, mealybugs)	Leaf yellowing, curling, stunted growth; honeydew & sooty mould; sometimes vectoring viral diseases	Example: Aphids — small, soft-bodied insects; winged or wingless; feed by sucking sap. Thrips — tiny, slender insects, often hiding under the leaf surface.
Leaf-eating caterpillars/defoliators (e.g. cutworms, armyworms, leafrollers, caterpillars of moths/butterflies)	Chewed leaves, defoliation, reduced photosynthesis, crop weakening	Many lepidopterous larvae feed voraciously; small-scale farms may often detect only damage, not larvae.
Stem, shoot or root borers/borers (e.g. stem-fly larvae, shoot-fly, root borers)	Wilting, stem breakage, internal stem damage, poor nutrient/water transport, reduced yield or plant death	E.g. for pulses, stem-fly larvae bore into stems or petioles in early stages. For rice: root grub or stem borer damage at the root or base.
Earhead / grain pests (in cereals such as rice, sorghum, maize)	Damaged grains, shrivelled grain, reduced yield and grain quality	For example, in sorghum, earhead bugs and caterpillars feed on developing grains.
Storage/ post-harvest pests (e.g. grain-mites, weevils, tuber borers/ weevils)	Grain/tuber damage during storage: holes, tunnelling, spoilage, loss of viability	Grain mite (e.g. *Acarus siro*) attacks stored grains, feeding on the surface. For root/tuber crops like potato/sweet potato, tuber moths or weevils may cause damage in the field or storage.

Note: On small-scale farms, mixed cropping or crop rotation is common. This can increase the diversity of pest species — including pests that may not be serious in monocultures and shift pest pressure dynamically over seasons.

Challenges for Pest Management in Small-Scale Farms

Small-scale farms often face constraints that make pest management difficult:

- ❖ Limited access to commercial pesticides or specialized equipment (e.g., pheromone traps, light traps).
- ❖ Risk of chemical misuse (wrong dosage, timing), which may harm beneficial insects, soil health, or produce unsafe consumption.
- ❖ Lack of detailed pest-monitoring systems or expert support for diagnosis.
- ❖ Diverse cropping systems: multiple crops grown in a small area, crop rotation, mixed cropping, which may favour pest build-up or shifting pests.

As highlighted in reviews for small-scale farms in developed economies (though context differs globally), there is a lack of “scale-appropriate” IPM modules tailored to small farms. Thus, pest management strategies for small-scale farms need to be low-cost, low-input, integrated, and ecologically sensitive.

Integrated Pest Management (IPM) for Small-Scale Farms: Practical Strategies

The concept of Integrated Pest Management (IPM) offers a valuable framework combining cultural, biological, mechanical and chemical methods adapted to the small-farm context. Here is a practical outline and suggestions:

1. Cultural and Preventive Methods

- ❖ **Crop rotation and intercropping**: Rotating crops or intercropping with legumes/other crops can break pest life cycles and reduce pest pressure. For instance, in sorghum, intercropping with legumes reduces stem-borer damage.
- ❖ **Clean cultivation and field sanitation**: Removing crop residues, weeds, stubble and destroying infested plant parts reduces habitat for pests and pupae.
- ❖ **Synchronized planting / timely sowing**: Avoiding continuous or staggered planting avoids prolonged vulnerable stages, which favour pests. In pulses, early or synchronized sowing may help escape stem-fly attack.
- ❖ **Use of resistant/tolerant varieties when available**: Some crop varieties show tolerance to certain pests adoption may reduce pest impact and reliance on chemicals.

2. Mechanical / Physical Methods

- ❖ **Light traps or pheromone traps**: Useful for monitoring and reducing adult moths or other flying pests (e.g., in sorghum, earhead bugs, borers).

- **Hand-picking / manual removal of egg masses, larvae, and infested leaves**: Especially feasible in small plots with low infestation, and avoids chemical sprays.

3. Biological and Eco-friendly Methods

- **Conservation or release of natural enemies**: Predators (ladybugs, lacewings), parasitoids (parasitic wasps), entomopathogens (e.g., viruses, bacteria, nematodes) can suppress pest populations.
- **Microbial and botanical control agents**: Use of biocontrol agents like Bacillus thuringiensis (Bt) against lepidopteran larvae, or botanical extracts (e.g., neem-based, natural oils) where available and safe.

4. Judicious Use of Chemical Control

When pest pressure is high and other methods are insufficient with careful use:

- Use selective, low-toxicity insecticides rather than broad-spectrum ones.
- Apply at recommended dosages and timing; avoid overuse.
- Combine with other IPM methods to avoid resistance development or pest resurgence. For instance, for pulses: sowing seed treated/pelleted with insecticide may reduce early pest attack.

5. Monitoring, Early Detection & Decision-Making

Regular field monitoring (scouting), recognizing early signs of pest presence or damage, and acting promptly rather than reacting after damage becomes severe is essential. For small farms, simple record-keeping and visual inspection may suffice.

Recent advances are showing promise: for example, automated pest-identification systems based on computer vision and deep learning are being developed (e.g., for Pyralidae pests) which could, in future, bring affordable monitoring even for small farms.

Case Study: Success of Farmer-Friendly IPM for an Invasive Pest

A 2024 field-level study in India demonstrated the effectiveness of a four-component IPM module in controlling Spodoptera frugiperda (Fall Armyworm, FAW) in maize. Compared to conventional farmer practice (largely insecticide-based), the IPM approach significantly reduced egg mass and larval infestations, and resulted in yield increases of 8–15% over three years.

Implementation Guidelines for Small-Scale Farms

To translate the above into actionable practice, small-scale farmers and extension workers may consider the following guidelines:

1. **Survey & baseline:** At the beginning of each cropping season, survey the farm to record existing crops, rotation history, and known pests.
2. **Adopt cultural practices:** Rotate crops, intercrop, remove weeds/ residues, and maintain sanitation.
3. **Monitor regularly:** Walk the fields weekly (or more often, depending on crop), look for early signs: leaf damage, pests on undersides of leaves, egg masses, larvae, wilting or stunted plants.
4. **Promote biodiversity:** Encourage beneficial insects to maintain hedges, flowering plants, and avoid indiscriminate pesticide use.
5. **Use mechanical/biological control first:** Hand-picking, biocontrol agents, botanical sprays where possible.
6. **Use chemicals carefully and selectively:** If needed, target pests specifically, following recommended dosages; avoid repeated blanket spraying.
7. **Record & adapt:** Maintain simple records of pest presence, damage levels, control methods used, and results — adjust strategies over seasons.
8. **Seek community cooperation:** For pests affecting multiple farms (e.g., migratory pests), coordinated action helps; also, pooling resources for traps or biocontrol agents may reduce cost.

Discussion & Opportunities

- **Sustainability and environment:** IPM and reduced reliance on synthetic pesticides protect soil health, beneficial organisms, and reduce environmental contamination — crucial for long-term productivity of small farms.
- **Economics:** As shown by the FAW-maize study, IPM can increase yield and farmer profitability compared to conventional pesticide-heavy practices.
- **Scalability and adaptation:** While many IPM recommendations and textbooks originate from large-scale or commercial agriculture, the principles — cultural, biological, and mechanical controls — scale well to small farms. However, more research and extension work are needed to develop

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context-specific IPM modules (for small farms, resource-constrained settings, mixed cropping).

- **Technology adoption:** Emerging tools — e.g., computer-vision pest detection, low-cost traps, simple pheromone/ light traps — may soon become accessible to smallholder farmers, improving monitoring and early detection.
- **Policy & extension support:** Government agencies, NGOs, and agricultural extension services can play a big role by distributing information on IPM, providing training for farmers, and facilitating access to biological control agents or improved resistant varieties.

CONCLUSION

Insect pests remain a key constraint for small-scale farms worldwide. However, by combining accurate identification, proactive monitoring, and a suite of integrated pest-management strategies emphasizing cultural, biological, and mechanical controls, small farms can effectively minimize crop damage while preserving environmental health and farm profitability. The success of recent farmer-friendly IPM modules against invasive pests, such as Fall Armyworm, demonstrates that sustainable pest management is not only possible but also economically beneficial for smallholders. To maximize impact, efforts should focus on developing scale-appropriate IPM modules, improving farmer awareness and capacity, and promoting affordable technologies, thereby ensuring that small-scale farms continue to contribute meaningfully to food security, livelihoods, and ecological sustainability.

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