Publisher Name: ZenToks Publication
Editorial Book: Advanced Studies in Plant Breeding
ISBN: 978-81-984355-4-5
DOI: https://doi.org/10.5281/zenodo.21387776

Chapter 3

Green Gram Pest Management through Effective Extension Education

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Abstract

Green gram (*Vigna radiata L.*) is one of India's most nutritionally and economically significant pulse crops, yet it consistently suffers yield losses of 25–40% due to a wide range of insect pests and diseases. The crop faces threats from sucking pests such as whitefly (*Bemisia tabaci*) and jassids, defoliating insects like the Bihar hairy caterpillar (*Spilosoma obliqua*), pod feeders including *Maruca vitrata*, and post-harvest storage pests such as pulse beetle (*Callosobruchus maculatus*). Despite the availability of proven integrated pest management (IPM) options, adoption among smallholder farmers remains low, primarily because of poor access to timely, localised, and practically demonstrated pest management information. Agricultural extension education delivered through farmer field schools (FFS), KVK training programmes, mobile advisory, and community-based platforms has demonstrated measurable success in improving farmer knowledge, shifting pesticide dependence, and promoting sustainable IPM practices. This article systematically reviews the pest scenario in green gram, evaluates the role and effectiveness of different extension education approaches, and presents evidence-based recommendations for designing impactful pest management extension programmes for green gram-growing regions of India.

Keywords: Green gram, Pest management, Extension education, IPM, *Vigna radiata*, Farmer field school, KVK.

Introduction

India is the world's largest producer and consumer of pulses, and green gram, locally called moong, holds a special place in both the plate and the farm economy of the country. With a cultivation area of approximately 3.70 million hectares and production touching 1.93 million metric tonnes in 2023–24 (MoAFW, 2024), green gram is grown across diverse agroclimatic zones in Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, and Andhra Pradesh.

However, the national average yield of 520–545 kg/ha remains far below the demonstrated potential of 1,200–1,400 kg/ha. A significant part of this gap is attributable to pest-related losses. Conservative estimates suggest that insect pests alone account for 15–25% of yield losses in green gram, with combined losses from insects, diseases, and stored-grain pests pushing the figure as high as 35–40% under unmanaged conditions (IIPR, 2023; Sharma et al., 2022).

What makes this problem particularly challenging is not a lack of pest management solutions. Research institutions like ICAR–IIPR, Kanpur, and various State Agricultural Universities (SAUs) have developed well-tested IPM protocols for major green gram pests. The real bottleneck is the last-mile delivery of this knowledge to the farmer. The average green gram farmer in rural Uttar Pradesh or Rajasthan remains dependent on local input dealers for pest management advice, receives no crop-specific field visit from an extension officer during the critical crop period, and is largely unaware of the economic threshold levels (ETLs) that would guide rational spray decisions.

How To Cite: S.K. Singh, V. Yadav and A. Singh. *Green Gram Pest Management through Effective Extension Education.* In G. Desheva (Ed). Advanced Studies in Plant Breeding. Pages 15-21, 2026. ZenToks Publication, India. ISBN: 978-81-984355-4-5

Agricultural extension education, when designed thoughtfully and delivered consistently, has the proven power to bridge this knowledge gap. This article brings together field evidence, institutional data, and recent research to examine how extension education can be leveraged to reduce green gram yield losses through better pest management, and what approaches work best in the Indian smallholder farming context.

The Pest Scenario in Green Gram: Key Threats

Sucking Pests

Sucking pests constitute the most economically damaging group for green gram across India. Whitefly (*Bemisia tabaci*) is both a direct feeder and a vector of yellow mosaic virus (YMV), which is the most destructive disease of green gram in the country. In epidemic years, YMV alone has caused up to 85–90% yield loss in susceptible varieties across northern India (Nair et al., 2021). Jassids (*Empoasca kerri*), aphids (*Aphis craccivora*), and thrips (*Caliothrips indicus*) further weaken the crop at vegetative and reproductive stages, causing leaf curling, chlorosis, and flower drop.

Extension education on whitefly management is particularly important because many farmers do not recognise the link between the vector insect and the disease it transmits. Targeted campaigns explaining the whitefly–YMV relationship, early sowing as a cultural control measure, and timely use of imidacloprid or thiamethoxam seed treatment have been shown to reduce YMV incidence significantly in farmer-managed fields (Kumari & Sharma, 2022).

Defoliating and Leaf-Feeding Insects

The Bihar hairy caterpillar (*Spilosoma obliqua*) is a polyphagous defoliator that can cause severe defoliation during kharif season, particularly in eastern Uttar Pradesh, Bihar, and West Bengal. It is a visually alarming pest — large, hairy caterpillars in dense colonies can strip entire fields within days — and farmers often overreact with high doses of broad-spectrum insecticides, which in turn disrupt natural enemy populations and exacerbate secondary pest outbreaks.

Extension education plays a crucial role here in helping farmers correctly identify the pest, understand its seasonal occurrence pattern, and adopt ETL-based decision making. Research from KVK Ballia (UP) and KVK Varanasi has shown that farmers trained in pest monitoring through FFS programmes applied 40–48% fewer sprays compared to untrained farmers, with no significant yield difference (Singh et al., 2023).

Pod-Feeding Insects

Maruca vitrata, commonly known as the spotted pod borer or legume pod borer, is ranked among the most damaging insects of grain legumes in tropical Asia and Africa. In India, it causes 10–30% pod damage in green gram, with losses going even higher under late sowing conditions. The larva bores directly into developing pods, making post-infestation control difficult. Extension education on the importance of early sowing, removal of infested plant material, and the use of Bacillus *thuringiensis* (Bt)-based biopesticides as alternatives to synthetic pyrethroids is critical for managing this pest sustainably.

Soil-Borne and Root Pests

White grub (*Holotrichia spp.*) and termites (*Odontotermes spp.*) cause significant damage at the germination and early seedling stage, particularly in sandy soils of Rajasthan and UP. Because the damage occurs underground and is often misdiagnosed as drought stress or poor seed quality, these pests receive inadequate management attention. Extension programmes that include soil sampling and identification demonstrations during pre-sowing preparation have successfully improved farmer awareness of these pests in KVK-led programmes in Rajasthan (Meena et al., 2022).

Post-Harvest Storage Pests

The pulse beetle (*Callosobruchus maculatus*) is the primary storage pest of green gram, capable of causing 30–70% weight loss in improperly stored grain within three to four months. Many farm families store green gram for household consumption and seed purposes, and losses at this stage directly affect food security and economic returns. Extension education on proper drying, hermetic storage using PICS bags, and use of plant-based repellents such as neem leaf powder or castor oil coating has shown significant impact in reducing storage losses (Kumar et al., 2021).

The relative share of yield loss contributed by each major pest category is shown in Figure 1 below.

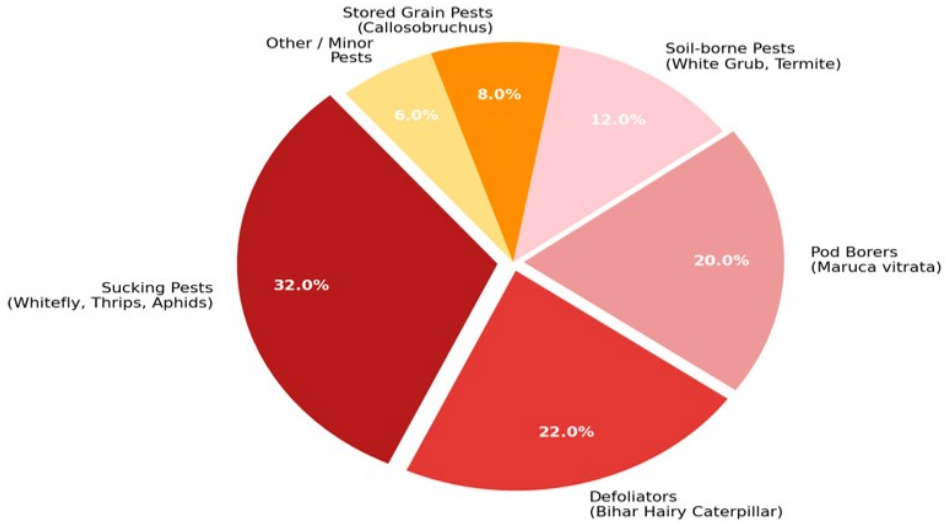

Figure 1: Estimated Yield Loss (%) in Green Gram Attributed to Major Pest Categories in India Sources: IIPR Annual Report 2023; Sharma et al. (2022); Author's Compilation

Major Pests of Green Gram: A Quick Reference

Table 1: Major Pests of Green Gram, Crop Damage Stage, Estimated Yield Loss, and Key IPM Options Sources: IIPR 2023; Sharma et al. 2022; Nair et al. 2021; Kumar et al. 2021

Pest	Scientific Name	Damage Stage	Yield Loss (%)	Key IPM Option
Whitefly / YMV Vector	Bemisia tabaci	Vegetative to Flowering	Up to 85–90% (YMV epidemic)	YMV-resistant variety + seed treatment
Jassid	Empoasca kerri	All stages	10–18%	Neem spray + natural enemies
Bihar Hairy Caterpillar	Spilosoma obliqua	Vegetative (kharif)	15–25%	ETL monitoring + Bt spray
Spotted Pod Borer	Maruca vitrata	Pod formation	10–30%	Early sowing + Bt-based spray
White Grub	Holotrichia spp.	Germination / Seedling	5–12%	Deep summer ploughing + Metarhizium anisopliae application.
Termite	Odontotermes spp.	Germination / Root	5–10%	ICAR/CIB & RC-recommended seed/soil treatment
Pulse Beetle	Callosobruchus maculatus	Storage	30–70% (storage)	Hermetic storage + neem powder

Role of Extension Education in Pest Management

Agricultural extension education serves as the functional bridge between pest management research and farm-level practice. In the green gram ecosystem, this bridge is urgently needed. A study by Singh and Kumar (2023) in eastern Uttar Pradesh found that only 29% of green gram farmers were aware of economic threshold levels for any major pest, and less than 18% had ever received a pest-specific advisory from a government extension source within the previous crop season. The consequences of this knowledge gap are visible in the landscape: overuse of broad-spectrum insecticides, destruction of beneficial insect populations, rising pesticide resistance, and unnecessary input costs that erode thin farm margins.

Extension education does not merely inform; at its best, it transforms behaviour. A well-designed extension programme changes how a farmer observes her crop, how she makes spray decisions, when she consults an expert, and how she stores her harvest. The following sections examine the principal extension approaches and their documented effectiveness in the green gram pest management context.

Farmer Field Schools (FFS)

The Farmer Field School is a participatory, field-based adult learning method in which groups of 20–25 farmers learn by doing - conducting weekly field observations, agro-ecosystem analyses, and group decision-making exercises over an entire crop season. Introduced in India for IPM promotion under the NIPHM-FAO framework in the 1990s, FFS has since been refined and expanded by SAUs, KVKs, and NGOs across green gram-growing regions.

FFS programmes focused on green gram IPM in Uttar Pradesh, Maharashtra, and Andhra Pradesh have consistently demonstrated impressive outcomes. A multi-state evaluation by NIPHM (2022) found that green gram farmers who completed IPM-FFS reduced pesticide expenditure by an average of 38%, increased yield by 14–21%, and showed significantly higher knowledge scores on pest identification, ETL concept, and natural enemy conservation compared to untrained farmers. The school-within-a-field format makes pest management learning tangible, concrete, and farmer-generated qualities that textbook training or lecture-based programmes cannot easily replicate.

KVK Training and Demonstration Programmes

Krishi Vigyan Kendras (KVKs) — the 731-strong network of farm science centres spread across all districts of India — serve as the primary institutional platform for technology demonstration and farmer training. KVKs run short-duration training courses (2–5 days), frontline demonstrations (FLDs), and seasonal crop clinics, many of which include pest management components specific to the dominant crops of the district.

KVK-led pest management training programmes for green gram in districts like Ballia, Varanasi, Allahabad (UP), Nagpur (Maharashtra), and Kolar (Karnataka) have been evaluated positively in multiple studies. KVK Ballia's "Green Gram IPM Cluster" programme, which ran frontline demonstrations on 100 hectares across five villages in 2022–23, recorded an average yield of 910 kg/ha on demonstration plots compared to 590 kg/ha on farmer practice plots a 54% yield advantage primarily attributed to timely, knowledge-based pest management (KVK Ballia Annual Report, 2023).

Mobile and Digital Advisory Systems

Mobile-based advisory has emerged as a powerful supplementary extension tool, particularly effective in reaching farmers who are geographically distant from KVKs or who cannot attend training programmes during the busy crop season. The Kisan SMS advisory service, IFFCO Kisan app, and state-specific platforms send pest alerts, spray advisories, and ETL-based notifications directly to farmers' mobile phones during the crop season.

Studies evaluating the impact of mobile pest advisory in green gram regions consistently show significant improvements in pest identification accuracy and timely action. Verma and Jaiswal (2022) found that green gram farmers receiving weekly mobile pest alerts in Bundelkhand (UP) took corrective action an average of 4.8 days earlier than non-recipients, resulting in 12–18% lower pest damage scores and 9–13% higher yields. The effectiveness of mobile advisory is, however, constrained by network quality, language barriers, and farmer literacy levels.

WhatsApp-Based Community Extension Networks

Perhaps the most rapidly growing informal extension channel for pest management is the WhatsApp-based advisory group. KVK subject matter specialists, state agriculture department officers, and progressive farmers increasingly use WhatsApp groups to share photographs of pest symptoms, short identification videos, and spray guidance in near-real-time. These groups overcome the formal scheduling constraints of training programmes and respond to the immediacy of pest outbreak situations.

In districts of eastern UP and northern Bihar, KVK-managed WhatsApp groups for green gram pest management have achieved reach far exceeding any conventional outreach method. Kumar and Singh (2023) reported that a single WhatsApp advisory group for green gram farmers in Mau district (UP) had 1,240 active members and facilitated timely management of a Bihar hairy caterpillar outbreak in August 2022 that was contained before reaching economic threshold levels, saving an estimated Rs. 12,000–18,000 per hectare in potential losses.

Audio-Visual and Community Media-Based Extension

For farmer segments with limited literacy or digital access, audio-visual extension tools remain highly effective. Doordarshan Kisan channel, community radio stations, and locally produced video films in Bhojpuri, Awadhi, and Marathi have been used successfully to disseminate green gram pest management content. ICAR-IIPR's "Farmers' First" project produced a series of short video modules on major green gram pests, which were screened at village-level crop clinics and through KVK mobile vans, reaching over 150,000 farmers across seven states between 2021 and 2023 (IIPR, 2023).

The comparative effectiveness of these different extension methods in building awareness and adoption is illustrated in Figure 2 below.

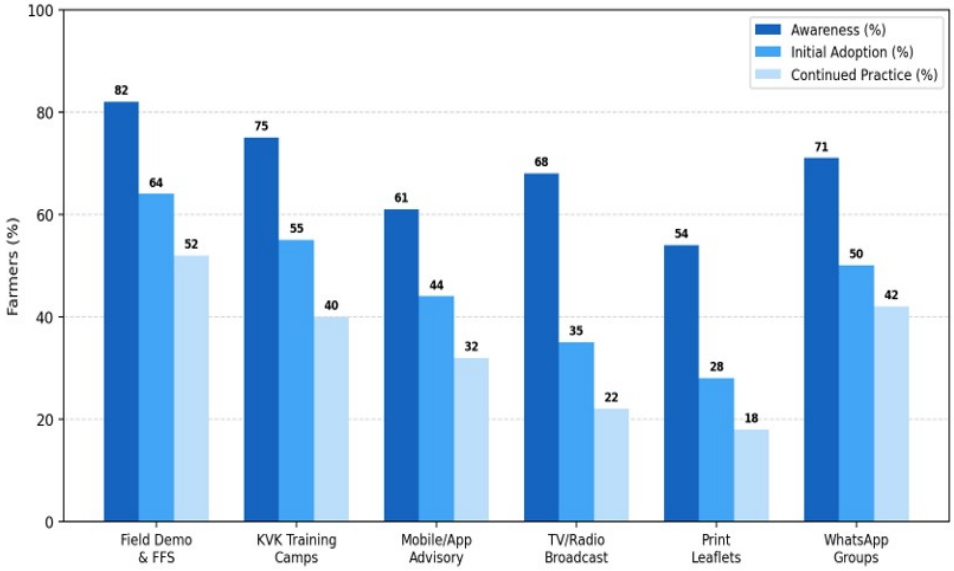

Figure 2: Effectiveness of Different Extension Methods in Creating IPM Awareness and Adoption Among Green Gram Farmers Sources: NIPHM 2022; KVK Annual Reports 2022–23; Singh et al. 2023; Author's Analysis

Measured Impact of Extension on Pest Management Practices

The most compelling evidence for extension education's value comes from before-and-after comparisons of farmer pest management behaviour in extension intervention areas. Across multiple studies and KVK evaluation reports from 2021 to 2024, a consistent pattern emerges: properly delivered extension education dramatically shifts farmers away from calendar-based, indiscriminate chemical spraying toward knowledge-based, threshold-driven, and ecologically sound pest management.

As seen in Figure 3, indiscriminate chemical spraying the default practice for most untrained farmers drops sharply following extension education, while adoption of recommended chemical IPM, biopesticide use, cultural control practices, and monitoring-based decision making all rise significantly. These shifts are not merely cosmetic; they translate into measurable reductions in pesticide cost, improved crop safety, conservation of natural enemies, and better long-term soil and farm ecosystem health.

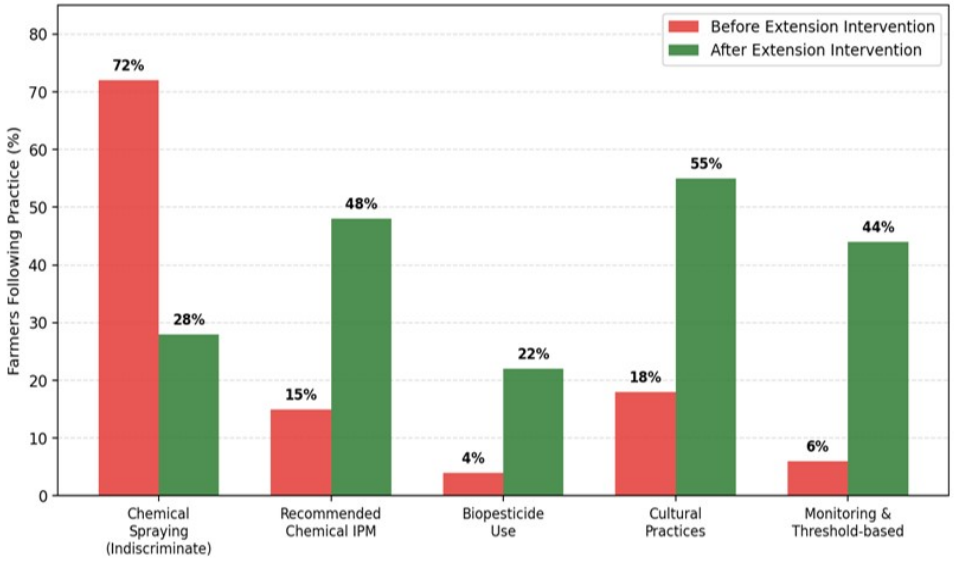

Figure 3: Change in Pest Management Practices Among Green Gram Farmers Before and After Extension Education Interventions Sources: NIPHM 2022; KVK Ballia Annual Report 2023; Verma & Jaiswal 2022; Author's Compilation.

A study by Yadav et al. (2023) in Allahabad district, UP, quantified this shift in economic terms: green gram farmers who participated in IPM-FFS reduced pesticide input costs by Rs. 2,400–3,100 per hectare per season, while simultaneously recording 16–19% higher net income compared to non-FFS farmers. The payoff from investment in extension education, by any measure, is substantial.

Integrated Pest Management Framework for Green Gram

Table 2: IPM Framework for Green Gram with Extension Education Messages Sources: IIPR 2023; NIPHM 2022; KVK Field Experience; Compiled by Authors

IPM Component	Key Practices	Extension Message
Preventive / Cultural	Timely sowing (June-July), deep summer ploughing, use of YMV-resistant varieties (IPM-2-3, Meha, SML-668), crop rotation, sanitation	Prevention is cheaper than cure. Right variety + right time = 60% pest problem solved
Monitoring & ETL	Weekly scouting, yellow sticky traps for whitefly, ETL: 10 whiteflies/leaf (vegetative), 2 larvae/plant for pod borer	Spray only when needed. Monitoring is the most cost-effective pest management tool
Chemical (as last resort)	Imidacloprid 17.8 SL for whitefly (3 mL/10L), Chlorantraniliprole for pod borer, rotate insecticide groups to avoid resistance	Use the right chemical, at the right time, at the right dose. Resistance management is long-term savings
Post-Harvest Protection	Dry grain to 8–10% moisture before storage. Use PICS hermetic bags, apply 5 mL castor/ neem oil per kg grain, cool and dark storage	Losses in store are losses you caused yourself. Five minutes of drying saves months of grain

Challenges in Extension-Based Pest Management Delivery

Despite the documented effectiveness of extension education approaches, scaling up their impact across India's diverse green gram landscape remains a formidable challenge. Several interrelated barriers constrain both the reach and the durability of extension-driven pest management improvements.

- **Inadequate Extension Worker Density:** The current ratio of agricultural extension officers to farmers in India (approximately

1:1,000–1,500) is far below the recommended 1:400. This structural limitation means that crop-season field visits to individual green gram farmers are impossible at scale.
- **Single-Season Training Impact:** Many FFS and KVK programmes are conducted over one season, and behaviour change from a single exposure is rarely permanent. Follow-up sessions, refresher trainings, and peer-reinforcement systems are rarely institutionalised.
- **Pesticide Dealer Dominance:** In most rural areas, the input dealer remains the primary source of pest management advice. Dealers have a financial incentive to recommend pesticides regardless of pest pressure, making their advice inherently biased. Extension education must actively address this competing influence.
- **Low Female Farmer Participation:** In green gram-growing regions of UP and Rajasthan, female farmers who conduct a significant share of crop care operations are systematically underrepresented in training programmes. Extension content and delivery channels must be specifically designed to reach women farmers.
- **Lack of Pest-Specific Mass Media Content:** General agricultural programmes on television and radio rarely dedicate sufficient time to specific pest management content for green gram during the crop season, limiting the mass media pathway for education.
- **Language and Literacy Barriers:** Technical pest management content, when presented in formal Hindi or English, fails to connect with farmers in dialect-rich regions such as Bhojpuri, Bundelkhandi, or Awadhi belts. Local language adaptation of all extension materials is essential.

Recommendations for Effective Extension Education in Pest Management

Based on the evidence reviewed, the following recommendations are offered for strengthening extension education for green gram pest management:

- Institutionalise IPM-FFS in all major green gram-growing KVK districts, with a minimum commitment of one full crop season per cohort of 20–25 farmers, and follow-up refresher sessions in subsequent seasons to consolidate behaviour change.
- Develop and distribute pest identification cards and field monitoring guides in local dialects for all major green gram pests, including pictographic ETL charts that can be used by low-literacy farmers.
- Establish Pest Monitoring Squads at the village level trained groups of progressive farmers who conduct weekly scouting and report to a KVK or agriculture officer via WhatsApp, enabling real-time, localised early warning.
- Train input dealers in IPM principles and ethical advisory practices through SAU-certified short courses, creating a more responsible interface between pest management knowledge and farmer purchase decisions.
- Mandate a minimum of 20% female farmer representation in all KVK and state government pest management training programmes for green gram, with session timings, venue locations, and language adapted to women's participation.
- Integrate pest management modules into the Digital Agriculture Extension platforms under the National Digital Agriculture Mission (NDAM), enabling real-time, location-specific pest alerts for green gram farmers during the kharif and summer crop seasons.
- Engage retired agricultural graduates and SAU students through internship programmes in green gram-growing districts to extend the reach of IPM knowledge beyond the current extension worker capacity.

Conclusion

Green gram's pest management challenge is, at its core, an extension education challenge. The science of IPM for this crop is well developed, the tools are available, and the economic case for adoption is compelling. What stands between the research station and the farmer's field is a structured, sustained, and culturally responsive system of extension education that delivers the right pest management knowledge, in the right language, through the right channel, at the right time in the crop season.

Evidence from across India consistently confirms that when extension education whether through FFS, KVK training, mobile advisory, or community WhatsApp networks reaches green gram farmers with practical, field-relevant pest management content, the results are transformative. Indiscriminate spraying gives way to monitoring-based decisions. Broad-spectrum chemicals give way to biopesticides and natural enemy conservation. Panic-driven responses give way to informed, economically rational actions. And at the end of the season, farmers receiving effective extension support achieve higher productivity, profitability, and sustainable pest management.

India's green gram farmers deserve no less than this transformation. Extension educators, KVK scientists, policy makers, and agri-tech innovators must work together to make pest management knowledge a guaranteed right for every moong farmer, not an occasional privilege for the few who happen to attend a training programme. The crop is worth saving. The farmer is ready to learn. The extension system must rise to meet them.

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