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The Georgian Model of Integrated Pest Management Against Halyomorpha halys as a Regional Response to a Global Agricultural Threat

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Abstract

The Brown marmorated stink bug, *Halyomorpha halys*, has been a significant invasive pest in Georgia since 2016, severely affecting hazelnuts, fruits, and vegetables. To mitigate this threat, a regionally adapted Integrated Pest Management (IPM) model was designed and implemented in the most affected western regions. This study evaluates the effectiveness of the IPM strategy, which combined pheromone-based monitoring using MDT-baited traps, targeted insecticide applications, biological control trials with *Trissolcus grandis*, and extensive public outreach. Between 2017 and 2024, over 60,000 pheromone traps were deployed annually, enabling real-time, data-driven interventions and minimizing unnecessary pesticide use. The results revealed a marked reduction in *H. halys* populations and a significant decrease in crop losses. The coordinated IPM approach proved effective and scalable, providing a replicable model for managing invasive agricultural pests in similar agroecological contexts.

Keywords: *Halyomorpha halys*, Integrated Pest Management, *Trissolcus grandis*.

Introduction

Halyomorpha halys (Hemiptera: Pentatomidae), the Brown marmorated stink bug, is an invasive pest species native to East Asia that has rapidly spread across Europe and North America [1]. Its wide host range and high reproductive capacity have caused substantial damage to many important crops worldwide, including fruits, vegetables, and hazelnuts [6]. In Georgia, *H. halys* was first recorded in 2016 and quickly established populations, especially in the western regions known for hazelnut cultivation [2, 8].

The arrival of this pest represented a serious challenge for Georgian agriculture, threatening both crop yields and the economic stability of farming communities. Recognizing the urgency of the problem, the Georgian government, with technical and financial support from international organizations such as United States Department of Agriculture (USDA), United States Agency for International Development (USAID), Ferrero, and the European Plant Protection Organization (EPPO), initiated a comprehensive management strategy [9, 8, 3, 2]. This strategy focused on developing an Integrated Pest Management (IPM) model adapted to local ecological and agricultural conditions.

The Georgian IPM model combines pheromone-based pest monitoring [1], targeted insecticide applications, biological control agent evaluations [5] and public outreach efforts. This multi-faceted approach aims to reduce the economic impact of *H. halys* while promoting environmentally sustainable control measures. The model's design and implementation reflect a commitment to scientific research, stakeholder collaboration, and practical pest management solutions suitable for the country's diverse agro ecosystems [4, 7].

Main Part

MATERIALS AND METHOD

This study was carried out from 2017 to 2024 in six western Georgian municipalities Zugdidi, Ozurgeti, Lanchkhuti, Senaki, Abasha, and Tsalenjikha selected based on historical infestation data, agro-climatic conditions, and their significance in hazelnut and fruit production. These areas consistently reported the highest levels of crop loss due to *Halyomorpha halys*. The methodology was informed by data from Georgia's National Monitoring Program, field observations, [2] and publicly available documentation from the National Food Agency of Georgia [7].

Each year, approximately 7,000 pheromone traps were deployed across affected regions. The traps were baited with methyl decatrienoate (MDT), the aggregation pheromone specific to *H. halys* [3] and placed in orchards, gardens, and adjacent natural vegetation. Monitoring data were recorded using a mobile application developed for the NFA's national IPM program.

Insecticide applications were conducted by trained mobile teams. Registered insecticides mainly Synthetic pyrethroids were applied site-specifically and time-bound based on infestation data and weather conditions. All application events were logged and reviewed by the NFA.

Laboratory and field trials were conducted to evaluate the egg parasitoid *Trissolcus grandis* as a biological control agent. The parasitoid was found in Samegrelo-Zemo Svaneti region, reared under quarantine at the laboratory. Field releases were carried out in sentinel egg plots in Zugdidi and Senaki. Parasitoid emergence was assessed under stereomicroscopy using taxonomic keys [5, 9].

Public involvement included workshops, hotline support, and mobile-based reporting tools. Community reporting significantly enhanced the spatial resolution of pest distribution maps.

Crop damage assessments were performed by comparing managed and unmanaged control plots and through interviews and surveys among hazelnut producers [4].

All data trap counts, insecticide treatment logs, parasitism rates, field observations, and stakeholder feedback were compiled into a central NFA database. Statistical analyses were used to assess effectiveness and guide future model revisions.

RESULTS

The implementation of the Integrated Pest Management (IPM) model in the six target municipalities of western Georgia led to substantial improvements in monitoring efficiency, pest population control, and crop protection outcomes between 2017 and 2024. The following results reflect data collected from pheromone trap surveillance, chemical intervention records, biological control trials, and grower feedback [4, 5, 7].

Pheromone Trap Data and Monitoring Expansion: The national monitoring program recorded a consistent decline in *Halyomorpha halys* adult captures per trap over the study period, despite an increase in the total number of traps deployed. This suggests improved area-wide suppression of pest populations as a result of targeted interventions.

Table 1. DEPLOYMENT OF PHEROMONE TRAPS BY YEAR

Year	No. of traps installed	Monitoring period	No. of municipalities covered
2017	7,000	Apr–Oct	34
2018	7,000	Apr–Oct	38
2019	7,000	Apr–Oct	42
2020–2024	7,000 + each year	Apr–Oct	62

Average weekly trap catches dropped from 80–100 adults per trap in 2017 to 15–30 by 2024. This reduction coincided with enhanced accuracy in chemical application and increased effectiveness of community-based interventions.

Table 2. CHEMICAL APPLICATION EFFICIENCY INDICATORS

Indicator	2017	2024
Average treatments per hectare	2	2
Treated area (hectares)	120	80
Farmer-reported efficacy (%)	45–50	85–90

Impact of Chemical Interventions: Chemical control became more precise and reduced in frequency as trap data enabled localization of treatments. Mobile teams treated only confirmed hotspots, reducing broad-spectrum spraying.

Biological Control: Field trials demonstrated a rising trend in parasitism rates by *Trissolcus grandis*. The parasitoid, reared in a dedicated facility, was released in sentinel plots for field exposure.

Table 3. PARASITISM RATE OF TRISSOLCUS GRANDIS (2021-2023)

Year	Location	No. of egg masses exposed	Mean parasitism rate (%)
2021	Zugdidi	70	12.4
2022	Senaki	50	18.6
2023	Zugdidi/Senaki	45	25.3

Crop Protection and Yield Outcomes: Hazelnut and vegetable producers reported noticeable reductions in crop damage and improvements in yield quality. Independent yield surveys and grower interviews confirmed these observations.

Table 4. IMPACT OFIPM ON CROP LOSS AND SATISFACTION

Parameter	Before IPM (2016)	After IPM (2024)
Average crop loss (%)	25–40	5–10
Grower satisfaction (scale 1–5)	2	4.5
Estimated export loss (€/year)	>30 million	<8 million

These findings affirm that Georgia's regional IPM model achieved effective pest population control, improved farmer confidence, and contributed to agricultural recovery in heavily affected regions. The integration of localized data collection, biological control, and community reporting proved essential to its success.

DISCUSSION AND CONCLUSIONS

The Georgian IPM model against *Halyomorpha halys* demonstrated that coordinated, data-driven approaches can significantly reduce pest populations and agricultural losses in highly vulnerable areas. Combining pheromone monitoring, targeted chemical treatments, biological control, and citizen engagement proved to be a highly efficient strategy. The consistent decline in trap catches and crop damage, as well as the improved satisfaction of growers, indicates that integrated efforts can achieve sustainable pest suppression.

The release of *Trissolcus grandis* in controlled laboratory settings, marked a key milestone in the biological control component of the programme. While field trials showed increasing parasitism rates, long-term monitoring is required to assess its establishment and broader ecological impact.

Limitations of the study include environmental variability across regions, uneven community participation, and the need for continuous funding and institutional support. In comparison to strategies implemented in Italy and the U.S. [9]. Georgia's model proved uniquely successful due to its strong interagency coordination and real-time response capacity.

Future directions should focus on expanding the biological control component, improving early detection systems through mobile technology, and integrating the IPM model into broader agricultural policy frameworks. Regional cooperation and continued alignment with international standards (FAO, EPPO) will enhance both national preparedness and knowledge transfer opportunities [2, 4].

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აზიური ფაროსანას წინააღმდეგ მავნე ორგანიზმების ინტეგრირებული მართვის ქართული მოდელი, როგორც რეგიონული რეაგირება გლობალურ სასოფლო-სამეურნეო საფრთხეზე

ნიკოლოზ მესხი, მირანდა წეროძე

რეფერატი

აზიური ფაროსანა (*Halyomorpha halys*) საქართველოში ერთ-ერთ ყველაზე დამაზიანებელ ინვაზიურ მავნებელს წარმოადგენს (2016 წლიდან), რომელიც სერიოზულ ზიანს აყენებს სასოფლო-სამეურნეო კულტურებს, თხილს, თესლოვან და კურკოვან ხეხილს, სიმინდს და სხვ. ამ საფრთხის შესამცირებლად დასავლეთ საქართველოს ყველაზე დაზარალებულ რეგიონებში შემუშავდა და განხორციელდა რეგიონულ პირობებზე მორგებული მავნე ორგანიზმების ინტეგრირებული მართვის (IPM) მოდელი. წარმოდგენილი კვლევა აფასებს IPM სტრატეგიის ეფექტიანობას, რომელიც მოიცავდა ფერომონიანი დამჭერებით მავნებლის მონიტორინგს, ეფექტური ინსექტიციდებით მიზნობრივ დამუშავებას, ბიოლოგიური კონტროლის საველე ექსპერიმენტებს *Trissolcus grandis*-ის გამოყენებით და მოსახლეობის ცნობიერების ამაღლებას მათი ჩართულობის მიზნით. 2017–2024 წლებში, მონიტორინგისათვის ყოველწლიურად გამოიყენება 7000-ზე მეტი ფერომონიანი დამჭერი, რაც უზრუნველყოფდა რეალურ დროში მონაცემებზე დაფუძნებულ ღონისძიებების გატარებას და ამცირებდა ქიმიური პრეპარატების არამიზნობრივ გამოყენებას. მიღებულმა შედეგებმა ცხადყო *H. halys*-ის პოპულაციის მკვეთრი შემცირება და მოსავლის დანაკარგების მნიშვნელოვანი კლება. კოორდინირებულმა IPM მიდგომამ დაამტკიცა თავისი ეფექტიანობა და მასშტაბურობა, რაც შესაძლებელს ხდის ინვაზიური მავნებლების მართვისთვის მსგავსი აგროწარმოებითი პირობების ფარგლებში გამოყენებულ იქნას სხვა რეგიონებშიც.

საკვანძო სიტყვები: *Halyomorpha halys,* მავნე ორგანიზმების ინტეგრირებული მართვა.