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Comparative Analysis of Tea Pest Entomofauna and Infestation Dynamics in the Black Sea Basin of Georgia and Turkey

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Abstract

This study presents a comparative analysis of arthropod pests affecting tea (*Camellia sinensis* (L.) Kuntze) in the Eastern Black Sea basin, specifically in Georgia (Khelvachauri-Kobuleti) and Turkey (Artvin-Rize). Field surveys conducted during the 2024-2025 growing seasons involved systematic sampling across ten representative tea estates. A total of 16 arthropod species were identified. Species richness was higher in Georgia (16 species) than in Turkey (10 species), likely due to microclimatic conditions and agricultural management. Six key species *Helopeltis theivora*, *Homona coffearia*, *Empoasca onukii*, *Polyphagotarsonemus latus*, *Parametriotes theae*, and *Pulvinaria floccifera* were identified as having major phyto-sanitary significance, directly affecting the vegetative development and quality of the tea flushes. This research provides a scientific baseline for transboundary Integrated Pest Management (IPM) in the region.

Keywords: Camellia sinensis (L.) Kuntze, Arthropod pests, Georgia, Turkey, Black Sea region.

Introduction

Tea (*Camellia sinensis (L.) Kuntze*) remains the second most consumed beverage globally, surpassed only by water [1]. Currently, tea is cultivated in over 30 countries, with Georgia and Turkey maintaining a significant presence in the Black Sea basin. In regions such as Rize-Artvin (Turkey) and Khelvachauri-Kobuleti (Georgia), tea cultivation has been historically defined by unique ecological and geographical parameters. Turkey, in particular, stands as a major contributor to the global tea market [2].

Unlike tropical tea-growing zones, the Black Sea plantations experience distinct climatic conditions that regulate pest population dynamics. Traditionally, cold winters served as a natural check on arthropod populations; however, rising mean temperatures and the accidental introduction of invasive polyphagous species are increasingly disrupting this ecological equilibrium. These environmental shifts underscore the urgent need for a precise understanding of local entomofauna to monitor and mitigate crop damage effectively.

The production of high-quality tea is constrained by various biological factors. Arthropod pests, including insects and mites, are primary limiting agents capable of reducing yields by 5% to 55% [3, 4]. Beyond yield loss, infestations alter the chemical profile of tea flushes, affecting secondary metabolites such as polyphenols and amino acids, which are critical to the sensory characteristics of the final product. This study aims to identify and compare the arthropod entomofauna in Georgia and Turkey, providing a taxonomic baseline to support regional Integrated Pest Management (IPM) focused on crop health and leaf integrity.

Main Part

Materials and methods - The study was conducted during the 2024 and 2025 growing seasons in experimental plots located within the tea-growing regions of Georgia (Khelvachauri and Kobuleti) and Turkey (Rize and Artvin). Initially, an extensive literature review was performed to compile a comprehensive list of arthropod species previously recorded in the Eastern Black Sea basin. To verify the presence of these species and identify emerging pests, systematic field surveys were carried out at regular intervals across ten representative tea estates.

Surveys were conducted at weekly intervals from April to October. In each estate, 20 × 20 m blocks were established in two replications for random sampling. Leaves, shoots, and branches were systematically inspected for pest-induced damage following a standardized diagnostic framework. The recorded symptoms included: Curled

or deformed leaves, Necrotic stripes or dark brown spots, Discoloration and chlorosis, Leaf perforation (holes), Leaves or buds folded or tied with silk, Desiccated (dried) foliage, Presence of frass or sawdust on the ground beneath the plants.

Collected samples were examined under a stereomicroscope and preserved in 70% ethanol for further taxonomic identification. Mite and thrips samples were prepared following the protocols of Ben-Dov and Hodgson [5]. Taxonomic identification was performed using specialized dichotomous keys and reference sources, including Cobanoglu [6], Gill [7], and Kawai [8]. All observations were documented to determine pest presence, relative abundance, and damage intensity, thereby providing a robust quantitative and qualitative baseline for the regional tea entomofauna.

Results and discussion

Identifying pests in tea plantations is often challenging, as many species are cryptic or not easily detected. Consequently, their presence is frequently inferred from specific diagnostic symptoms and infestation patterns. A comparison with preliminary data from 2015-2016 [9] shows that the total number of identified arthropod species remains consistent at 16. However, the present study reveals significant changes in population dynamics and infestation intensity. While taxonomic richness has remained stable, the biological pressure on tea plantations has increased, with certain species demonstrating higher dominance and population densities. The growing prevalence of sap-sucking pests suggests a potential ecological shift, likely associated with ongoing climate warming trends in the Black Sea basin.

Field observations revealed a diverse range of infestation symptoms, including: Curled or deformed leaves, Necrotic stripes and dark brown spots, Evidence of chlorosis and leaf perforations, Silk-bound leaves or buds (indicative of leaf rollers), Sooty mold development and desiccated foliage, Frass or sawdust on the ground, further confirming wood-boring or canopy activity.

Based on their feeding habits, tea pests are broadly classified into leaf feeders, stem borers, and root feeders; however, this study focused exclusively on leaf feeders, as they represent the most immediate threat to the quality of the harvestable flushes.

A total of 16 arthropod species were identified across the studied tea cultivation zones. Species richness was higher in Georgia (16 species) compared to Turkey (10 species). This variation may be attributed to the increased humidity levels and more heterogeneous agroecosystems found in the Georgian tea-growing regions. Furthermore, differences in pest pressure likely reflect variations in pesticide application regimes and the age structure of the plantations (Table 1). The identified taxa represent a diverse range of families, including single species from Agonoxenidae, Cicadellidae, Coccidae, Diaspidiae, Eriophyidae, Miridae, Noctuidae, Scarabaeidae, Tarsonemidae, Tetranychidae, Thripidae and Tortricidae.

Table 1. Recorded pests of tea in research areas.

N	Family	Species	Georgia	Turkey
1	Agonoxenidae	*Parametriotes theae* Kusnetzov	+	+
2	Cicadellidae	*Empoasca onukii* (Matsuda)	+	+
3	Coccidae	*Coccus hesperidum* Linnaeus	+	+
4	Coccidae	*Coccus pseudomagnoliarum* (Kuwana)	+	-
5	Coccidae	*Pulvinaria floccifera* Westwood	+	+
6	Diaspididae	*Abgrallaspis cyanophylli* (Signoret)	+	-
7	Diaspididae	*Aonidiella citrina* (Coquillett)	+	+
8	Eriophyidae	*Acaphylla theae* (Watt & Mann)	+	-
9	Eriophyidae	*Calacarus carinatus* (Green)	+	-
10	Miridae	*Helopeltis theivora* (Waterhouse)	+	+
11	Noctuidae	*Agrotis segetum* (Denis & Schiffermüller)	+	+
12	Scarabaeidae	*Polyphylla fullo* (Linnaeus)	+	+
13	Tarsonemidae	*Polyphagotarsonemus latus* (Banks)	+	+
14	Tetranychidae	*Oligonychus coffeae* (Nietner)	+	-
15	Thripidae	*Thrips spp.*	+	+
16	Tortricidae	*Homona coffearia* (Nietner)	+	-

While 16 arthropod species were identified, six are recognized as having significant phytosanitary importance due to their impact on plant vigor and leaf quality: *Helopeltis theivora, Homona coffearia, Empoasca onukii, Polyphagotarsonemus latus, Parametriotes theae,* and *Pulvinaria floccifera* (Figure 1).

Small sucking insects and mites are primarily found on the undersides of leaves or within developing buds. Their feeding activity results in curling, discoloration, and eventual desiccation of the foliage. Mites, in particular, concentrate near the central vein, sucking sap and causing the leaves to wither or fall prematurely.

Helopeltis theivora (Tea Mosquito Bug): Targets young shoots, leaving dark necrotic stains. Population peaks between July and November. By sucking sap from the buds, it leaves circular dark brown or black necrotic stains. Severe infestations can cause bushes to cease shoot formation entirely, halting flushing for weeks. Its population peaks between July and November, coinciding with the primary flushing season.

Empoasca onukii (Tea Green Leafhopper): Causes yellow spotting or “purpling” of leaves. It prefers shaded environments and feeds on the underside of leaves. In addition to sap extraction, feeding damage disrupts nutrient transport within plant tissues. This species is highly multivoltine and may produce up to ten generations per year.

Pulvinaria floccifera (Cottony Camellia Scale): This species infests leaves, bark, and fruit. While often associated with ornamental plants, it represents a persistent threat to tea foliage in the Black Sea basin.

Aonidiella citrina (Yellow Scale): Primarily attacking leaves and fruit, heavy infestations lead to leaf drop and apical twig dieback, rendering the affected plant parts unmarketable.

Homona coffearia (Tea Tortrix): While many caterpillars in this family are minor pests, the leaf-rolling behavior of H. coffearia can cause notable localized damage to the tea canopy.

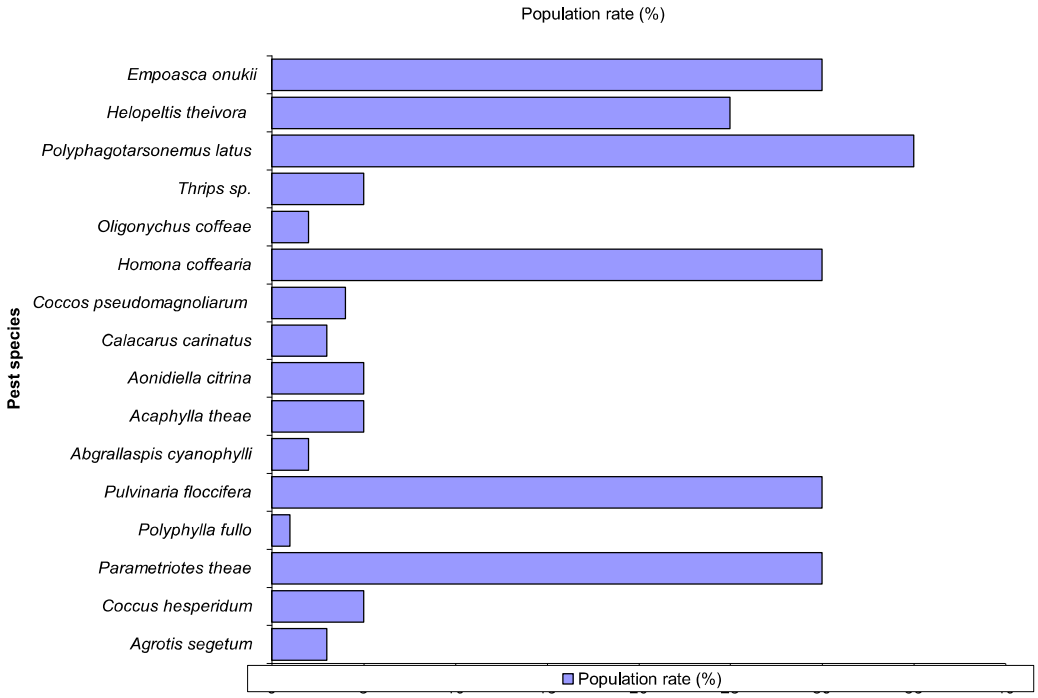


Figure 1. Population ratio of tea pests

Polyphagotarsonemus latus (Yellow Mite/Broad Mite): This species is a significant pest at lower elevations during the summer months. By piercing plant cells and extracting sap, it disrupts photosynthesis and the plant's water balance. Damage is most evident on young buds and terminal leaves, which become cupped, distorted, and thickened. Feeding injury often manifests as corky brown areas between the main veins on the underside of the leaf, and foliage may take on a characteristic rust-colored, stunted appearance.

Parametriotes theae (Tea Moth): A major pest in both the Georgian and Turkish tea-growing zones. The larvae and pupae develop within the leaf epidermis and shoots, creating galleries (mines) as they feed. This internal feeding strategy protects the pest while directly compromising the vascular integrity of the young flushes.

Conclusion

The comparative analysis of tea entomofauna in the Eastern Black Sea regions of Georgia and Turkey reveals a diverse arthropod complex, with species richness notably higher in Georgian tea plantations (16 species) than in Turkish ones (10 species). This difference is likely attributable to local microclimatic conditions and variations in agricultural management practices.

Among the identified species, *Helopeltis theivora, Homona coffearia, Empoasca onukii, Polyphagotarsonemus latus, Parametriotes theae,* and *Pulvinaria floccifera* represent the most significant threats to tea productivity and leaf quality. This study provides a critical diagnostic baseline for the development of transboundary Integrated Pest Management (IPM) strategies. Future research and management should prioritize optimized agro-technical practices and enhanced biological control to ensure long-term sustainability of the Black Sea tea industry.

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ჩაის მავნებელი ენტომოფაუნის შედარებითი ანალიზი და გავრცელების დინამიკა საქართველოსა და თურქეთის შავი ზღვის აუზში

მირანდა წეროძე, თემელ გოკთურქი

რეფერატი

ნაშრომში წარმოდგენილია აღმოსავლეთ შავი ზღვის აუზში, კერძოდ საქართველოში (ხელვაჩაური-ქობულეთი) და თურქეთში (ართვინი-რიზე), ჩაის (*Camellia sinensis* (L.) Kuntze) მავნებლების გავრცელების შედარებითი ანალიზი. 2024-2025 წლების სავეგეტაციო პერიოდის განმავლობაში ჩატარებული საველე სამუშაოები მოიცავდა სისტემატურ კვლევას ათ სადემონსტრაციო ნაკვეთზე. გამოვლინდა 16 ართროპოდი სახეობა. სახეობრივი მრავალფეროვნების მაღალი მაჩვენებელი თურქეთთან შედარებით (10 სახეობა) დაფიქსირდა საქართველოში (16 სახეობა), რაც სავარაუდოდ განპირობებულია ადგილობრივი მიკროკლიმატური პირობებითა და აგროტექნიკურ ღონისძიებებს შორის სხვაობით.

გამოიყო ექვსი ძირითადი ფიტოსანიტარული მნიშვნელობის სახეობა *Helopeltis theivora*, *Homona coffearia*, *Empoasca onukii*, *Polyphagotarsonemus latus*, *Parametriotes theae* და *Pulvinaria floccifera*, რომლებიც პირდაპირ გავლენას ახდენენ მცენარის ვეგეტატიურ განვითარებასა და ჩაის ფოთლის ხარისხზე. მიღებული შედეგები წარმოადგენს სამეცნიერო საფუძველს ტრანსსასაზღვრო ზონაში მცენარეთა ინტეგრირებული დაცვის (IPM) სტრატეგიების შემუშავებასა და დანერგვისთვის.

საკვანძო სიტყვები: *Camellia sinensis* (L.) Kuntze, მავნებლები, საქართველო, თურქეთი, შავი ზღვის რეგიონი.