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AGRICOOP

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Cooperation through Tech-Based Practices to Struggle Invasive Species and Climate Change for a Sustainable and Resilient Agriculture

AGRICULTURAL PRODUCT COTALOGUING STUDY

PP3-BSU GEORGIA

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AGRICOOP PROJECT
PP3 GEORGIA
WP1 – Activity A1.1
AGRICULTURAL PRODUCTS CATALOGUING STUDY

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Programme	Interreg NEXT Black Sea Basin 2021–2027
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A1.1 Lead organisation	Batumi Shota Rustaveli State University (BSU)
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Executive Summary

This Agricultural Products Cataloguing Study presents the final Georgian output prepared by PP3—LEPL Batumi Shota Rustaveli State University under AGRICOOP Activity A1.1. It integrates documentary research, stakeholder consultation, multi-criteria prioritisation and seasonal field validation to catalogue five priority crops: citrus, hazelnut, blueberry, kiwifruit and maize. The assessment focuses on four selected invasive alien pests—Halyomorpha halys, Orosanga japonica, Aleurothrixus floccosus and Drosophila suzukii—and distinguishes direct field evidence from literature-based associations and risks requiring further validation. Between 2 April and 13 August 2026, 15 fieldwork missions generated 35 visits to agricultural plots across 21 locations in Kobuleti, Khelvachauri, Batumi and Keda municipalities. The resulting catalogue provides a traceable technical basis for pilot monitoring, farmer-oriented recommendations, early-warning arrangements and subsequent measures under Activity A1.2.

1. Introduction

Agriculture in the Autonomous Republic of Adjara is characterised by humid subtropical conditions, a high proportion of small and fragmented household farms, and the coexistence of perennial commercial crops with subsistence-oriented production. These systems are increasingly exposed to interacting climatic pressures and invasive alien species (IAS), which may affect crop development, yield stability, product quality, marketability and farm income. A structured catalogue of priority agricultural products is therefore required to connect crop importance with verified pest occurrence, susceptible phenological stages and practical monitoring needs.

1.1. Relevance and Significance of the Study

The catalogue translates the evidence generated under Activity A1.1 into a concise technical instrument for subsequent AGRICOOP activities. Its significance lies in establishing a transparent link between five agriculturally important crops, four priority invasive pests, the geographical distribution of field observations and the monitoring requirements of the project's pilot zones. It supports harmonised reporting, GIS-oriented data organisation, farmer communication, early-warning design and the development of mechanical, biotechnical and integrated pest-management measures under Activity A1.2. The catalogue is not a statutory pest-risk assessment; it is an evidence-based project output designed to guide targeted validation and practical intervention.

1.2. Aim and Specific Objectives

The principal aim is to catalogue the agricultural products considered most relevant to the combined pressures of climate variability and invasive alien pests in the Georgian project area. The specific objectives are to: (i) document the agronomic and socio-economic relevance of each crop; (ii) identify the principal affected product and vulnerable phenological stages; (iii) establish crop associations with the four selected IAS; (iv) distinguish confirmed observations from literature-based or provisional risks; (v) define practical field-monitoring indicators; and (vi) clarify the relevance of each crop profile to the core pilot zones and subsequent project activities.

2. Selection and Cataloguing Methodology

2.1. Timing and Rationale for Crop Selection

Crop identification and prioritisation began during the desk-review and stakeholder-consultation stages of Activity A1.1 and was refined through seasonal field validation during Reporting Period 2. The final selection was confirmed after completion of the field programme conducted from 2 April to 13 August 2026. During this period, PP3 completed 15 fieldwork missions comprising 35 individual visits to agricultural plots across 21 monitoring locations in Kobuleti, Khelvachauri, Batumi and Keda

municipalities. Several plots were revisited at different dates and phenological stages, allowing seasonal changes in pest occurrence and crop condition to be assessed.

Five crops—citrus, hazelnut, blueberry, kiwifruit and maize—were selected because they collectively represent the strongest convergence of regional agricultural importance, smallholder or commercial value, climatic sensitivity, exposure to the selected IAS and suitability for repeated monitoring. Citrus and hazelnut are long-established pillars of western Georgian agriculture; blueberry and kiwifruit are high-value crops whose vulnerable fruit-development stages require targeted surveillance; and maize is widely cultivated in mixed smallholder systems and has documented host associations with Halyomorpha halys and Orosanga japonica. Its lower frequency in stakeholder responses reflects the consultation's emphasis on commercial perennial crops rather than limited agroecological importance.

2.2. Evidence Sources and Field Validation

The catalogue integrates four complementary evidence streams: a structured review of 37 scientific, institutional, policy and regulatory sources; anonymised stakeholder consultation records; expert interpretation; and georeferenced field observations. Documentary evidence was used to establish taxonomic identity, distribution, host associations and known damage mechanisms. Stakeholder information supported interpretation of perceived importance and locally applied practices but was not treated as a substitute for species-level diagnosis. Field validation included visual crop inspection, examination of damaged plant organs, identification of developmental stages, deployment and checking of pheromone and sticky traps, documentation of trap catches and symptoms, and consultation with farmers.

2.3. Multi-Criteria Prioritisation

The five crops were assessed using the harmonised AGRICOOP framework developed by BSU. Four equally weighted criteria were applied: agronomic importance, socio-economic importance, climate sensitivity and IAS exposure or impact. Each criterion was scored from 1 to 5 and supported by a concise evidence-based justification. The arithmetic mean of the four scores determined the overall priority class: High (4.00–5.00), Moderate (3.00–3.99) or Low (below 3.00). This scoring supported transparent comparison, while the subsequent catalogue provided the more detailed crop-level interpretation. Full methodological specifications are presented in the A1.1 National Report and are not repeated here.

2.4. Catalogue Construction and Evidence Quality

A standard profile was prepared for each selected crop, covering taxonomic identity, the principal agricultural product, regional importance, agroecological requirements, climate sensitivity, IAS associations, susceptible organs and phenological stages, damage pathways, monitoring indicators and pilot-zone relevance. Evidence was interpreted according to three levels: E1, direct national or local evidence; E2, reliable scientific or institutional evidence requiring limited geographical extrapolation; and E3, preliminary information requiring further confirmation. Where crop- or site-specific damage had not been quantified, the catalogue records a monitoring priority rather than presenting an unsupported loss estimate.

3. Evidence Base for Crop–IAS Cataloguing

The working inventory contained 31 evidence records relating to invasive alien species and other harmful organisms of potential relevance to agriculture. These records should not be interpreted as representing 31 distinct or independently confirmed IAS, as the raw inventory includes repeated observations, broader taxonomic categories, general pest groups, and organisms whose ecological or regulatory status requires further clarification.

Of the 31 records, nine were assigned to evidence level E1, representing direct national or local evidence; 14 were classified as E2, representing reliable scientific or institutional evidence involving limited geographical extrapolation; and eight were assigned to E3, indicating preliminary or otherwise credible information requiring additional confirmation.

Evidence level	Interpretation	Number of records	Share
E1	Direct national or local evidence	9	29.0%
E2	Reliable evidence requiring limited extrapolation	14	45.2%
E3	Preliminary evidence requiring further confirmation	8	25.8%
Total		**31**	**100%**

According to the taxonomic categories used in the working inventory, 28 records referred to insects or other arthropods, two to mites, and one to a plant pathogen. Following the exclusion of records representing higher taxonomic groups or general descriptive categories, 13 species-level names were retained prior to the final reconciliation of synonyms and duplicate records. The final national inventory will therefore distinguish clearly between confirmed IAS, regulated organisms, other agriculturally important pests or pathogens, and provisional risk records.



The documentary evidence was concentrated most strongly around subtropical perennial production systems. *Halyomorpha halys* emerged as the most consistently documented polyphagous IAS of direct agricultural relevance. Its occurrence and impacts have been reported for Batumi, Adjara, and other parts of western Georgia, with documented associations with hazelnut, citrus, kiwi, blueberry, and other fruit crops. The available evidence indicates damage to fruits and kernels, deterioration of commercial quality, and increased crop-protection costs (Dumbadze et al., 2019; Kereselidze et al., 2022).

Drosophila suzukii was identified as a priority emerging threat to blueberry and other soft-fruit production systems. Its occurrence in Georgia has been documented scientifically, providing a credible basis for its inclusion in the regional risk assessment (Japoshvili et al., 2018). Nevertheless, the available documentary evidence remains insufficient for determining its current distribution, seasonal abundance, or level of damage across individual blueberry-producing areas of Adjara. These aspects therefore require targeted field validation.

The citrus-related evidence was comparatively extensive and included recent phytosanitary monitoring undertaken in the Adjara–Guria region. The reviewed sources documented *Aleurocanthus spiniferus*, *Panonychus citri*, and *Phyllocnistis citrella* in citrus plantations, together with other economically relevant organisms such as *Coccus hesperidum* and *Phyllocoptruta oleivora*. Reported impacts included damage to young leaves and fruits, reduced photosynthetic capacity, weakening of vegetative growth, fruit russeting, the development of sooty mould, and deterioration of commercial fruit quality (Gabaidze et al., 2024).

Records concerning *Ricania japonica* and *Orosanga japonica* indicated the presence of a polyphagous planthopper associated with citrus, hazelnut, kiwi, grapevine, and vegetable crops. Before the final inventory is approved, these records require taxonomic reconciliation and the consistent application of the currently accepted scientific name and relevant synonymy.

The review also identified records relating to *Cydalima perspectalis*, *Hyphantria cunea*, *Corythucha ciliata*, and several additional arthropod groups. Although these organisms are relevant to the broader assessment of biological invasions in Adjara and western Georgia, some are associated predominantly with forests, ornamental vegetation, or semi-natural ecosystems. They were therefore not treated as primary determinants in the selection of the four priority agricultural crops.

Crop-specific findings

The strongest and most diverse documentary evidence concerned mandarin and other citrus production systems. The reviewed literature covered crop diseases, insect and mite pests, phytosanitary

monitoring, agroclimatic suitability, orchard management, and the effects of climatic conditions on fruit quality. Citrus production was also the crop category for which the clearest municipality-level evidence was available, particularly for Kobuleti, Khelvachauri, and Batumi.

For hazelnut, the desk review identified *Halyomorpha halys* as the principal documented IAS of economic significance. Its feeding activity is associated with kernel damage, deformation, deterioration of quality, and reduced marketability. Polyphagous planthoppers were identified as an additional potential pressure requiring more detailed local assessment.

For blueberry, the principal IAS-related concern was *Drosophila suzukii*. Blueberry represents a relatively recent but rapidly expanding high-value crop in Adjara and neighbouring production areas. Its soft fruits are particularly vulnerable during ripening and harvesting, while high temperature, irregular rainfall, and water stress may further influence crop phenology and susceptibility.


Visit to a blueberry plantation

For kiwi, the evidence base indicated potential exposure to *Halyomorpha halys* and polyphagous planthoppers. However, locally specific evidence concerning pest abundance, crop damage, and climate-related sensitivity was less extensive than that available for citrus or hazelnut. Kiwi therefore requires targeted field observations to strengthen the existing documentary assessment.

The desk-review findings provided the principal documentary basis for the subsequent multi-criteria prioritisation of crops. Within the common assessment framework, mandarin/citrus achieved the highest overall score of 5.00, followed by hazelnut with 4.50, blueberry with 4.00, and kiwi with 3.75.

Priority crop	Agronomic importance (A)	Socio-economic importance (B)	Climate sensitivity (C)	IAS exposure/impact (D)	Overall score	Prioritisation class
Mandarin/Citrus	5	5	5	5	5.00	High
Hazelnut	5	5	4	4	4.50	High
Blueberry	4	4	4	4	4.00	High
Kiwi	4	4	4	3	3.75	Moderate
Maize	3	4	4	4	3.75	Moderate

These scores represent analytical prioritisation within the project framework and should not be interpreted as formal phytosanitary risk classifications. They reflect the combined strength of available evidence concerning agronomic importance, socio-economic relevance, climatic sensitivity, and documented or credible exposure to IAS.

Climate-related findings

The climate-related literature confirmed the sensitivity of Adjara's subtropical agricultural systems to changes in temperature, precipitation, humidity, soil conditions, and the frequency of extreme events. These factors may affect crop phenology, flowering and fruit development, product quality, pathogen development, and the seasonal activity and geographical suitability of harmful organisms.

The reviewed material provided particularly relevant evidence concerning the agroclimatic requirements of mandarin production and the influence of climatic and soil conditions on citrus-fruit quality. National climate-policy documents also recognised agriculture as a climate-sensitive sector requiring adaptation measures.

Nevertheless, only four sources were classified as directly climate-related, and comparatively few studies evaluated climate, crop vulnerability, and IAS dynamics within a single analytical framework. The desk review therefore identified a significant knowledge gap concerning the quantitative relationships

between climatic variables, pest phenology, population development, and crop damage under the specific agroecological conditions of Adjara. The available evidence supports the plausibility of climate-related changes in IAS pressure but does not, on its own, permit statistical attribution of observed pest dynamics to climate change.

Institutional and regulatory findings

The review confirmed that Georgia has an established regulatory framework governing plant protection, phytosanitary control, border and quarantine procedures, pesticide and agrochemical use, product registration, labelling, storage, transportation, and sustainable application. The National Food Agency and the relevant state programmes constitute the principal institutional basis for phytosanitary surveillance and official response.

The regulatory architecture was comparatively well documented. However, the reviewed sources provided more limited evidence of a fully integrated operational mechanism for consolidating IAS observations, farmer notifications, scientific records, municipal information, and monitoring results within a single interoperable system. Similarly, evidence concerning routine interinstitutional data exchange and harmonised early-warning procedures remained fragmented. This finding reinforces the relevance of developing integrated digital monitoring, data-sharing, and early-warning approaches within the AGRICOOP project.

Evidence limitations and quality-assurance requirements

The desk review demonstrated that the quantity and quality of available evidence vary substantially among organisms, crops, and municipalities. Citrus-related evidence was relatively comprehensive, whereas the local evidence base for blueberry and kiwi was more limited. Several records originated from western Georgia more broadly and therefore require field-level confirmation before being interpreted as direct evidence of occurrence in a specific pilot zone.

The working IAS inventory also contains repeated records, taxonomic synonyms, higher-level taxonomic categories, and organisms that may be agriculturally important without necessarily satisfying the ecological or regulatory definition of an invasive alien species. Accordingly, the final consolidation of the inventory requires:

1. removal or merging of duplicate records;
2. verification of accepted scientific names and taxonomic synonymy;
3. explicit differentiation between confirmed IAS, regulated organisms, other pests and pathogens, and risk-only records;
4. retention of geographical qualifiers when evidence has been extrapolated from other parts of western Georgia; and
5. further field, laboratory, or institutional confirmation of E3-level records.

Overall conclusion: The desk review established a robust and traceable evidence base for the prioritisation and cataloguing of citrus, hazelnut, blueberry, kiwifruit and maize. These five crops show the strongest combined profile of agronomic and socio-economic importance, climate sensitivity, documented or credible exposure to invasive alien species, and relevance to field validation in the Georgian project area.

At the same time, the review revealed important differences in the spatial and taxonomic strength of the available evidence. The documentary findings should therefore be interpreted as a scientifically grounded basis for targeted validation rather than as a statistically representative assessment of IAS prevalence across Adjara. Their principal value lies in identifying priority crops, organisms, geographical areas, and evidence gaps requiring verification through stakeholder consultations and systematic field observations.



4. Stakeholder Consultation Results

The stakeholder workbook summarises multiple-response questions. Crop responses total 124 mentions and pest/species responses total 108 mentions. Percentages below are calculated against these mention totals. They are not respondent percentages. The final report must state the verified number of unique respondents and reconcile the 30 anonymised workbook records with the wider PP3 log of 43 consultations/interviews.

Crop	Mentions	Share of 124 mentions	Corrected rank
Citrus	34	27.4%	1
Hazelnut	29	23.4%	2
Blueberry	16	12.9%	3
Kiwi	15	12.1%	4
Vegetables	12	9.7%	5
Grape	7	5.6%	6=
Persimmon	7	5.6%	6=
Corn	2	1.6%	8
Walnut	1	0.8%	9=
Loquat	1	0.8%	9=

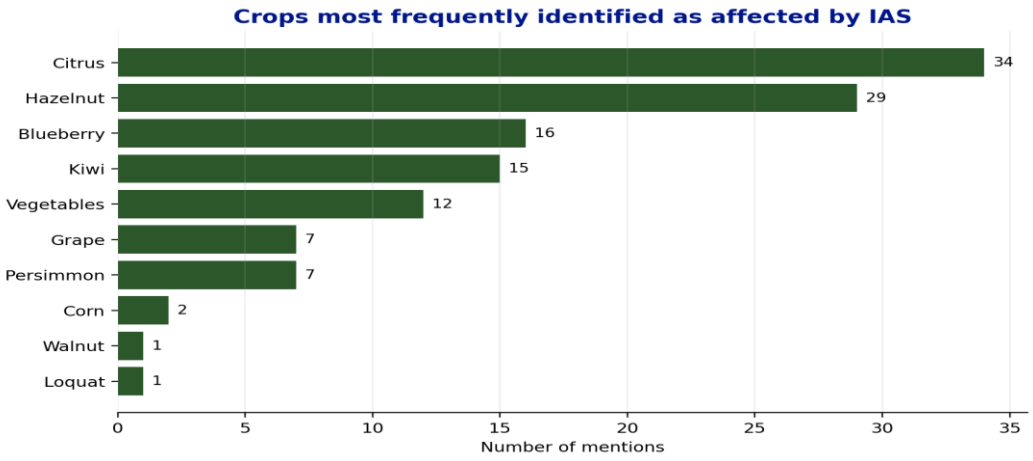


Figure 1. Stakeholder mentions of crops affected by IAS. Source: PP3 stakeholder-results workbook; multiple responses allowed.

4.1. Reported Pests and Invasive Species

Pest / species group	Mentions	Share of 108 mentions	Rank
Brown marmorated stink bug	31	28.7%	1
Aphids	16	14.8%	2
Bud mites	14	13.0%	3
Whiteflies	12	11.1%	4
Scale insects	12	11.1%	5
Leaf miners	6	5.6%	6
Lace bugs	5	4.6%	7
Drosophila suzukii	5	4.6%	8
Thrips	4	3.7%	9
Spider mites	3	2.8%	10

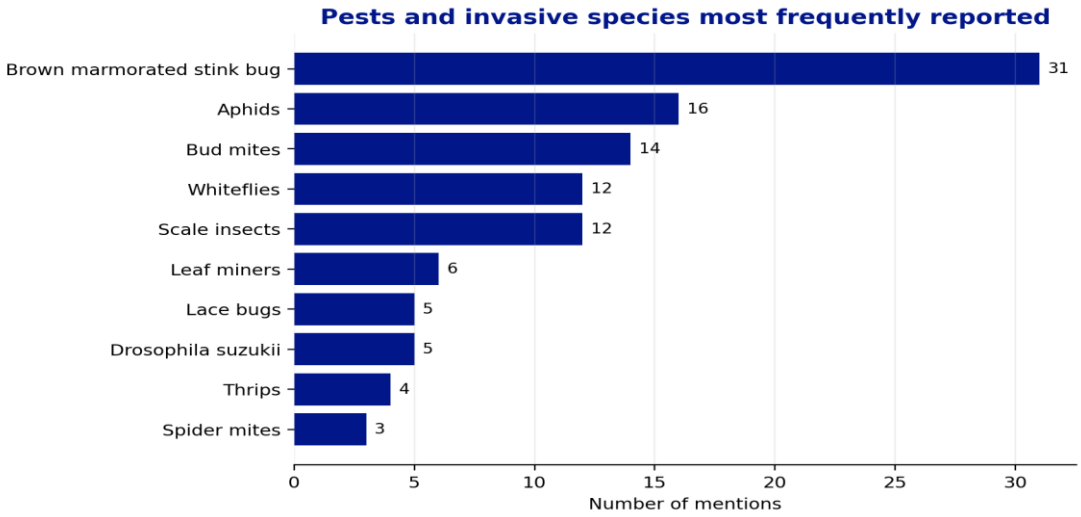


Figure 2. Stakeholder mentions of priority pests/species. Source: PP3 stakeholder-results workbook; multiple responses allowed.

4.2. Interpretation

Citrus and hazelnut clearly dominate the crop responses, jointly accounting for 50.8% of all crop mentions. Blueberry and kiwi occupy the next tier and justify continued monitoring as high-value crops. Brown marmorated stink bug is the most frequently cited pest/species, with 28.7% of all pest mentions. Aphids, bud mites, whiteflies and scale insects form a second group of recurrent pressures. The responses corroborate the desk-review prioritisation but should be interpreted as stakeholder-perceived importance rather than prevalence estimates.

5. Consolidated Selection Results

Integrated Evidence and Final Validation Outcomes

On the basis of the integrated evidence generated through the desk review, stakeholder consultations and completed field validation, three core pilot zones were confirmed, five priority agricultural crops were catalogued and four invasive alien pest species were selected for further assessment. The four priority IAS are Halyomorpha halys, Orosanga japonica, Aleurothrixus floccosus and Drosophila suzukii. Other harmful organisms recorded during monitoring are treated only as supplementary crop-health pressures and are not included in the selected priority group.

5.1. Final Multi-Criteria Crop Scoring and Prioritisation

The final crop prioritisation integrated evidence from 37 scientific, institutional and technical sources, anonymised stakeholder records and the completed field-validation programme. Between 2 April and 13 August 2026, PP3 carried out 15 fieldwork missions comprising 35 individual visits to agricultural plots across 21 monitoring locations in the Autonomous Republic of Adjara—Kobuleti, Khelvachauri, Batumi and Keda municipalities. Selected plots were revisited at different dates and phenological stages; consequently, the number of visits exceeds the number of locations.

Five crops were assessed and retained: (1) mandarin and other citrus crops; (2) hazelnut; (3) blueberry; (4) kiwifruit; and (5) maize.

The crops were evaluated using four equally weighted criteria: **A — Agronomic importance, B — Socio-economic importance, C — Climate sensitivity, D — IAS exposure or impact (**See Methodology Subsection 3.5).

5.2. Final Scoring Results

Priority crop	Agronomic importance (A)	Socio-economic importance (B)	Climate sensitivity (C)	IAS exposure/impact (D)	Overall score	Priority class
Mandarin/Citrus	5	5	5	5	**5.00**	**High**
Hazelnut	5	5	4	4	**4.50**	**High**
Blueberry	4	4	4	4	**4.00**	**High**
Kiwifruit	4	4	4	3	**3.75**	**Moderate**
Maize	3	4	4	4	3.75	Moderate

The final ranking identified mandarin/citrus as the highest-priority crop, with an overall score of 5.00. Hazelnut ranked second with 4.50, followed by blueberry with 4.00; all three were assigned to the high-priority category. Kiwifruit and maize each received an overall score of 3.75 and were classified as moderate priorities. Maize was retained because of its widespread role in mixed smallholder systems and its documented host associations with Halyomorpha halys and Orosanga japonica.

6. Catalogue of Priority Agricultural Products

6.1. Catalogue Scope and Evidence Base

Crop cataloguing was undertaken following completion of the multi-criteria prioritisation process and does not constitute an additional selection, scoring or ranking exercise. Its purpose is to provide standardised, scientifically substantiated and mutually comparable profiles of the five selected priority crops: mandarin/citrus, hazelnut, blueberry, maize and kiwifruit. The cataloguing procedure follows the methodology presented in Subsection 3.6.

The catalogue integrates evidence derived from the desk review, stakeholder consultations, targeted field validation and available spatial information. Each crop profile addresses taxonomic identity,

regional distribution, agronomic and socio-economic importance, agroecological requirements, climate sensitivity, associations with invasive alien species (IAS) and other crop-health organisms, vulnerable phenological stages, types of damage, monitoring indicators and relevance to the selected pilot zones.

The catalogue distinguishes confirmed occurrence from potential host association and surveillance relevance. The presence of a crop-health organism during fieldwork does not, by itself, establish its formal status as an invasive alien species. Biogeographic origin, establishment status, invasiveness, regulatory status and taxonomic identification are therefore treated as separate analytical variables.

6.1.1. Summary Catalogue of the Selected Crops

Catalogue code and crop	Principal affected product	Overall score and priority class	Principal priority IAS or IAS-related organisms	Relevant pilot zones
GE-CROP-01 — Mandarin/Citrus	Fresh citrus fruit	5.00 — High	Aleurothrixus floccosus and Halyomorpha halys	PZ-01, PZ-02 and PZ-03
GE-CROP-02 — Hazelnut	In-shell nuts and kernels	4.50 — High	*Halyomorpha halys*; *Orosanga japonica* as a surveillance-relevant organism	PZ-01 and PZ-03
GE-CROP-03 — Blueberry	Fresh berries	4.00 — High	*Drosophila suzukii*; supplementary surveillance for *Halyomorpha halys*	PZ-01 and PZ-02
GE-CROP-04 — Kiwifruit	Fresh fruit	3.75 — Moderate	*Halyomorpha halys*; *Orosanga japonica* as a surveillance-relevant organism	PZ-01 and PZ-02
GE-CROP-05 — Maize	Grain and green ears	3.75 — Moderate	Halyomorpha halys and Orosanga japonica	PZ-02 and PZ-03

6.2. GE-CROP-01 — Mandarin and Other Citrus Crops

Crop name: Mandarin/Citrus
Scientific name: *Citrus reticulata* Blanco; broader production category: *Citrus* spp.
Family: Rutaceae
Production type: Perennial fruit crop; citrus orchard
Principal affected product: Fresh citrus fruit and citrus fruit intended for primary processing
Prioritisation result: 5.00 — High priority

Regional and Socio-Economic Importance -Mandarin and other citrus crops constitute one of the principal components of the humid subtropical agricultural system of Adjara. Production is particularly important in Kobuleti and Khelvachauri municipalities and in agricultural and peri-urban areas surrounding Batumi. Citrus contributes substantially to farm income, seasonal employment, local markets and the regional agricultural value chain.Citrus was the most frequently reported crop in the stakeholder dataset, accounting for 34 of the 124 crop mentions, or 27.4% of all crop mentions.

Agroecological Requirements and Climate Sensitivity-Citrus production requires relatively mild winters, a long growing season, adequate moisture and well-drained soils. The principal climate-related stressors include:

- early or late frost events;
- prolonged or intense precipitation;
- excessive soil moisture and inadequate drainage;
- high temperatures and water deficit;
- strong winds and associated mechanical damage to fruit; and
- humidity regimes favourable to the development of harmful organisms and associated diseases.

The most vulnerable phenological stages include the development of new vegetative flush, flowering, fruit set, fruit enlargement and ripening.

Associated IAS and Evidence Status

Aleurothrixus floccosus — Occurrence is supported by scientific sources and direct AGRICOOP field documentation. Active populations were recorded in citrus plots in Kobuleti Municipality and in the BSU citrus collection. Evidence level: **E1**.



Aleurocanthus spiniferus — This citrus pest is supported by scientific and phytosanitary records from western Georgia and remains relevant as a supplementary monitoring target. It is not included among the four priority IAS selected for the present catalogue.

Halyomorpha halys — A confirmed polyphagous IAS in Adjara and western Georgia and a relevant surveillance target for citrus production. Any crop- and site-specific impact should nevertheless be documented independently.

Stakeholder references to "whitefly" corroborate the management relevance of the whitefly complex but do not provide independent species-level confirmation of either *A. spiniferus* or *A. floccosus*.

Other Relevant Crop-Health Organisms-Other harmful organisms recorded during field monitoring included: *Aleurocanthus woglumi*; *Toxoptera aurantii*; *Chrysomphalus dictyospermi*; *Lepidosaphes beckii*; and *Pulvinaria* spp. These organisms are relevant to the phytosanitary condition of citrus orchards. However, their occurrence must not automatically be interpreted as evidence of IAS status.

Damage Profile and Potential Consequences - Whiteflies, scale insects and aphids feed on plant sap, weaken young shoots and leaves, and may produce substantial quantities of honeydew. Honeydew accumulation promotes the development of sooty mould, which can reduce the effective photosynthetic surface of leaves and adversely affect the commercial appearance of fruit.

Potential consequences include: reduced plant vigour and productivity; deterioration in fruit quality and marketability; fruit deformation or premature fruit drop; and increased crop-protection and production costs.

Monitoring Indicators - Priority monitoring indicators include:

- regular inspection of the lower surfaces of young leaves;
- recording of whitefly eggs, nymphs, puparia and waxy secretions;
- documentation of honeydew deposits and sooty-mould development;
- use of yellow or other coloured sticky cards for monitoring flying insects;
- deployment of pheromone traps for *H. halys*; and
- systematic linkage of photographs, coordinates, trap records and field observations within the project database.

Relevance to the Pilot Zones

Citrus is represented in all three core pilot zones: Gelauri, the BSU experimental agricultural plot in Tamari settlement, and Kakhaberi. The Tamari site is particularly valuable for repeated comparative monitoring because it contains citrus and other subtropical fruit crops, ornamental plants, blueberry, open-field vegetables and greenhouse-grown vegetables. Green Cape is retained only as a supplementary low-intervention citrus comparison site.

6.3. GE-CROP-02 — Hazelnut

Crop name: Hazelnut
Scientific name: *Corylus avellana* L.
Family: Betulaceae

Production type: Perennial nut crop; orchard
Principal affected product: In-shell hazelnuts and kernels
Prioritisation result: 4.50 — High priority

Regional and Socio-Economic Importance - Hazelnut is an important agricultural crop in western Georgia and Adjara. Its production is closely associated with the income of small and medium-sized farms, local processing activities and domestic and export-oriented value chains. Hazelnut was the second most frequently reported crop in the stakeholder dataset, accounting for 29 of the 124 crop mentions, or 23.4%.

Climate Sensitivity and Vulnerable Phenological Stages - Hazelnut productivity may be affected by:

- winter and spring temperature fluctuations;
- late frost events;
- drought and prolonged periods of high temperature;
- irregular precipitation;
- excessive humidity; and
- mechanical damage caused by strong winds or heavy precipitation.

Particularly important phenological stages include bud development, flowering, fruit set, kernel filling and ripening.

Associated IAS and Evidence Status

Halyomorpha halys — The principal confirmed IAS associated with hazelnut. The species is established in western Georgia, and its occurrence in Adjara is supported by scientific and field evidence. Evidence level: **E1**.

Orosanga japonica — A polyphagous organism associated with hazelnut in scientific literature. Its crop-specific occurrence and impact in individual hazelnut orchards in Adjara require further field confirmation. Evidence level: **E2** for national or ecologically contiguous evidence; any unverified local record should remain **E3**.

Halyomorpha halys was the most frequently reported pest in the stakeholder dataset, accounting for 31 of the 108 pest mentions, or 28.7%. These are pest mentions and must not be interpreted as reports from 31 different respondents.

Other Relevant Crop-Health Organisms

Other important organisms recorded in hazelnut orchards included: *Phytoptus avellanae*, the hazelnut bud mite; and *Myzocallis coryli*, the hazelnut aphid.

Damage associated with *P. avellanae* was repeatedly recorded in hazelnut orchards in Kobuleti and Khelvachauri municipalities. At one orchard in Chakvi, potential production reduction was provisionally estimated at up to approximately 40%. This was a site-specific field estimate and should not be interpreted as a standardised measurement of yield loss or extrapolated to Adjara as a whole.

Damage Profile and Potential Consequences

- Feeding by *H. halys* may result in:
- arrested or incomplete nut development;
- empty or poorly developed kernels;
- kernel necrosis and deterioration in quality;
- premature fruit drop; and
- reduced marketability and export value.

Phytoptus avellanae causes enlarged, deformed and non-productive buds, thereby reducing the crop's subsequent fruiting potential. Its crop-health importance should be reported separately from the IAS status of *H. halys*.

Monitoring Indicators: Priority indicators include:

- pheromone-trap monitoring of *H. halys*;
- visual recording of eggs, nymphs and adults;
- inspection of overwintering shelters;
- examination of damaged nuts and kernels;
- recording of enlarged and deformed buds; and
- assignment of unique identification codes to trap records, photographs and collected specimens.

Relevance to the Pilot Zones: Hazelnut is particularly relevant to the Gelauri pilot zone, which includes farmer-managed and institutional plots. It is also relevant to the Kakhaberi urban–agricultural pilot zone, where high *H. halys* activity was recorded in a pheromone trap.

6.4. GE-CROP-03 — Blueberry

Crop name: Blueberry
Scientific name: Primarily *Vaccinium corymbosum* L. and cultivated hybrids
Family: Ericaceae
Production type: Perennial berry crop; plantation
Principal affected product: Fresh blueberries
Prioritisation result: 4.00 — High priority


Blueberries are one of the main agricultural crops in the region.

Regional and Socio-Economic Importance: Blueberry is a relatively recent but rapidly expanding high-value crop in Adjara and neighbouring production areas. It is increasingly important for commercial plantation agriculture, farm income and the production of high-quality fresh fruit. Blueberry accounted for 16 of the 124 stakeholder crop mentions, corresponding to 12.9% of the total.

Agroecological Requirements and Climate Sensitivity: Blueberry requires acidic, organic-matter-rich and well-drained soils, together with a stable water supply. The principal climate-related stressors include:

- high temperatures and solar injury;
- water deficit;
- excessive precipitation and inadequate drainage;
- high humidity during fruit ripening;
- physical damage to fruit caused by intense rainfall; and
- climate-related changes in ripening and harvesting periods.

The crop is particularly vulnerable during flowering, fruit set, colour development, ripening and harvesting.

Associated IAS and Evidence Status

Drosophila suzukii — The principal priority IAS associated with blueberry. The presence of the species is supported at the Adjara regional level and corresponds to evidence level **E1**.

Field monitoring confirmed the late-season occurrence of Drosophila suzukii in the surveyed blueberry plantation. Under the comparatively cool spring and summer conditions of 2026, the pest appeared close to the completion of harvest and did not cause substantial documented damage to the monitored crop during the reporting period. Its rapid reproductive capacity nevertheless justifies continued phenology-based surveillance.


Drosophila suzukii on Bluebbery

Halyomorpha halys — A confirmed polyphagous IAS for which supplementary surveillance in blueberry plantations is appropriate. Any site-specific crop impact requires independent documentation.

Drosophila suzukii accounted for five of the 108 stakeholder pest mentions, corresponding to 4.6%.

Damage Profile and Potential Consequences: Unlike most drosophilid flies associated with damaged or fermenting fruit, female *D. suzukii* can oviposit in ripening fruit that appears externally undamaged. Larval development may result in:

- softening and breakdown of fruit tissue;
- increased susceptibility to secondary microbial infection;
- reduced fruit quality and storage potential;
- loss of marketability; and
- increased costs associated with harvesting, sorting and monitoring.

Monitoring Indicators

- Priority monitoring activities include:
- deployment of baited or species-targeted traps;
- weekly inspection of traps during the fruit-ripening period;
- targeted sampling of ripe and overripe fruit;
- assessment of fruit softening, depressions, juice leakage and larval presence;
- documentation of crop phenology and harvesting dates; and
- comparison of monitoring results with temperature, humidity and precipitation data.

The absence of *D. suzukii* during early-season inspections must not be interpreted as evidence of absence, as the detectability and impact of the pest are strongly associated with fruit ripening and harvesting.

Relevance to the Pilot Zones: Blueberry is represented in the Gelauri and Tamari monitoring settings. These locations are particularly relevant for evaluating the seasonal dynamics of D. suzukii, its relationship with fruit phenology and the correspondence between pest occurrence and locally recorded climatic conditions.

6.5. GE-CROP-04 — Kiwifruit

Crop name: Kiwifruit
Scientific name: *Actinidia deliciosa* (A.Chev.) C.F.Liang & A.R.Ferguson
Family: Actinidiaceae
Production type: Perennial climbing fruit crop; plantation
Principal affected product: Fresh kiwifruit
Prioritisation result: 3.75 — Moderate priority

Regional and Socio-Economic Importance

Kiwifruit is a high-value fruit crop suited to the humid subtropical conditions of Adjara. It is cultivated in farmer-managed, institutional and collection plots. Kiwifruit accounted for 15 of the 124 stakeholder crop mentions, corresponding to 12.1% of the total.

Agroecological Requirements and Climate Sensitivity: Kiwifruit requires a relatively mild climate, an adequate and stable water supply, high but non-excessive humidity, well-drained soils and protection from strong winds. The principal climate-related stressors include:

- winter and spring frost;
- strong winds and associated damage to young shoots;
- high temperatures;
- water deficit;
- excessive precipitation and waterlogging of the root zone; and
- disruption of flowering and fruit-development processes.

The principal vulnerable stages are bud break, young-shoot development, flowering, fruit set, fruit enlargement and ripening.

Associated IAS and Evidence Status

Halyomorpha halys — A confirmed polyphagous IAS in Adjara with documented potential to affect kiwifruit shoots and fruit. Regional evidence corresponds to level **E1**, although crop- and site-specific associations must be documented separately.

Orosanga japonica — A polyphagous organism associated with kiwifruit in scientific literature. National and ecologically contiguous regional evidence is available, but crop-specific impact in individual kiwifruit plantations in Adjara requires further confirmation. Evidence level: **E2**; unverified local records should remain **E3**.

Damage Profile and Potential Consequences

- Potential effects of polyphagous sap-feeding organisms include:
- injury to young shoots and leaves;
- deformation of the fruit surface;
- deterioration in fruit quality and commercial appearance;
- disruption of plant growth and fruit development; and
- increased monitoring and management costs.

No mass occurrence of harmful organisms was recorded during the early-season inspections of the monitored kiwifruit plots. These observations relate only to the phenological stages inspected and do not confirm the absence of pests throughout the production season.

Monitoring Indicators. Priority indicators include:

- visual inspection of young shoots, leaves and fruit;
- use of pheromone traps for *H. halys*;
- use of coloured sticky cards for monitoring flying insects;
- documentation of feeding injury, deformation and possible oviposition marks;
- inspection of plantation margins and adjacent wild vegetation; and
- integration of pest observations with crop-phenology and microclimatic data.

Relevance to the Pilot Zones: Kiwifruit is represented in Gelauri and in the diversified BSU experimental agricultural plot in Tamari settlement. Monitoring should continue during shoot development, flowering, fruit development and ripening, when pest occurrence and crop-specific effects can be assessed most reliably.

6.6. GE-CROP-05 — Maize

Crop name: Maize
Scientific name: Zea mays L.
Family: Poaceae
Production type: Annual cereal crop; predominantly mixed smallholder and household production
Principal affected product: Grain and green ears
Prioritisation result: 3.75 — Moderate priority

Regional and Socio-Economic Importance

Maize is widely cultivated across western Georgia, including the humid subtropical and foothill production systems of Adjara. It is commonly grown in household gardens and small, fragmented plots, often below one hectare, and contributes to household food supply, livestock feeding and local market production. Its relatively low frequency in the stakeholder dataset reflects the consultation's stronger orientation towards commercial perennial crops rather than limited agroecological relevance. The crop was therefore retained as the fifth priority product on the basis of its broad distribution, smallholder importance and documented host associations with the selected invasive pests.

Agroecological Requirements and Climate Sensitivity

Maize requires adequate soil moisture and warmth during establishment and vegetative growth but is sensitive to prolonged waterlogging, drought and heat stress during flowering and grain filling. Irregular precipitation may impair germination, root development and nutrient uptake, while excessive humidity can favour secondary crop-health problems. The most vulnerable stages include seedling establishment, rapid vegetative growth, tasselling, silking, ear formation and grain filling.

Associated IAS and Evidence Status

Halyomorpha halys — Maize is documented among the principal Georgian hosts of this highly polyphagous IAS. Adults and nymphs may feed on developing ears and kernels. The species is established in Adjara and western Georgia and corresponds to evidence level E1, although plot-specific damage must be quantified independently.

Orosanga japonica — Maize is included among the documented host plants of this invasive polyphagous planthopper across the Caucasus–Black Sea region. Direct crop-specific loss has not yet been quantified in the Georgian project area; the association is therefore used to define a surveillance priority rather than a measured loss estimate.

Damage Profile and Potential Consequences

Potential damage includes sap removal from vegetative tissues, feeding injury to developing ears and kernels, impaired grain filling, contamination by honeydew and associated sooty mould, and reduced product quality. These mechanisms are biologically plausible and supported by the general feeding ecology of the selected organisms, but their magnitude in maize under local production conditions remains to be established through repeated field observations.

Monitoring Indicators and Pilot Relevance

Priority indicators include visual inspection of leaves, stems, tassels and ears; recording of egg masses, nymphs and adults of H. halys; inspection of crop margins and adjacent vegetation for O. japonica; documentation of feeding lesions and malformed or incompletely filled kernels; and georeferenced recording of crop phenology and pest abundance. Maize is particularly relevant to the Kakhaberi pilot zone and to diversified smallholder plots monitored across the project area. Supplementary observations may also be undertaken at the Tamari experimental site where host continuity and comparative trapping can be evaluated.

7. Integrated Cataloguing Outcome and Recommendations

The cataloguing process produced five standardised and mutually comparable crop profiles integrating agronomic and socio-economic importance, climate sensitivity, IAS exposure, other crop-health pressures, vulnerable phenological stages and monitoring requirements.

The results demonstrate crop-specific patterns of risk. Citrus supports the most diverse documented complex of harmful organisms, with Aleurothrixus floccosus and Halyomorpha halys constituting the principal selected IAS. Halyomorpha halys is the most consequential confirmed IAS for hazelnut, while Orosanga japonica remains relevant to surveillance of hazelnut, kiwifruit and maize. Drosophila suzukii is the principal priority IAS for blueberry and requires monitoring aligned with fruit ripening. Maize warrants systematic surveillance because it is widely cultivated in smallholder systems and can function as a host for both H. halys and O. japonica.

The catalogue should be maintained as a living and updateable evidence system. New field observations, trap results, diagnostically adequate photographs, validated species identifications and climate data should be incorporated while preserving traceability of the source, date, location and evidence level. The present catalogue provides the evidence base for farmer-oriented measures, pilot monitoring, early-warning arrangements and the testing of integrated management options under Activity A1.2.

References

Abbaszadeh, S., Karimi-Malati, A., & Jalali Sendi, J. (2021). Semi-field demographic performance of the invasive planthopper, Orosanga japonica (Hemiptera: Ricaniidae) on two host plants. Journal of Asia-Pacific Entomology, 24(3), 614–621. https://doi.org/10.1016/j.aspen.2021.05.007

Ak, K. (2026). Current status of the invasive species Orosanga japonica (Melichar, 1898) (Hemiptera: Ricaniidae) under natural enemy pressure in Türkiye. Egyptian Journal of Biological Pest Control, 36, Article 12. https://doi.org/10.1186/s41938-026-00892-5

Akıner, M. M., Öztürk, M., & Sevgili, H. (2022). Invasion history of Orosanga japonica in Türkiye, comparisons with other Ricaniidae using molecular tools and modelling. Turkish Journal of Entomology, 46(1), 99–114. https://doi.org/10.16970/entoted.1022151

Amiranashvili, A. G., Japaridze, N. D., Kartvelishvili, L. G., Khazaradze, K. R., & Revishvili, A. A. (2022). Changeability of the monthly mean values of air effective temperature on Missenard in Batumi in 1956–2015. Journal of the Georgian Geophysical Society, 25(2), 49–58. https://doi.org/10.48614/ggs2520225960

Amiranashvili, A. G., Kartvelishvili, L. G., Khakhutashvili, T. V., & Megrelidze, L. D. (2019). Changeability of the meteorological parameters associated with some simple thermal indices and tourism climate index in Adjara and Kakheti (Georgia). Journal of the Georgian Geophysical Society, 21(2), 77–94. https://ggs.openjournals.ge/index.php/GGS/article/view/2529

Asplen, M. K., Anfora, G., Biondi, A., Choi, D.-S., Chu, D., Daane, K. M., Gibert, P., Gutierrez, A. P., Hoelmer, K. A., Hutchison, W. D., Isaacs, R., Jiang, Z.-L., Kárpáti, Z., Kimura, M. T., Pascual, M., Philips, C. R., Plantamp, C., Ponti, L., Vétek, G., . . . Desneux, N. (2015). Invasion biology of spotted wing Drosophila (Drosophila suzukii): A global perspective and future priorities. Journal of Pest Science, 88(3), 469–494. https://doi.org/10.1007/s10340-015-0681-z

CABI. (2021). Aleurothrixus floccosus (woolly whitefly). CABI Compendium. https://doi.org/10.1079/cabicompendium.4538

Dumbadze, G., Gokturk, T., Jgenti, L., & Chelidze, N. (2019). Distribution, biology, ecology and control mechanisms of Halyomorpha halys Stål in Batumi (Georgia). SETSCI Conference Proceedings, 9, 539–542. https://doi.org/10.36287/setsci.4.6.152

European and Mediterranean Plant Protection Organization. (2017). First report of Halyomorpha halys in Georgia (EPPO Reporting Service No. 2017/077). https://gd.eppo.int/reporting/article-6045

European and Mediterranean Plant Protection Organization. (2019). First report of Drosophila suzukii in Georgia (EPPO Reporting Service No. 2019/133). https://gd.eppo.int/reporting/article-6563

European and Mediterranean Plant Protection Organization. (2024). Aleurocanthus spiniferus (ALECSN) [Datasheet]. EPPO Global Database. https://gd.eppo.int/taxon/ALECSN/datasheet

European and Mediterranean Plant Protection Organization. (2025). First report of Aleurocanthus woglumi and Aleurocanthus spiniferus in Georgia (EPPO Reporting Service No. 2025/002). https://gd.eppo.int/reporting/article-8013

Gabaidze, M., Mepharishvili, S., Khalvashi, N., Memarne, G., Gorgiladze, L., Turmanidze, M., & Vanishvili, L. (2024). Outcomes of phytosanitary monitoring in the citrus plantations of Adjara–Guria. Annals of Entomology, 42(1), 75–82. https://doi.org/10.59467/AE.2024.42.75

Giakoumaki, M.-V., Milonas, P., Antonatos, S., Evangelou, V., Partsinevelos, G., Papachristos, D., & Ramadan, M. M. (2023). A survey in Hawaii for parasitoids of citrus whiteflies (Hemiptera: Aleyrodidae), for introduction into Greece. Insects, 14(11), Article 858. https://doi.org/10.3390/insects14110858

Gokturk, T. (2024). Current status of Halyomorpha halys in Turkey. Georgian Scientists, 6(4), 518–528. https://doi.org/10.52340/gs.2024.06.04.47

Government of Georgia. (2009, April 14). Order No. 278 on addressing the Parliament of Georgia regarding the change of administrative boundaries between the self-governing city of Batumi and Khelvachauri Municipality. Legislative Herald of Georgia. https://matsne.gov.ge/ka/document/view/2226890

Hulme, P. E. (2017). Climate change and biological invasions: Evidence, expectations, and response options. Biological Reviews, 92(3), 1297–1313. https://doi.org/10.1111/brv.12282

IPPC Secretariat. (2018). ISPM 6: Surveillance. Food and Agriculture Organization of the United Nations. https://www.ippc.int/static/media/files/publication/en/2018/06/ISPM_06_2018_En_Surveillance_2018-05-20_PostCPM13_KmRiysX.pdf

IPPC Secretariat. (2021a). ISPM 8: Determination of pest status in an area. Food and Agriculture Organization of the United Nations. https://www.ippc.int/publications/determination-pest-status-area

IPPC Secretariat. (2021b). Scientific review of the impact of climate change on plant pests: A global challenge to prevent and mitigate plant-pest risks in agriculture, forestry and ecosystems. Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cb4769en

IPPC Secretariat. (2021c). Surveillance guide: A guide to understand the principal requirements of surveillance programmes for national plant protection organizations (2nd ed.). Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cb7139en

Ismaylova, G. (2021). New record of Orosanga japonica (Melichar, 1898) (Hemiptera: Fulgoromorpha: Ricaniidae) from Azerbaijan. Punjab University Journal of Zoology, 36(2), 141–145. https://doi.org/10.17582/journal.pujz/2021.36.2.141.145

Japoshvili, G., Arabuli, T., Salakaia, M., Tskaruashvili, Z., Kirkitadze, G., & Talamas, E. J. (2022). Surveys for Halyomorpha halys (Stål) (Hemiptera: Pentatomidae) and its biocontrol potential by parasitic wasps in the Republic of Georgia (Sakartvelo). Phytoparasitica, 50(1), 127–137. https://doi.org/10.1007/s12600-021-00949-1

Japoshvili, G., Dzneladze, N., Kirkitadze, G., Kiss, B., & Kaydan, M. B. (2018). A new and dangerous pest for the Caucasus—Drosophila suzukii (Matsumura, 1931) (Diptera: Drosophilidae). Annals of Agrarian Science, 16(4), 464–465. https://doi.org/10.1016/j.aasci.2018.05.006

Japoshvili, G., Murvanidze, M., Inasaridze, N., Meskhi, N., Lipartia, Z., & Namicheishvili, L. (2024). Population monitoring and status evaluation of the new invasive pest, Drosophila suzukii (Matsumura) (Diptera: Drosophilidae), in various crop systems of Georgia (Sakartvelo). Hellenic Plant Protection Journal, 17(2), 111–123. https://doi.org/10.2478/hppj-2024-0010

Karataş, A., Karataş, A., Yavuz, N., & Genç, M. (2020). Distribution and activity period of the invasive Orosanga japonica (Melichar, 1898) (Hemiptera: Ricaniidae) in Turkey. Zoology in the Middle East, 66(3), 246–252. https://doi.org/10.1080/09397140.2020.1793502

Kereselidze, M., Pilarska, D., Guntadze, N., & Linde, A. (2022). Halyomorpha halys Stål, (Hemiptera: Pentatomidae) feeding effects on some agricultural fruits in Georgia. Turkish Journal of Zoology, 46(3), 298–303. https://doi.org/10.55730/1300-0179.3058

Lee, D.-H., & Leskey, T. C. (2015). Flight behavior of foraging and overwintering brown marmorated stink bug, Halyomorpha halys (Hemiptera: Pentatomidae). Bulletin of Entomological Research, 105(5), 566–573. https://doi.org/10.1017/S0007485315000462

Lee, J. C., Wang, X., Daane, K. M., Hoelmer, K. A., Isaacs, R., Sial, A. A., & Walton, V. M. (2019). Biological control of spotted-wing drosophila (Diptera: Drosophilidae)—Current and pending tactics. Journal of Integrated Pest Management, 10(1), Article 13. https://doi.org/10.1093/jipm/pmz012

Leskey, T. C., Hamilton, G. C., Biddinger, D. J., Buffington, M. L., Dieckhoff, C., Dively, G. P., Fraser, H., Gariepy, T., Hedstrom, C., Herbert, D. A., Hoelmer, K. A., Hooks, C. R. R., Inkley, D., Krawczyk, G., Kuhar, T. P., Lee, D.-H., Nielsen, A. L., Pfeiffer, D. G., Rodriguez-Saona, C., . . . Wiman, N. (2013). Halyomorpha halys (brown marmorated stink bug). CABI Compendium. https://doi.org/10.1079/cabicompendium.27377

Meladze, G., & Meladze, M. (2015). Impact of global warming on the vegetation durable and distribution area of crops in the humid subtropical and mountainous regions of Georgia. American Journal of Environmental Protection, 4(3-1), 162–167. https://doi.org/10.11648/j.ajep.s.2015040301.35

Ministry of Environment and Natural Resources Protection of Georgia. (2013). Climate change strategy of Ajara. United Nations Development Programme. https://www.undp.org/georgia/publications/climate-change-strategy-ajara-2013

Ministry of Environmental Protection and Agriculture of Georgia. (2021). Georgia's fourth national communication under the United Nations Framework Convention on Climate Change. United Nations Development Programme. https://unfccc.int/documents/271341

Ministry of Environmental Protection and Agriculture of Georgia. (2025, October 29). David Songulashvili: "Promoting the sale of Georgian citrus requires maintaining the highest product quality and the government firmly supports farmers through a variety of targeted assistance programs" [Press release]. https://mepa.gov.ge/En/News/Details/24189

Mokrane, S., Cavallo, G., Tortorici, F., Romero, E., Fereres, A., Djelouah, K., Verrastro, V., & Cornara, D. (2020). Behavioral effects induced by organic insecticides can be exploited for a sustainable control of the orange spiny whitefly Aleurocanthus spiniferus. Scientific Reports, 10, Article 15746. https://doi.org/10.1038/s41598-020-72972-x

Morrison, W. R., III, Blaauw, B. R., Short, B. D., Nielsen, A. L., Bergh, J. C., Krawczyk, G., Park, Y.-L., Butler, B., Khrimian, A., & Leskey, T. C. (2019). Successful management of Halyomorpha halys (Hemiptera: Pentatomidae) in commercial apple orchards with an attract-and-kill strategy. Pest Management Science, 75(1), 104–114. https://doi.org/10.1002/ps.5156

Murvanidze, M., Japoshvili, G., Inasaridze, N., & Deutsch, F. (2022). Drosophilid flies of Georgia with new records for the country. Caucasiana, 1, 25–28. https://doi.org/10.3897/caucasiana.1.e87258

National Food Agency of Georgia. (2018, June 11). Asian brown marmorated stink bug control is progressing successfully [News release in Georgian]. https://nfa.gov.ge/ge/News/Details/62

National Food Agency of Georgia. (2025, July 15). Measures against the Asian brown marmorated stink bug are underway in Upper Adjara [News release in Georgian]. https://nfa.gov.ge/en/News/Details/603

National Statistics Office of Georgia. (2025). Agriculture of Georgia, 2024. https://www.geostat.ge/en/single-categories/102/agriculture-of-georgia

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, Article n71. https://doi.org/10.1136/bmj.n71

Parliament of Georgia. (2009, June 26). Resolution on changing the administrative boundaries between the self-governing city of Batumi and Khelvachauri Municipality. Legislative Herald of Georgia. https://matsne.gov.ge/ka/document/view/46042

Robinet, C., & Roques, A. (2010). Direct impacts of recent climate warming on insect populations. Integrative Zoology, 5(2), 132–142. https://doi.org/10.1111/j.1749-4877.2010.00196.x

Rural Development Agency. (2025, July 1). The Preferential Agrocredit Project has added a subcomponent for financing primary blueberry production. https://rda.gov.ge/en/articles/news/034002-proeqts-sheghavatiani-agrokrediti-qvekomponenti-motsvis-pirveladi-tsarmoebis-daphinansebistvis-daemata/

Skendžić, S., Zovko, M., Živković, I. P., Lešić, V., & Lemić, D. (2021). The impact of climate change on agricultural insect pests. Insects, 12(5), Article 440. https://doi.org/10.3390/insects12050440

Talukder, B., Hipel, K. W., & vanLoon, G. W. (2018). Using multi-criteria decision analysis for assessing sustainability of agricultural systems. Sustainable Development, 26(6), 781–799. https://doi.org/10.1002/sd.1848

Tello Mercado, V., Fernández, E. S., & Giliomee, J. H. (2014). Life table parameters of the woolly whitefly Aleurothrixus floccosus (Hemiptera: Aleyrodidae) and its parasitoid Cales noacki (Hymenoptera: Aphelinidae). European Journal of Entomology, 111(2), 251–256. https://doi.org/10.14411/eje.2014.020

Thomson, L. J., Macfadyen, S., & Hoffmann, A. A. (2010). Predicting the effects of climate change on natural enemies of agricultural pests. Biological Control, 52(3), 296–306. https://doi.org/10.1016/j.biocontrol.2009.01.022

Tougeron, K., Brodeur, J., Le Lann, C., & van Baaren, J. (2020). How climate change affects the seasonal ecology of insect parasitoids. Ecological Entomology, 45(2), 167–181. https://doi.org/10.1111/een.12792

Ulusoy, M. R., Vatansever, G., Erkılıç, L., & Uygun, N. (2003). Studies on Aleurothrixus floccosus (Maskell) (Homoptera, Aleyrodidae) and its parasitoid, Cales noacki Howard (Hymenoptera, Aphelinidae) in the East Mediterranean Region of Turkey. Journal of Pest Science, 76, 163–169. https://doi.org/10.1007/s10340-003-0014-5