

SPECIES COMPOSITION OF CEREAL BUGS AND SUNN PEST DAMAGE TO WINTER WHEAT GRAIN IN KAZAKHSTAN AND UZBEKISTAN

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ABSTRACT

Monitoring surveys were conducted across different agroecosystems in Kazakhstan and Uzbekistan from 2023 to 2025 to determine the species composition of cereal bugs in winter wheat, characterize phenotypic variation among local Sunn pest populations, and assess variety-specific grain damage. Researchers recorded ten bug species from five genera—Eurygaster, Aelia, Halyomorpha, Dolycoris, and Carpcoris—in winter wheat fields in the Turkestan and Tashkent regions. The Sunn pest (*Eurygaster integriceps* Put.) was the dominant species, accounting for 89.4% of all recorded phytophagous bugs. Researchers also detected the invasive quarantine pest, the brown marmorated stink bug (*Halyomorpha halys* S.), in winter wheat fields, which represented 1.8% of the bug community. The results showed no clear association between phenotypic characteristics, including body pattern and background coloration, and the Sunn pest's damage potential. The increased frequency of morphotype 4 in commercial wheat fields may reflect population responses to agroecosystem conditions, including possible effects associated with cultivated wheat genotypes. Comparative evaluations under natural and artificial infestation clearly differentiated the winter wheat germplasm by grain-damage extent. 'Bogarnaya 56' and 'Egemen 20' showed the lowest grain damage and were identified as promising candidates for further resistance evaluation and breeding programs. In contrast, 'Ilgor', 'OK Marvarid', and 'Alekseyich' showed high susceptibility under artificial infestation and may require targeted management during periods of high Sunn pest pressure. These findings provide useful information on cereal bug diversity, Sunn pest phenotypic variation, and varietal responses and may contribute to the development of more effective integrated pest management strategies for winter wheat.

Keywords: Winter wheat, Cereal bugs, Sunn pest, Grain damage, Kazakhstan, Uzbekistan.

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1. INTRODUCTION

Winter bread wheat (*Triticum aestivum* L.) is an important cereal crop in Kazakhstan and Uzbekistan. In Kazakhstan, approximately 400–410 thousand ha are sown annually, mainly in the southern and south-eastern parts of the country and in several western regions. In Uzbekistan, winter wheat occupies approximately 1.30–1.35 million ha each year, accounting for about 35% of the country's total arable land. Regular phytosanitary monitoring of cereal crops enables specialists and researchers to assess species diversity, detect harmful organisms in a timely manner, and analyse their developmental and distributional dynamics. Particular attention is given to the occurrence and development of economically important pests, especially cereal bugs (Toreniyazov & Bauetdinov, 2022; Rsaliyev et al., 2025b).

In Central Asia, heteropteran bugs are among the most abundant groups of phytophagous insects damaging small-grain cereals. The Sunn pest (*Eurygaster integriceps* Put.) is among the most destructive pests of winter wheat and can substantially reduce both yield and grain quality (Ivantsova, 2013; Khalaf et al., 2017; Davari & Parker, 2018; Kapustkina & Frolov, 2022). By comparison, other species, including the tortoise bug (*Eurygaster maura* L.) and *Aelia* spp., are generally less economically important (Salis et al., 2013; Vaccino et al., 2017; Gibicsár & Keszthelyi, 2023). In recent years, the brown marmorated stink bug, *Halyomorpha halys* S., has expanded its distribution in the

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region (Esenbekova, 2017; Neimorovets, 2018; Mityushev, 2020). This species is highly abundant, has substantial damage potential, a broad geographic distribution, and ecological plasticity; consequently, its populations require continuous monitoring.

Damage caused by cereal bugs are largely determined by the action of digestive enzymes injected into the endosperm during feeding. These enzymes act on major plant biopolymers and may markedly impair the properties of damaged grain. The extent of quality deterioration depends on the bug species and the activity of its digestive enzymes. *Eurygaster* spp. and *Aelia* spp. have the highest enzymatic activity and can hydrolyse the principal storage components of grain. In particular, the presence of 2–5% kernels damaged by *E. integriceps* or more than 10% kernels damaged by *Aelia* bugs in a wheat lot can impair flour bread-making quality and reduce the commercial grade of the grain (Armstrong et al., 2019; Konarev et al., 2019; Dizlek & Özer, 2021, 2024; Shpanev & Kapustkina, 2025). Seed lots with 6–10% or more Sunn pest-damaged kernels may also show a 22–25% reduction in germination. When 10–20% of wheat seed is damaged by the Sunn pest, the grain may be downgraded to feed quality (Pavlushin et al., 2015; Kapustkina & Nefedova, 2017). Grain losses from the Sunn pest may reach 20–50%, depending on soil and climatic zone, crop production system, and variety; losses may be even greater in susceptible varieties when protective measures are not applied (Moore & Edgington, 2006; Davari & Parker, 2018).

Population dynamics and cyclic outbreaks of cereal bugs, particularly the Sunn pest, are strongly influenced by environmental factors, including climatic conditions and anthropogenic pressure (Pavlushin et al., 2015; Neimorovets, 2018; Rsaliyev et al., 2025b). Beyond affecting abundance, these factors may drive adaptive microevolutionary changes in pest populations, including the development of pesticide resistance, the emergence of biotypes capable of overcoming host-plant resistance, and disruption of natural population regulation mechanisms. These processes may favour the formation of more aggressive pest populations and increase damage, thereby worsening the phytosanitary situation and increasing reliance on chemical treatments in agroecosystems (Pavlushin et al., 2015; Frolov, 2019). Studies in various agroclimatic zones of Uzbekistan show that climate change, inadequate pest control, and the biological adaptation of species in the genus *Eurygaster* have increased the frequency and severity of pest damage. As a result, significant quantities of wheat lose their quality characteristics or become unfit for human consumption, necessitating the development of specialized diagnostic methods and technological solutions to mitigate these consequences (Tadjiyeva et al., 2026).

In Kazakhstan and Uzbekistan, active research has been conducted on winter wheat resistance to fungal diseases, resulting in the creation of advanced genotypes with high resistance to rust species (Kokhmetova et al., 2021; Meliev et al., 2023; Rsaliyev et al., 2025a; Jiao et al., 2026), high drought tolerance (Rsaliyev et al., 2024; Mamatkulova et al., 2025) and excellent yield potential (Baboev et al., 2021; Baboeva et al., 2025). However, to date, few studies in the region have determined the composition of the grain bug population or assessed damage to Sunn pest wheat varieties. Timely phytosanitary and phenotypic monitoring is therefore required to assess cereal bug abundance and population status, forecast wheat yield losses, and implement scientifically justified control measures.

The objectives of this study were to determine the species composition of cereal bugs in winter wheat fields, assess the extent of grain damage, and characterize the phenotypic diversity of *Eurygaster* spp. populations in different agroecosystems of Kazakhstan and Uzbekistan. The results are expected to improve models for estimating cereal bug abundance and damage, including those for the *E. integriceps*, and to support the development of region-specific monitoring systems and optimized winter wheat protection strategies.

2. MATERIALS AND METHODS

2.1. Plant Material

Field investigations were conducted using nine commercial winter bread wheat (*Triticum aestivum* L.) of different geographical origin: six varieties of Kazakhstan selection, two varieties of Uzbekistan selection and one variety of Russian selection (Table 1).

Table 1: Winter bread wheat varieties used to assess Sunn pest damage

No	Variety	Pedigree	Breeding institution
1	Bogarnaya 56	Jub.Oset/Oct.Trit.LV-1//Bezostaya I	KRIAPG ¹
2	Steklovidnaya 24	Bogarnaya 56/Tepl.2//Rostovchanka	KRIAPG ¹
3	Egemen 20	Alm.6783-69/7 (K-50431/Bezostaya I)	KRIAPG ¹
4	Momyshuly	Steklovidnaya 24/Almaly	KRIAPG ¹
5	Pamyat 47	K298669/L10/I30H2/320/B.1/47157	Krasnovodopad AES ²
6	Krasnovodopad 210	Krasnovodopad 49/Bima//Bezostaya I	Krasnovodopad AES ²
7	OK Marvarid	Unumli bugdai/K5076 (SAFVIR)	IGPEB ³
8	Ilgor	IBWSN.1291 FPAU\SERI\IB\AMAD\...	IGPEB ³
9	Alekseyich	Lut.2935k51/Fortuna	Lukyanenko NGC ⁴

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2.2. Assessment of Cereal Bugs

Cereal bugs were collected from commercial and experimental fields over three growing seasons (2023–2025) at four geographical locations in Central Asia: the Kazakh Research Institute of Agriculture and Plant Growing (KRIAPG; Almaty Region, Kazakhstan; 43°22'26"N, 76°68'23"E), the Ural Agricultural Experimental Station (Ural AES, West Kazakhstan Region, Kazakhstan; 51°14'41"N, 51°17'01"E), the Krasnovodopad Agricultural Experimental Station (Krasnovodopad AES, Turkestan Region, Kazakhstan; 41°27'52"N, 69°26'02"E), and the Institute of Genetics and Plant Experimental Biology (IGPEB; Tashkent Region, Uzbekistan; 41°36'90"N, 69°40'48"E) (Fig. 1). In 2024, weather conditions were most favorable for the development of winter wheat and the Sunn pest across all regions, whereas 2023 and 2025 were characterized by severe and moderate drought, respectively.



Fig. 1: Location of field experiments in Kazakhstan (Kazakh Research Institute of Agriculture and Plant Growing, KRIAPG; Ural Agricultural Experimental Station, Ural AES; Krasnovodopad Agricultural Experimental Station, Krasnovodopad AES) and Uzbekistan (Institute of Genetics and Plant Experimental Biology, IGPEB).



Fig. 2: Field cages used to assess Sunn pest damage to winter wheat grain (A, Kazakhstan; B, Uzbekistan).

Bug pattern	Background color – Dark	Background color – Light
With a pattern	 Morphotype 1	 Morphotype 2
Without a pattern	 Morphotype 3	 Morphotype 4

Fig. 3: Phenotypic structure of Sunn pest populations (Pavlushin et al., 2015).

and hemelytral background coloration (Fig. 3).

The identified morphotypes are highly stable throughout bug ontogeny and are not sex-linked. Differences among

Winter wheat surveys began after air temperature had stabilized above +5°C. Pest density was assessed three times during the growing season by direct counts within a 1-m² sampling frame. An entomological sweep net (0.3 m diameter, 0.6 m depth, and 1.5 m handle) was used to determine the age structure of bug populations. One sample consisted of 10 consecutive sweeps, corresponding approximately to 1.0 m². Sampling was repeated at 7–10-day intervals to refine the observations (Artokhin, 2013).

To assess winter wheat grain damage caused by the Sunn pest in Kazakhstan and Uzbekistan, collected insects were introduced into mesh field cages enclosing plants of the tested varieties at a density of 10 individuals per cage. To do this, in the spring, during the pest's migration period, each variety was covered with a 1 × 1 × 1 m gauze cover (Fig. 2).

2.3. Cereal Bug Identification

Species and sex were determined at the All-Russian Research Institute of Plant Protection (St. Petersburg, Russia) using a Stemi 2000-C stereoscopic binocular microscope. Identification was based on adult morphological characters following Ribes et al. (2007), Derjanschi & Pericart (2016) and Neymorovets (2019). A total of 501 bugs of various developmental stages, collected in Kazakhstan and Uzbekistan from nine varieties of winter soft wheat, were used to identify the species composition of the pest (Table 1).

2.4. Analysis of the Phenotypic Structure of Sunn Pest Populations

Phenotypic structure was assessed using a "phenetic composition" approach that combined discrete adult traits, specifically the scutellar pattern

local Sunn pest populations from different regions are expressed as variation in the frequencies of individual morphotypes. The phenes defining these morphotypes may also be used to analyze the population structure of several *Eurygaster* species closely related to the Sunn pest (Pavlushin et al., 2015).

2.5. Assessment of Wheat Grain Damage

Wheat sheaves were collected from production and experimental fields used to study Sunn pest populations. After threshing, average samples weighing at least 0.3–0.4 kg was extracted from each grain batch. A total of 17 average wheat samples were obtained, and from each sample, five sub-samples of 100 grains each were taken by thorough mixing. To ensure the reliability of the results, the analysis was performed in triplicate, resulting in a total count of 1500 analyzed grains for each average sample. Each grain in the sample is examined from all sides under an infrared microscope to determine the etiology and extent of damage based on diagnostic features such as the location of puncture sites bug, the clarity of lesion boundaries, and the intensity of darkening (Shpanev & Kapustkina, 2025).

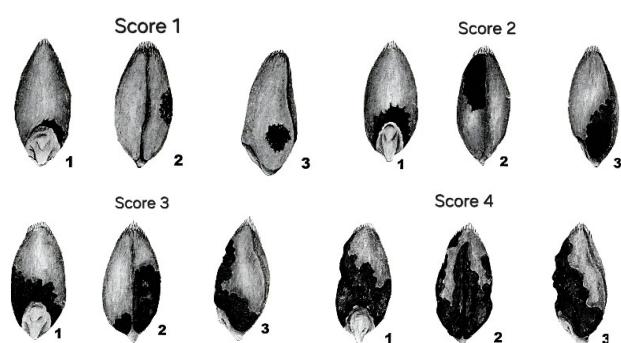


Fig. 4: Scale of wheat grain damage caused by the Sunn pest (Pavlushin et al., 2015): 1) Dorsal view; 2) Ventral view; 3) Lateral view.

A 4-point scale is used to assess the severity of damage (Pavlushin et al., 2015): a score of 1–2 indicates that the damaged area covered no more than approximately one-quarter to one-fifth of the grain; a score of 3 indicates that the damage extended over more than one-third of the dorsal and lateral surfaces of the endosperm; and a score of 4 indicates that the grain was completely damaged and severely deformed. Damage scored as 3 or 4 has the greatest pathological effect on grain properties (Fig. 4).

After the damage scores had been assigned, the weighted mean damage score for each wheat variety was calculated using the following formula:

$$B = \frac{(1 \times A1) + (2 \times A2) + (3 \times A3) + (4 \times A4)}{N}$$

Where B is the weighted mean damage score; 1, 2, 3 and 4 are the damage scores; A1, A2, A3 and A4 are the numbers of kernels assigned to the corresponding scores; and N is the total number of assessed kernels, including undamaged kernels, which were assigned a score of zero.

Based on damage intensity, the varieties were classified into three groups: group 1 – up to 10% damaged kernels (slightly damaged); group 2 – 10–20% damaged kernels (moderately damaged); and group 3 – more than 20% damaged kernels (severely damaged).

2.6. Statistical Analysis

All experimental data were analyzed in R version 4.3.1 (R Core Team, 2023). Intraspecific differentiation among shield bug populations was assessed using Zhivotovsky's phenetic similarity index (r) (Zhivotovsky, 1991):

$$r = \frac{\sum (x_i \cdot y_i)}{\sqrt{\sum x_i^2 \cdot \sum y_i^2}}$$

Where X_i is the frequency of the i^{th} morphotype in the first population sample, and Y_i is the frequency of the i^{th} morphotype in the second population sample.

To test the null hypothesis that both samples belonged to the same statistical population, the identity criterion (I) was calculated as follows:

$$I = \frac{8 \cdot n_1 \cdot n_2}{n_1 + n_2} (1 - r)$$

where n_1 and n_2 are the sample sizes of the first and second populations, respectively.

Grain damage was summarized as the percentage of damaged kernels and the weighted mean damage score. Pearson's correlation coefficient was used for an exploratory analysis of the association between morphotype 4 frequency and grain damage across three cultivars, with a two-tailed significance level of $\alpha = 0.05$. The repeated grain assessments within each composite sample represent within-sample replication and do not, by themselves, establish

independent field replication. Differences in grain damage among cultivars and infestation conditions were therefore interpreted descriptively.

3. RESULTS

3.1. Species Composition of Cereal Bugs in Winter Wheat Fields

An analysis of 501 cereal bug specimens collected in the Turkestan Region (Kazakhstan) and the Tashkent Region (Uzbekistan) revealed 10 species inhabiting winter wheat crops, belonging to five genera: *Eurygaster*, *Aelia*, *Halyomorpha*, *Dolycoris*, and *Carpocoris* (Table 2).

Table 2: Species composition of cereal bugs in winter wheat fields of the Turkestan and Tashkent regions (N=501)

No	Scientific name	Common English name*	Relative abundance (%)
1	<i>Eurygaster integriceps</i> Put.	Sunn pest	89.4
2	<i>Eurygaster maura</i> L.	Tortoise bug	0.8
3	<i>Aelia melanota</i> F.	<i>Aelia melanota</i>	4.6
4	<i>Aelia acuminata</i> L.	Bishop's mitre	0.4
5	<i>Aelia rostrata</i> Boh.	<i>Aelia rostrata</i>	0.4
6	<i>Aelia furcula</i> F.	<i>Aelia furcula</i>	0.4
7	<i>Halyomorpha halys</i> S.	Brown marmorated stink bug	1.8
8	<i>Dolycoris baccarum</i> L.	Sloe bug	1.4
9	<i>Carpocoris fuscispinus</i> Tam.	Sharp-shouldered shield bug	0.6
10	<i>Carpocoris seidenstueckeri</i> Boh.	Flower shield bug	0.2

Note: * - "Common English names" are taken from the EPPO Global Database website <https://gd.eppo.int/>

E. integriceps Put was the most abundant species, accounting for 89.4% of all collected bugs. It was followed by *A. melanota* F. (4.6%), *H. halys* S. (1.8%), *D. baccarum* L. (1.4%), *E. maura* L. (0.8%), *C. fuscispinus* Tam. (0.6%), *A. acuminata* L., *A. rostrata* Boh., *A. furcula* F. (by 0.4%), and *C. seidenstueckeri* Boh. (0.2%).

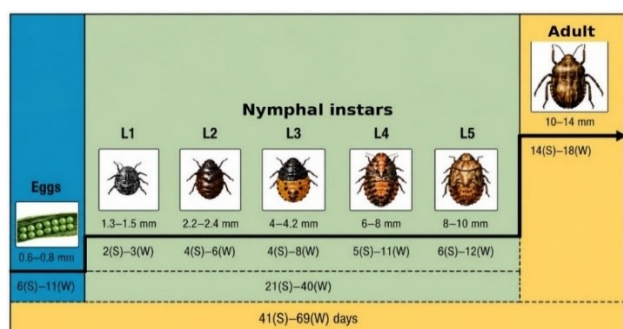


Fig. 5: Developmental chronology of the Sunn pest in winter wheat fields. Numbers indicate body size (mm) and the duration of each developmental stage (days) in the Turkestan and Tashkent regions (S, south) and western Kazakhstan (W, west).

3.2. Age Structure of Sunn Pest Populations at Different Winter Wheat Growth Stages

In the Turkestan Region of Kazakhstan and the Tashkent Region of Uzbekistan, Sunn pest development on winter wheat proceeded more rapidly than in western Kazakhstan. The mean durations of the egg, nymphal, and adult stages were 6, 21, and 14 days, respectively. This accelerated development was favored by the high temperature and low air humidity prevailing in southern Kazakhstan and Uzbekistan. In the principal grain-producing areas of western Kazakhstan, including the West Kazakhstan and Aktobe regions, where temperature and moisture conditions were more moderate, Sunn pest development on winter wheat was prolonged. In this region, the mean durations of

the egg, nymphal, and adult stages were 11, 40, and 14 days, respectively (Fig. 5).

The proportions of different Sunn pest developmental stages were determined in southern Kazakhstan (Turkestan Region), southeastern Kazakhstan (Almaty Region), and western Kazakhstan (West Kazakhstan Region) during three winter wheat growth stages: heading-flowering, grain filling, and milk-wax maturity. During heading and flowering, early-instar nymphs (L1-L3) predominated in nearly all regions, whereas late-instar nymphs (L4-L5) and adults were dominant by the milk-wax maturity stage (Fig. 6).

3.3. Phenotypic Structure of Sunn Pest Populations on Different Wheat Varieties

The analysis of the frequency of discrete, non-metric morphological traits in *E. integriceps* revealed the presence of all four previously identified morphotypes in the structure of the studied populations. Furthermore, based on the relative frequency of morphotypes, local Sunn pest populations were found to correspond to the ancestral ecotype, characterized by rates of 18.5% for morphotype 1, 43.6% for morphotypes 2, and 18.7-19.2% for morphotypes 3 and 4. Nevertheless, the studied populations showed a pronounced increase in morphotype 4 and a decrease in morphotype 2 relative to typical ancestral-ecotype populations in both commercial and research fields (Fig. 7).

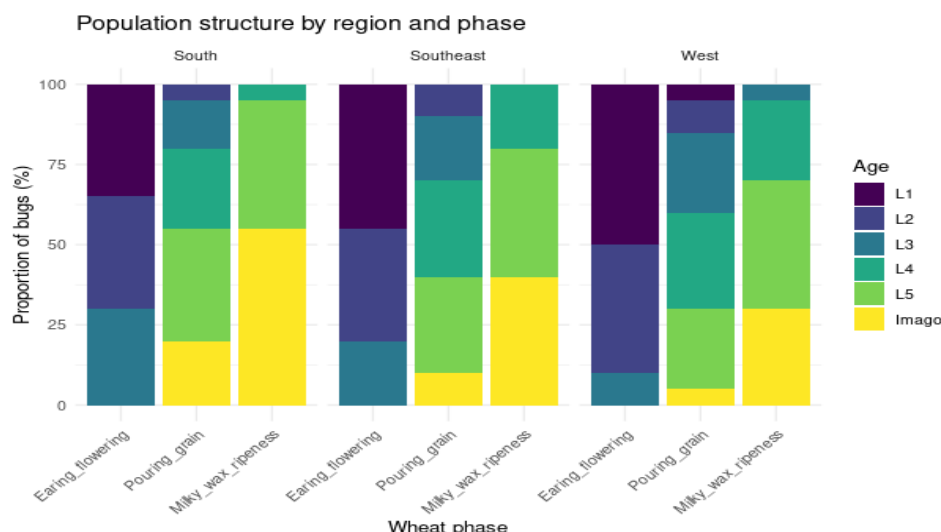


Fig. 6: Age structure of Sunn pest populations at different winter wheat growth stages.

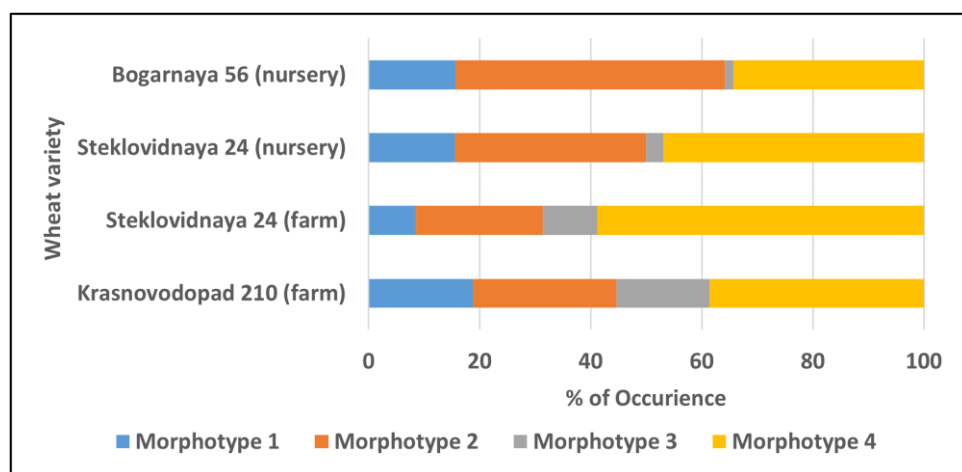


Fig. 7: Phenotypic structure of Sunn pest populations on winter wheat varieties in southern Kazakhstan.

Phenetic similarity among populations developing in different winter wheat fields remained high (0.70–0.92). The most pronounced structural shift occurred in a commercial field of Steklovidnaya 24, where the frequencies of the dominant morphotypes and morphotype 3 declined, whereas morphotype 4 increased. These differences were statistically significant ($r = 0.70$; $I = 61.8$). A similar but less pronounced pattern was observed in the research plots of the same variety, where morphotype frequencies were 15.6% for morphotype 1, 34.4% for morphotype 2, 3.1% for morphotype 3, and 46.9% for morphotype 4. These values also differed significantly from those of the ancestral ecotype ($r = 0.83$; $I = 55.4 \geq \chi^2 = 16.9$). In populations collected from commercial fields of Krasnovodopad 210, the frequency of morphotype 2 did not exceed 25.8%, whereas morphotype 1 reached 18.8%. The frequencies of the minor groups also changed: morphotype 3 declined to 16.8%, while morphotype 4 increased to 38.6%.

3.4. Winter Wheat Grain Damage by Sunn Pest under Natural and Artificial Infestation

Analysis of winter wheat grain samples from southern Kazakhstan showed that mean Sunn pest damage ranged from 0.19% to 4.06%, irrespective of whether the crop was grown in commercial fields or research plots. The lowest levels of grain damage were recorded for Egemen 20, Bogarnaya 56, Steklovidnaya 24 and Momyshtuly (0.19–0.67%; weighted average score 0.004–0.02 units); the proportion of kernels with the most severe damage scores (3–4) did not exceed 36.1%. By contrast, mean grain damage reached 1.67% in Pamyat 47, and 4.06% in Krasnovodopad 210, with the weighted average score being 0.06, and 0.11 units. In these more heavily damaged varieties, the proportion of kernels assigned to the most severe damage classes increased to 48.2% (Fig. 8).

Artificial infestation resulted in higher levels of winter wheat grain damage, with an overall mean of 9.3% at a weighted average score of 0.22 units (Fig. 8). The lowest damage was recorded for Bogarnaya 56: 5.4% of the kernels were damaged, weighted average score of 0.09 units and 35.3% of the damaged kernels were assigned scores of 3–4. The most severe development of the pest was noted in the varieties "Alekseyich" and "Krasnovodopad 210": the total damage to grain reached 10.8% and 11.2%, respectively.

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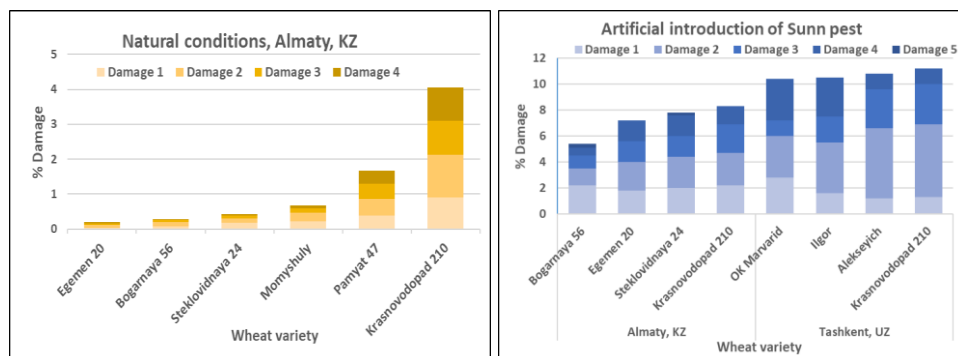


Fig. 8: Sunn pest damage to winter wheat grain under natural and artificial infestation in Kazakhstan (KZ) and Uzbekistan (UZ).

4. DISCUSSION

In winter wheat fields of the Turkestan and Tashkent regions, the Sunn pest (*Eurygaster integriceps*) was the most abundant bug species and represented 89.4% of all collected individuals. It was followed by *Aelia melanota* (4.6%), *Halyomorpha halys* (1.8%), *Dolycoris baccarum* (1.4%), *E. maura* (0.8%), *Carpocoris fuscispinus* (0.6%), *A. acuminata*, *A. rostrata*, *A. furcula* (by 0.4%), *C. seidenstueckeri* (0.2%) (Table 2).

The occurrence of the brown marmorated stink bug (*Halyomorpha halys*) in winter wheat fields warrants attention because this species is classified as a particularly dangerous pest and is included in the Common List of Quarantine Pests of the Eurasian Economic Union (Common List, 2016). The species was first recorded in the Almaty Region in 2017, and subsequent observations indicate range expansion in southeastern Kazakhstan and its occurrence in several other parts of the country (Esenbekova, 2017; Azhimakhan et al., 2025). Our findings may reflect either gradual spread from southeastern to southwestern Kazakhstan or a local anthropogenic introduction. However, the low frequency of *H. halys* in winter wheat fields (1.8%) does not indicate mass reproduction or the formation of new outbreak foci in the Turkestan and Tashkent regions. These interpretations are preliminary and require continued monitoring to detect and control the pest.

The tortoise bug (*Eurygaster maura*) can cause substantial yield losses in cereal crops in northwestern Italy, northern Iran, northern Kazakhstan, central and southeastern Anatolia, and some regions of Russia. Recent studies reported grain damage of 6.2–18.2% caused by *E. maura* in the Altai Territory (Kapustkina, 2022). In the present study, *E. maura* accounted for only 0.8% of the bug assemblage, a relatively low frequency compared with *E. integriceps* (89.4%).

The data revealed close synchronization between the Sunn pest life cycle and winter wheat phenology, together with a pronounced climatic gradient among regions (Fig. 6). During heading and flowering, populations consisted predominantly of early-instar nymphs. Development was delayed in the western region, where early instars still accounted for more than half of the population, whereas their proportion had already declined in the south because of rapid transition to later stages. During grain filling, mass moulting and transition to older instars occurred. Development was most rapid in the south: by this stage, approximately one-fifth of the population had reached adulthood, and fifth-instar nymphs constituted the largest group. In western Kazakhstan, development was slower and fourth-instar nymphs still predominated. By milk-wax maturity, development of the summer generation was almost complete. Adults became the absolute dominant in the south and accounted for approximately half of the population. Southeastern and western regions showed the same general trend but lower proportions of adults. These findings support the conclusion that high temperature and low air humidity in southern Kazakhstan accelerate Sunn pest development relative to western regions, where developmental chronology is prolonged.

Agricultural intensification is known to induce shifts in the genetic and phenotypic diversity of pest populations, directly influencing their resilience and stability within agroecosystems (Cui et al., 2024; Özgökçe et al., 2025). Hasanvand et al. (2020) emphasized the importance of environmental factors, including temperature and habitat conditions, in shaping the population structure of *E. integriceps*. These factors can trigger local adaptation, promoting the development of different adaptive traits in populations depending on their habitats. Thus, studying the phenotypic diversity of *E. integriceps* population structure is critical for the development of effective integrated pest management strategies aimed at minimizing damage and implementing sustainable agricultural practices.

Our data indicate the preservation of the phenotypic structure of *E. integriceps* population's characteristic of the original ecotype, while the frequency of morphotypes changes under the influence of environmental factors, including anthropogenic ones. The identified intraspecific variability of the Kazakhstan population of *E. integriceps* is consistent with the results of previous studies describing similar patterns in Russian populations of this pest. In particular, Pavlushin et al. (2015) and Kapustkina (2018) emphasized the significance of intraspecific variability in *E. integriceps* and demonstrated a gradual transformation in the structure of Russian populations due to intensive anthropogenic impacts on wheat agroecosystems associated with insecticide use and sown varieties.

Comparative phenotypic analysis of *E. integriceps* populations on various wheat varieties showed the most pronounced morphotype variability in the adult sample developed on the Steklovidnaya 24 variety. It is known that the structure of the Sunn pest can be significantly transformed under the influence of selective pressure from wheat varieties (Kapustkina, 2018). This phenomenon occurs because varieties differ in morpho-anthemic characteristics, as well as in the physicochemical composition of the endosperm and ripening periods. These differences create specific environmental conditions that favor the survival and reproduction of only certain morphotypes (Kaplin & Burlaka, 2019). Consequently, long-term cultivation of the Steklovidnaya 24 wheat variety may have driven phenotypic diversification in local *E. integriceps* populations, with an increase in certain morphotypes (specifically type 4) and a decrease in others.

The study of the relationship between the pest's morphotypic structure and grain damage in three main varieties (Bogarnaya 56, Krasnovodopad 210, and Steklovidnaya 24), shown in Fig. 7, showed no statistically significant direct linear relationship between these parameters. In particular, the correlation between the frequency of morphotype 4 in the local population and the overall grain damage was $r = -0.106$ ($p = 0.932$). This result is consistent with the hypothesis that morphotypes primarily reflect environmental selection pressure and the pest's adaptation to unfavorable factors (Pavlushin et al., 2015; Özgökçe et al., 2025). The lower degree of grain damage observed in certain varieties supports further study under various conditions. The data obtained can be used to optimize the integrated protection of winter wheat against cereal bugs.

5. CONCLUSION

The Sunn pest (*Eurygaster integriceps* Put.) was the dominant species among the 10 bug species recorded in winter wheat crops in Kazakhstan and Uzbekistan, accounting for 89.4% of the total phytophagous bugs identified. The detection of the brown marmorated stink bug (*Halyomorpha halys* S.), a quarantine pest, in winter wheat crops, where it represented 1.8% of the bug community, highlights the need for continued monitoring of its distribution and population dynamics. No clear relationship was observed between body pattern or background coloration and the potential harmfulness of the Sunn pest. The increased occurrence of morphotype 4 in wheat fields may reflect population responses to agroecosystem conditions, including possible effects associated with cultivated wheat genotypes.

Comparative evaluation under natural and artificial infestation clearly differentiated the winter wheat germplasm according to the extent of grain damage. The varieties 'Bogarnaya 56' and 'Egemen 20' exhibited the lowest levels of grain damage and therefore represent promising candidates for further evaluation of resistance to Sunn pest. In contrast, 'Ilgor', 'OK Marvarid', 'Alekseyich', and 'Krasnovodopad 210' showed greater susceptibility under artificial infestation, with damaged grain exceeding the critical threshold of 10%. These susceptible varieties may therefore require timely pest monitoring and appropriate protective measures during periods of high Sunn pest pressure to minimize grain damage and potential yield losses.

Declarations

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Data Availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics Statement: The field experiments were conducted in accordance with national and institutional guidelines for agricultural research in Kazakhstan. The study did not involve human participants or vertebrate animals requiring ethical approval.

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REFERENCES

- Armstrong, P., Maghirang, E., & Ozulu, M. (2019). Determining damage levels in wheat caused by Sunn pest (*Eurygaster integriceps*) using visible and near-infrared spectroscopy. *Journal of Cereal Science*, 86, 102–107. <https://doi.org/10.1016/j.jcs.2019.02.003>
- Artokhin, K. (2013). Pests of agricultural crops. Volume I: Pests of grain crops. Moscow, Pechatny Gorod, 185–204.
- Azhimkhan, M., Suleiman, M., Khassanov, V., Dulat, B., & Dairbekova, Z. (2025). Brown-marmorated stink bug (*Halyomorpha halys* Stål)—dangerous quarantine pest for the territory of Kazakhstan. *Herald of Science of Seifullin Kazakh Agrotechnical University*, 128(4), 4–15. [https://doi.org/10.51452/kazatu.2025.4\(128\).2049](https://doi.org/10.51452/kazatu.2025.4(128).2049)
- Baboev, S., Muminjanov, H., Turakulov, K., Buronov, A., Mamatkulov, I., Koc, E., Ozturk, I., Dreisigacker, S., Shepelev, S., & Morgounov, A. (2021). Diversity and sustainability of wheat landraces grown in Uzbekistan. *Agronomy for Sustainable Development*, 41, 34. <https://doi.org/10.1007/s13593-021-00691-2>
- Baboeva, S., Kulmamatova, D., Nazarov, K., Buzrukova, S., & Baboev, S. (2025). International winter wheat yield trials in semi-arid and irrigated conditions of Uzbekistan. *BIO Web of Conferences*, 194, 01046. <https://doi.org/10.1051/bioconf/202519401046>
- Common List of Quarantine Pests of the Eurasian Economic Union (2016). Common list of quarantine pests of the Eurasian Economic Union (Decision No. 158). Eurasian Economic Commission.
- Cui, H., Dong, Z., Song, Y., Guo, W., Yu, Y., Li, L., Lv, S., & Men, X. (2024). Effect of agricultural intensification on the genetic diversity of *Helicoverpa armigera*. *Food and Energy Security*, 13(2), e525. <https://doi.org/10.1002/fes3.525>
- Davari, A., & Parker, B. L. (2018). A review of research on Sunn pest (*Eurygaster integriceps* Puton [Hemiptera: Scutelleridae]) management published 2004–2016. *Journal of Asia-Pacific Entomology*, 21(1), 352–360. <https://doi.org/10.1016/j.aspen.2018.01.016>
- Derjanschi, V., & Pericart, J. (2016). Hémiptères Pentatomoidea, Faune de France (Vol. 90). Fédération Française des Sociétés de Sciences Naturelles.
- Dizlek, H., & Özer, M. S. (2021). Improvement of bread characteristics of high-level Sunn pest (*Eurygaster integriceps*) damaged wheat by modification in kneading and fermentation conditions. *Journal of Cereal Science*, 102, 103336. <https://doi.org/10.1016/j.jcs.2021.103336>
- Dizlek, H., & Özer, M. S. (2024). A study to clarify whether Sunn pest (*Eurygaster integriceps*) increases amylase activity in wheat. *Heliyon*, 10(10), e30870. <https://doi.org/10.1016/j.heliyon.2024.e30870>
- Esenbekova, P. (2017). First record of *Halyomorpha halys* (Stål, 1855) (Heteroptera, Pentatomidae) from Kazakhstan. *Eurasian Entomological Journal*, 16(1), 23–24. <https://doi.org/10.15298/euroasentj.16.1.05>
- Frolov, A. (2019). Patterns of pest population dynamics and phytosanitary forecast. *Plant Protection News*, 101(3), 4–33. [https://doi.org/10.31993/2308-6459-2019-3\(101\)-4-33](https://doi.org/10.31993/2308-6459-2019-3(101)-4-33)
- Gibicsár, S., & Keszthelyi, S. (2023). Topographical-based significance of sap-sucking Heteropteran in European wheat cultivations: A systematic review. *Diversity*, 15(1), 109. <https://doi.org/10.3390/d15010109>
- Hasanvand, H., Izadi, H., & Mohammadzadeh, M. (2020). Overwintering physiology and cold tolerance of the Sunn pest, *Eurygaster integriceps*, with an emphasis on the role of cryoprotectants. *Frontiers in Physiology*, 11, 321. <https://doi.org/10.3389/fphys.2020.00321>
- Ivantsova, E. (2013). Bioecology of Sunn pest (*Eurygaster integriceps* Put.) in the conditions of the Lower Volga region. *Bulletin of Volgograd State University. Series 11, Natural Sciences*, 6(2), 45–52. <https://doi.org/10.15688/jvolsu.1.2013.2.6>
- Jiao, H., Awais, M., Rsaliyev, S., Turakulov, K., Meliev, S., Li, L., Ali, S., Zhao, J., Kang, Z., & Ma, J. (2026). Molecular and virulence characterization of *Puccinia striiformis* populations on cereal crops in Kazakhstan. *Plant Pathology*, 75(2), e70163. <https://doi.org/10.1111/ppa.70163>
- Kaplin, V. G., & Burlaka, G. A. (2019). Phenotypic variability of body coloration in populations of shield bugs (*Eurygaster* Laporte, Heteroptera, Scutelleridae) in cereal crop fields and the environmental factors determining it. *Entomological Review*, 98(4), 706–723. <https://doi.org/10.1134/S036714451904004X>
- Kapustkina, A. V. (2018). Phenotypic monitoring of intraspecific structure of *Eurygaster* spp. populations in various agrobiocenoses. *Plant Protection News*, 97(3), 55–61. [https://doi.org/10.31993/2308-6459-2018-3\(97\)-55-61](https://doi.org/10.31993/2308-6459-2018-3(97)-55-61)
- Kapustkina, A. V. (2022). Harmfulness of the tortoise bug *Eurygaster maura* (L.) (Heteroptera: Scutelleridae) in Altai Territory. *Proceedings of the Russian Entomological Society*, 93, 91–98. https://doi.org/10.47640/1605-7678_2022_93_91
- Kapustkina, A., & Frolov, A. (2022). Wheat grain damage by *Eurygaster integriceps* Puton (Hemiptera, Scutelleridae): Diagnostics and detection methods. *Entomological Review*, 102(1), 50–62. <https://doi.org/10.1134/S0013873822010043>
- Kapustkina, A., & Nefedova, L. (2017). Seed viability in wheat damaged by the Sunn pest. *Plant Protection News (Vestnik Zashchity Rasteniy)*, 92(2), 22–28.

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- Khalaf, M., Alrubeai, H., Sultan, A., & Abdulkareem, A. (2017). Evaluating some insecticides for controlling the Sunn pest *Eurygaster* spp. Puton (Hemiptera: Scutelleridae) under field conditions. *Journal of Agricultural Science and Technology*, 7, 264–267. <https://doi.org/10.17265/2161-6264/2017.04.003>
- Kokhmetova, A., Rsaliyev, S., Atishova, M., Kumarbayeva, M., Malysheva, A., Keishilov, Z., Zhanuzak, D., & Bolatbekova, A. (2021). Evaluation of wheat germplasm for resistance to leaf rust (*Puccinia tritica*) and identification of the sources of Lr resistance genes using molecular markers. *Plants*, 10(7), 1484. <https://doi.org/10.3390/plants10071484>
- Konarev, A., Dolgikh, V., Senderskiy, I., Konarev, A., Kapustkina, A., & Lovegrove, A. (2019). Characterization of proteolytic enzymes of *Eurygaster integriceps* Put. (Sunn bug), a major pest of cereals. *Journal of Asia-Pacific Entomology*, 22(1), 379–385. <https://doi.org/10.1016/j.aspen.2019.02.001>
- Mamatkulova, G., Erjigitov, D., Mukhammadiev, O., Sokiboyeva, D., Kholova, M., Oripova, B., Ernazarova, D., Baboev, S., Turaev, O., & Kushanov, F. (2025). Assessment of heat tolerance in wheat (*Triticum aestivum* L.) at the seedling stage. *SABRAO Journal of Breeding and Genetics*, 57(3), 1041–1049. <https://doi.org/10.54910/sabao2025.57.3.16>
- Meliev, S., Chinnikulov, B., Aytenov, I., Isoqulov, S., Ochilov, B., Shokirova, D., Murodova, S., Dolimov, A., Turakulov, K., Bozorov, T., & Baboev, S. (2023). Characterization of CIMMYT bread wheat germplasm for resistance to yellow rust and environmental factors. *SABRAO Journal of Breeding and Genetics*, 55(6), 1865–1877. <https://doi.org/10.54910/sabao2023.55.6.1>
- Mityushev, I. (2020). Invasion and trophic relations of the brown marmorated stink bug *Halyomorpha halys* (Stål) (Heteroptera) in South Russia. *Euroasian Entomological Journal*, 19(6), 356–358. <https://doi.org/10.15298/euroasentj.19.6.10>
- Moore, D., & Edgington, S. (2006). The Sunn pest—A grain of hope for its control. *Outlooks on Pest Management*, 17(3), 135–137. <https://doi.org/10.1564/17jun13>
- Neimorovets, V. (2018). Brown marmorated stink bug *Halyomorpha halys* (Heteroptera: Pentatomidae): Morphology, biology, distribution and threats to agriculture in the Russian Federation (analytical review). *Plant Protection News (Vestnik Zashchity Rasteniy)*, 95(1), 11–16. [https://doi.org/10.31993/2308-6459-2018-1\(95\)-11-16](https://doi.org/10.31993/2308-6459-2018-1(95)-11-16)
- Neimorovets, V. (2019). Distribution of species of the genus *Eurygaster* (Heteroptera: Scutelleridae) in Russia. *Plant Protection News (Vestnik Zashchity Rasteniy)*, 102(4), 36–48. <https://doi.org/10.31993/2308-6459-2019-4-102-36-48>
- Özgökçe, M., Doğaç, M., & Kara, H. (2025). Molecular phylogeny and population structure of *Eurygaster integriceps* (Hemiptera: Scutelleridae) in the Southeastern Anatolia Region of Türkiye. *Turkish Journal of Zoology*, 49(3), 135–147. <https://doi.org/10.55730/1300-0179.3219>
- Pavlushin, V., Vilkova, N., Sukhoruchenko, G., Nefedova, L., & Kapustkina, A. (2015). Sunn pest and other cereal bugs. St. Petersburg, 1–280.
- R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Ribes, J., Gapon, D. A., & Pagola-Carte, S. (2007). On some species of *Carpocoris* Kolenati, 1846: New synonymies (Heteroptera: Pentatomidae: Pentatominae). *Mainzer Naturwissenschaftliches Archiv / Beiheft*, 31, 187–198.
- Rsaliyev, S., Gulyaeva, E., Baranova, O., Kokhmetova, A., Urazaliyev, R., Shaydayuk, E., Abdikadyrova, A., & Abugali, G. (2025a). Characterizing the genetic basis of winter wheat rust resistance in Southern Kazakhstan. *Plants*, 14(7), 1146. <https://doi.org/10.3390/plants14071146>
- Rsaliyev, S., Sarbaev, A., Eserkenov, A., Bastaubayeva, S., Orazaliyev, N., Baimagambetov, A., & Yermekbayev, K. (2025b). Assessment of agroecological factors shaping the population dynamics of Sunn pest (*Eurygaster integriceps* Puton) in Kazakhstan. *Ecologies*, 6(4), 81. <https://doi.org/10.3390/ecologies6040081>
- Rsaliyev, S., Urazaliyev, R., Ziyaev, Z., & Yusupov, N. (2024). Drought tolerance in winter wheat grown in Kazakhstan and Uzbekistan. *SABRAO Journal of Breeding and Genetics*, 56(5), 1918–1928. <https://doi.org/10.54910/sabao2024.56.5.15>
- Salis, L., Goula, M., Izquierdo, J., & Gordún, E. (2013). Population density and distribution of wheat bugs infesting durum wheat in Sardinia, Italy. *Journal of Insect Science*, 13, 50. <https://doi.org/10.1673/031.013.5001>
- Shpanev, A., & Kapustkina, A. (2025). Damage to winter triticale grain by herbivorous bugs in the Leningrad region. *Plant Protection News (Vestnik Zashchity Rasteniy)*, 108(3), 190–196. <https://doi.org/10.31993/2308-6459-2025-108-3-16833>
- Tadiyeva, M., Egamberdiyeva, M. X., & Sobirjonova, G. S. (2026). Impact of *Eurygaster integriceps* infestation on the technological and baking properties of wheat grown in Uzbekistan. *The American Journal of Interdisciplinary Innovations and Research*, 8(2), 78–82. <https://doi.org/10.37547/tajir/Volume08Issue02-10>
- Toreniyazov, E., & Bauetdinov, B. (2022). Development of the Sunn pest on winter wheat crops in extreme conditions of the Republic of Karakalpakstan. *EPRA International Journal of Research & Development (IJRD)*, 7(8), 78–80. <https://doi.org/10.36713/epri10971>
- Vaccino, P. P., Ingegno, B. L., Pansa, M. G., Coppa, T., & Tavella, L. (2017). Common wheat and cereal bug interactions: Kernel quality depletion and immunodetection of damage. *The Journal of Agricultural Science*, 155(2), 193–204. <https://doi.org/10.1017/S0021859616000162>
- Zhivotovskiy, L. (1991). Population biometrics. Nauka.