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ACANTHOSCELIDES OBTECTUS (SAY, 1831) (COLEOPTERA: CHRYSOMELIDAE: BRUCHINAE): DEVELOPMENT AND HARMFULNESS ON LEGUMES (PHASEOLUS AND VIGNA)

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Abstract. *Common beans and other legume crops are of significant food and economic importance; however, their cultivation and storage are substantially complicated by the harmfulness of specialized pest insects, among which Acanthoscelides obtectus (Say) is particularly dangerous. The combination of field and storage development cycles, high ecological plasticity, and the hidden lifestyle of the larvae lead to significant quantitative and qualitative losses of legume seeds. The study aimed to clarify the biological characteristics of the bean weevil and assess its level of harmfulness on legume crops of the genera Phaseolus and Vigna under field conditions in the Kharkiv region and during seed storage. The research was conducted in 2023–2025 using standard methods. It was established that under field conditions, the pest forms one incomplete development cycle, while the mass emergence of adults and the development of subsequent generations occur during seed storage. Common bean and mung bean proved to be the most suitable host plants for A. obtectus. After the development of three generations of the bean weevil, the thousand-seed weight decreased by 11–26%, depending on the species of plant. A direct correlation was found between the number of exit holes in the seed and the decrease in laboratory germination. The results obtained confirm the high harmfulness of the bean weevil and the necessity of improving the monitoring and protection systems for legume seeds.*

Keywords: *Acanthoscelides obtectus, Phaseolus, Vigna, phenology, harmfulness, 1000-seed weight, laboratory germination.*

Introduction.

Common bean (*Phaseolus vulgaris*) and species of the genus *Vigna* are currently considered niche crops in Ukraine; however, in the context of climate change and the growing global demand for high-protein products, these crops are regarded as promising for the near future [22]. Owing to their high nutritional value and versatile use, they are of particular interest for the development of domestic agricultural production, especially within the export-oriented sector. According to analytical data, during 2018–2022 the volume of common bean exports from Ukraine increased by 7,178 tons (58.7%), while export value rose by 9,541 thousand USD, which is 2.32 times higher than in previous periods [25].

Currently, the common bean is cultivated on all continents, with its origins traced to the regions of South and Central America, from which the crop spread to other parts of the world over the last few centuries [18]. The intensive expansion of bean cultivation was accompanied by the dispersal of a complex of specialized phytophagous insects, among which seed beetles (Coleoptera: Chrysomelidae: Bruchinae) represent a particular threat.

In the 19th century, adventive species of seed beetles penetrated European territory, some of which acquired the status of serious pests of legume crops, notably the bean weevil *Acanthoscelides obtectus* Say, 1831 [9]. Their spread was primarily driven by anthropogenic factors, especially international and domestic trade in legume seeds infested with pests [1]. The concealed larval lifestyle provides protection against adverse environmental conditions, including fluctuations in temperature and humidity, and facilitates their unnoticed transport with seed material.

Bean seeds infested by early-instar larvae often lack visible signs of damage, which creates conditions for their transboundary movement within import–export consignments. In newly colonized ecological niches, such populations pose a serious phytosanitary threat because, in the absence of natural enemies, the pest rapidly adapts and forms numerous infestation foci [12].

The bean weevil infests seeds of *P. vulgaris* already under field conditions; however, the most severe damage is caused during post-harvest storage. It is in storage facilities that intensive development of several generations of the pest occurs, leading to significant quantitative and qualitative losses of seeds [3]. As a result of larval feeding by *A. obtectus* on seed contents, losses in dry seed weight may range from 10 to 40% in less than six months of storage, and under high pest densities the level of damage may occasionally reach up to 70% [16].

Given the growing importance of common bean and other legumes as food and export crops, as well as the high invasive potential of the bean weevil, an in-depth study of the biology of this pest and the specific features of its harmfulness is highly relevant. The aim of this study was to clarify the biological characteristics of the bean weevil and to assess its harmfulness to legume crops of the genera *Phaseolus* and *Vigna* under

field conditions in the Kharkiv region and during seed storage.

Materials and Methods.

The study of the biology and harmfulness of the bean weevil was conducted in 2023–2025 on crops of common bean (*Phaseolus vulgaris* L.), lima bean (*Phaseolus lunatus* L.), mung bean (*Vigna radiata* (L.)), and cowpea (*Vigna unguiculata* (L.)). Field observations were carried out at the Educational, Scientific and Production Center "Experimental field Dokuchaevske" of the State Biotechnological University and at the State Enterprise Experimental Farm "Elitne" of the Plant Production Institute named after V. Ya. Yuriev of the National Academy of Agrarian Sciences of Ukraine, as well as on a private farm in the Bohodukhiv district of the Kharkiv region.

To monitor the abundance and development dynamics of the bean weevil, standard entomological research methods were applied, including sweep-net sampling, visual inspection of plants, and dissection of pods and seeds of legume to detect eggs, larvae, and adult exit holes [24, 26].

The impact of seed damage on physical parameters was assessed by determining the 1,000-seed weight. For this purpose, damaged and undamaged seeds were weighed using portable electronic scales with an accuracy of 0.01 g, after which the percentage of seed weight loss resulting from larval feeding by the pest was calculated.

Laboratory germination of bean and cowpea seeds was determined in accordance with the requirements of the state standard DSTU 4138–2002 [11]. Depending on the level of damage, assessed by the number of bean weevil exit holes, the seeds were divided into seven groups: undamaged (0 holes) and seeds with 1, 2, 3, 4, 5, and more than 5 holes per seed. For each treatment, 10 seeds were germinated in four replicates under standard conditions.

Statistical analysis of the experimental data was performed using analysis of variance according to a standard procedure [29].

Results and Discussion.

The bean weevil is a Neotropical multivoltine phytophagous insect distributed across five continents, with the highest population densities recorded in Latin America and Africa. Central America is considered the native area of this species [14].

Previously, *A. obtectus* was regarded as a specialized pest of common bean [4]; however, subsequent studies have substantially expanded current understanding of its host range. In particular, the ability of the pest to develop on cowpea (*Vigna unguiculata*), adzuki bean (*Vigna angularis*), lentil (*Lens culinaris*), chickpea (*Cicer arietinum*), pigeon pea (*Cajanus cajan*), pea (*Pisum sativum*), and faba bean (*Vicia faba*) has been documented [1, 2].

The ecological plasticity of seed beetles and their ability to adapt to new, including unfavorable or toxic, feeding environments are considered among the key factors contributing to the expansion of their host plant range [19]. Infestation of common bean by *A. obtectus* begins already under field conditions, where females lay eggs on formed pods. In cases of delayed harvesting, the level of damage may be so severe that it occasionally results in complete crop loss [20, 27].

Larvae emerging from eggs exhibit high mobility and rapidly penetrate into the pod, where further development occurs inside the seed. Under tropical temperatures, the complete life cycle of the pest lasts approximately one month [17]. It is well known that *A. obtectus* is characterized by a short developmental cycle (3–4 weeks) and a high reproductive potential, which under favorable conditions ensures the formation of several generations per year [23].

The harmfulness of the bean weevil during the storage of legume seeds has been extensively documented in the scientific literature. In particular, computed tomography (CT) scanning of damaged seeds revealed a significant reduction in seed mass and nutritional value as a result of larval development [7]. According to some researchers, seed mass losses of common bean may reach approximately 10% after the development of a single pest generation [8, 15]. At the same time, under storage conditions without protective measures, seed weight losses range from 7 to 40% [10], while most authors report losses of 20–100% [5, 6, 13].

Numerous studies also confirm the negative impact of the bean weevil on laboratory seed germination. As a consequence of embryo damage caused by larval feeding, seed germination is significantly reduced or completely lost [21, 26, 28].

Field observations conducted in 2023–2025 demonstrated that under the climatic

conditions of the Kharkiv region the bean weevil completed only one incomplete developmental cycle. At harvest time, larvae of older instars and pupae were detected in common bean seeds, whereas larvae of younger and intermediate instars predominated in lima bean, mung bean, and cowpea. Mass emergence of adult beetles occurred mainly during seed storage.

The onset of infestation of common bean crops was observed in the first decade of July, coinciding with the flowering and pod formation stages. During this period, adults underwent additional feeding on flowers. Mass oviposition took place in the third decade of July, corresponding to the seed maturation stage. Newly hatched larvae penetrated pod valves, leaving characteristic spots, after which subsequent development proceeded inside the seeds. Earlier pod formation in common bean resulted in earlier and more intensive infestation compared with species of the genus Vigna.

Under field conditions, one larva typically developed within a single seed, while the occurrence of two or three larvae per seed was rare. Adult emergence was recorded predominantly during seed storage. Considering that common bean proved to be the most suitable host plant for the development of *A. obtectus*, phenological observations are presented specifically for this crop (Table 1).

The harmfulness of the bean weevil was assessed based on the thousand-seed weight and laboratory germination. It was established that after the development of three generations of the pest during the storage period until spring, the thousand-seed weight decreased by 19–26% in common bean, by 11–14% in lima bean, by 18–24% in mung bean, and by 13–20% in cowpea (Table 2). Consequently, when damaged seed material is used for sowing, an appropriate adjustment of the seeding rate is required.

A significant reduction in laboratory seed germination was also established depending on the level of damage. In particular, for common bean the decrease in germination ranged from 13.2 to 100.0% and was directly related to the number of exit holes formed by the bean weevil (Table 3).

The analysis of the obtained data indicates a direct correlation between the number of exit holes formed by the bean weevil and the degree of reduction in

laboratory germination of legume seeds. Even the presence of a single exit hole resulted in a noticeable deterioration of seed sowing quality, with the magnitude of this effect varying significantly among crop species. At five exit holes per seed, the seeds of common bean and mung bean completely lost their germination capacity, whereas only a small proportion of viable seeds remained in lima bean and cowpea. When more than five exit holes were present, seed germination was almost completely lost in all investigated legume crops.

Table 1 – Phenological synchronization of *A. obtectus* development and *Ph. vulgaris* stages in 2023-2025 in the conditions of the Kharkiv region

Pest phenological event	Plant phenological stage
Beginning of beetle colonization	Flowering – Pod formation
Mass colonization of plants by beetles	Seed filling in pods
Beginning of egg-laying	
Mass egg-laying	Seed maturation
Beginning of larval hatching	
Mass larval hatching	
Beginning of pupation	
Mass pupation	Full seed maturity
Beginning of adult emergence	
Mass adult emergence	

Notes: grouped by authors.

Table 2 – Reduction in the thousand-seed weight of legume crops after the development of *A. obtectus* during the storage period

Legume species	Reduction in 1000-seed weight, %	Degree of impact
Phaseolus vulgaris	19–26	Strong
Phaseolus lunatus	11–14	Moderate
Vigna radiata	18–24	Strong
Vigna unguiculata	13–20	Moderate

Notes: grouped by authors.

Table 3 – Reduction in laboratory germination of legume seeds depending on the number of exit holes caused by *A. obtectus*

Number of exit holes per seed, pcs	Decrease in germination of damaged seeds, %			
	Phaseolus vulgaris	*Phaseolus lunatus*	*Vigna radiata*	*Vigna unguiculata*
0	-	-	-	-
1	17,9	9,9	16,8	15,6
2	38,5	26,1	28,5	29,5
3	43,6	33,3	39,9	42,8
4	64,1	60,5	72,6	62,5
5	100,0	89,6	100,0	94,9
More than 5	100,0	98,0	100,0	100,0
$LSD_{0.05}$	3,8			

Notes: grouped by authors.

Conclusions.

It was established that *A. obtectus* is an ecologically plastic, multivoltine pest with a high invasive potential, capable of combining field and storage developmental cycles, which significantly increases its harmfulness to legume crops.

Under field conditions of the Kharkiv region during the 2023–2025 growing seasons, the pest completed one incomplete developmental cycle. Infestation of common bean crops began at the flowering – pod formation stage, whereas adult emergence occurred mainly during post-harvest storage.

The studied legume crops differed markedly in their suitability for the development of the bean weevil. Common bean and mung bean were identified as the most favorable host plants.

After the development of three generations of *A. obtectus* during the storage period, a significant reduction in thousand-seed weight was recorded, amounting to 19–26 % in common bean, 18–24 % in mung bean, 11–14 % in lima bean, and 13–20 % in cowpea, indicating substantial quantitative losses of seed material.

A direct negative relationship was observed between the number of exit holes and laboratory seed germination. Even minimal levels of damage resulted in deterioration

of sowing qualities, whereas at five or more exit holes per seed, the seeds of most crops completely lost their ability to germinate.

The obtained results confirm the particular danger posed by the bean weevil to legume seeds and substantiate the need for systematic monitoring of pest populations, timely harvesting, and improvement of seed protection measures during storage.

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