

Overview of the spread of soybean pests in the Russian Federation

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Abstract. Soy is the most demanded and widespread leguminous culture in the world. She received this status due to the rich chemical composition of seeds and its wide use for food, technical and fodder purposes. The sown area under this crop is increasing every year. Soy is an attractive object for many insects. In its agrocenosis there are both useful and harmful species. The object of our research was soybean pests. The article analyzes publications in order to clarify the species composition and distribution of soybean pests in the last century to the present. The paper presents data on the distribution of soy phytophages in the main regions of soybean cultivation in Russia. Among the pests of soybeans in the Russian Federation there are both specialized and multi -stage species: leaf - shocking insects - *Lepidoptera* (scaly), *Coleoptera* (hard -winged), *Hemiptera* (semi -burned -winged), *Homoptera* (equivalent), *Acariformes* (ticks), *Thysanoptera* - thrips (*Thrips* sp.), insects damaging seeds - diptera (double -winged). The most common phytophages causing significant harm to soybeans in Russia are: *Leguminivora glycinivorella* Mats., *Paraluperodes suturalis nigrobilineatus* Motsch., *Aphis glycines* Mats., *Loxostege sticticalis* L., *Etiella zinckenella* Tr., *Orthosia ella* Butl., *Pyrrhia umbra* Hufn., *Heliothis maritime* Grasl. and *Tetranychus urticae* C.L.Kocn. According to the results of phytosanitary monitoring in 2022 in Primorsky Krai, the most common soybean pests were: soybean striped leaf beetle, polyphagous soybean leaf beetle, soybean moth and various types of bugs.

1 Introduction

The most common crop among legumes and oilseeds is soybean, which is one of the three most important agricultural crops. She received this status due to the rich chemical composition of seeds and its wide use for food, technical and fodder purposes. In addition, having valuable technical qualities and providing highly nutritious products, soybeans, due to the presence of nitrogen-fixing nodules on the roots, improve the structure of the soil, enriching it with nitrogen [1].

Soybeans are mainly grown in six federal districts, which differ significantly in meteorological conditions. The largest are the Far Eastern, Central and Southern federal

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districts. The increase in the area under soybeans in the Russian Federation and non-compliance with the agricultural technology of its cultivation has led to the massive development of harmful organisms. Therefore, in the system of measures that ensure high yields of this valuable crop, a properly organized fight against its phytophages and diseases is of great importance.

The most important soybean pests are insects. In its agrocenosis there are both useful and harmful species. More than 150 species of phytophages are known to cause harm to soybeans, but no more than 20 of them cause significant damage. Among them, 22% are cosmopolitan (live on all continents), 35% are palearctic (live only in Eurasia). 20% of pests from the total number are localized in the Far East [2].

2 Materials and methods

When compiling the review, materials from publications on soybean pests in the Russian Federation and phytosanitary monitoring data for the main areas of crop cultivation in the Primorsky Territory were used.

When surveying soybean crops, the following accounting methods are used:

- Accounting for pests on the sites. For sessile pests, the count is carried out on square plots, usually 0.25 m² (0.55 x 0.45 m) in size.
- Accounting for pests by inspection of plants (visual). Accounting for pests is carried out by examining plants along the perimeter of the site in 10 places, 100 plants each.
- Accounting for pests by "mowing with a net". For mowing, standard entomological nets with a hoop diameter of 30 cm and a bag depth of 60 cm are used. 10 or 25 strokes are performed at one time (one sample). The area mowed at 25 strokes is 12.5 m².
- Accounting for soil pests. To account for pests living on soybean roots, 20 plants are selected from the accounting plot, carefully dug out, washed, taking into account the presence and number of insects.

The number of pests for each species is summarized and their number per 1 m² is determined by the formula:

$$X = \frac{PK}{M} \quad (1)$$

Where X is the average number per 1 m²; P is the sum of pest abundance in samples; M is the number of samples; K is the number of samples in 1 m².

3 Results and Discussion

Among soybean pests on the territory of the Russian Federation, there are both specialized and polyphagous species: leaf-eating insects - Lepidoptera (lepidoptera): soy moth (*Leguminivora glycinivorella* Mats.), meadow moth (*Loxostege sticticalis* L.), steel cutworm (*Pyrrhia umbra* Hufn.), cotton scoop (*Helicoverpa armigera*), scoop sweet clover (*Heliothis maritime* Grasl.), alfalfa cutworm (*Chloridea dipsacea* L.), Ella or dark gray early cutworm (*Orthosia ella* Butl.), Icelandic cutworm (*Euxoa ochrogaster* Gr.), red-brown Ussuri cutworm (*Sarcopolia illoba* Butl.), upsilon cutworm (*Agrotis ipsilon* Hufn.), acacia (bean moth (*Etiella zinckenella* Tr.), spotted brushtail (*Orgyia recens* Hbn), gloomy mustache (*Hypena tristalis* Led.), soy jaundice (*Colias erate polyographys* Motsch.), brown Amur crassula (*Phragmatobia amurensis* Seitz.), burdock (*Pyrameus cardui* L.); Coleoptera (coleoptera): polyphagous leaf beetle (*Luperodes menetriesi* Fald.), four-spot leaf beetle (*Monolepta quadriguttata* Motsch.), soy leaf beetle (*Luperodes menetriesi* Fald.),

soy striped leaf beetle (*Paraluperodes suturalis nigrobilineatus* Motsch.), gray beet weevil (*Tanymecus palliates* Fald), larvae of click beetles (*Agriotes lineatus* L. and *A. gurgistanus* L.), Japanese beetle (*Pohillia japonica* New.), quarantine species); sucking - Hemiptera (semiptera): berry bug (*Dolocoris baccarum* L.), alfalfa bug (*Adelphocoris lineolatus* Goeze), bright green bug (*Palomena viridissima* Poda), field bug (*Lygus pratensis* L.); Homoptera (Homoptera): soybean aphid (*Aphis glycines* Mats); Acariformes (mites): spider mite (*Tetranychus urticae* C.L. Kocn.); Thysanoptera - thrips (Thrips sp.); seed damaging insects – Diptera (Diptera): sprout fly (*Chortophila florilega* Zett.), nodule fly (*Rivelia sphenisca* Hendel.), mining flies (*Agromyzidae*), root fly (*Ophimyia shibatsuji* Kato).

At the beginning of the 20th century (1901-1933) in Russia, the meadow moth was the most harmful, causing significant losses in the soybean crop. The mass development of this pest was observed in 1901 and 1905, from 1912 to 1915 and from 1921 to 1923. From 1956 to the present, the most harmful phytophage for soybean seedlings is the striped soybean leaf beetle, and in the phase of the formation of beans of the culture - soybean codling moth. Also in recent years, the acacia bean moth has become widespread and developed [1, 3].

Currently, 52 species of soybean pests have been identified in the Krasnodar Territory (Southern Federal District). The predominant orders of phytophages are Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Homoptera, Thysanoptera. Seedling pests are represented by larvae of click beetles (wireworms), dark beetles (false wireworms) and sprout flies, caterpillars of nibbling scoops, lingering beetles, sandy, corn and striped nodule weevil. During the period of soybean leaf formation, the most harmful are: meadow moth, leaf-eating cutworms, leafhoppers, herbivorous bugs, spider mites, thrips and aphids. Of the most harmful bugs are field, berry and alfalfa. The most harmful species are the acacia bean moth and cotton bollworm, which damage beans and soybean seeds by type III (up to 16%). With mass reproduction of pests, yield losses can reach 50-80% [4].

In the conditions of the Lower Volga region, soybean is a new crop and therefore the species composition of soybean pests has not been completely formed. Now the entomofauna is represented by the orders Lepidoptera, Coleoptera, Orthoptera, Homoptera and Thysanoptera. During the period of seedlings, wireworms, winter scoops, nodule weevils harm; in the branching phase - alfalfa scoop, meadow moth, in the phase of flowering and ripening of beans - spider mite, soybean codling moth, cotton scoop, acacia bean moth. The most widespread and dangerous pests include the meadow moth and tobacco thrips [5].

The most common soybean pests in the Central Federal District are phytophages from the orders Lepidoptera, Coleoptera, Hemiptera, Homoptera, Thysanoptera. The species composition in this region is also represented by: pests of seedlings - nodule weevils, cabbage and alfalfa scoops, winter cutworms, burdock, click beetle larvae; pests of generative organs (beans and seeds) - alfalfa bug, pea and beet leaf aphids, soybean codling moth. The number of these pests is close to the economic threshold of harmfulness (ETL), and in some years even exceeds it.

Recently, the most harmful species are acacia (bean) moth and soybean codling moth, damage to beans and soybean grains reaches 41% and 14%, respectively. With the development of this pest, crop losses can exceed 50%. Intensive reproduction of the acacia bean moth is promoted by high temperature at low relative air humidity [6].

On the territory of the Siberian Federal District, nodule (striped, bristly, gray beet) weevils are populated among soybean crops during the germination period; leaf damage by the pest can reach 40.7%. Later found - soybean striped leaf beetle, soybean and pea aphids, thrips, meadow moth, polyphagous leaf beetle, field bugs, leaf-eating scoops (alfalfa, winter, cabbage). Damage to leaves, depending on the pest, ranges from 0.5 to 33% [7-8].

In the Russian Federation, one of the largest regions of soybean production is the Far East. The geographical location of the Far East creates favorable conditions for the development of soybean pests.

According to phytosanitary monitoring data in the Khabarovsk Territory, the soybean striped leaf beetle is widespread on soybean crops, which harms in the seedling phase (the average number can reach 9 ind./m²), soybean codling moth - damages soybeans in the seed ripening phase (up to 5%—beans and 3%—seeds) and spider mites, which damage leaves. Also, recently, soybean leaf beetle (average abundance - 0.4-5 ind./m²) and soybean aphid (average plant population - 5-8.5%) have been causing significant harm [9].

In the Amur Region, soybean pests such as soybean root miner or root fly, snow bear, soybean leaf beetle, soybean striped leaf beetle, steel cutworm, soybean codling moth, ella cutworm or early dark gray cutworm, sweet clover cutworm, meadow moth prevail. Among them, the soya bean moth causes significant harm (the percentage of damaged seeds can reach 40% in some years), sweet clover and steel cutworm (damage up to 11% of beans) [10-11].

If in the 50s of the last century in Primorsky Krai large crop shortages (up to 20-30%) were caused by such pests as soybean striped leaf beetle, polyphagous soybean leaf beetle, soybean codling moth, alfalfa cutworm and sprout fly [28], recently harmful specialized pests are: soybean aphid (up to 90 individuals/plant), soybean leaf beetle (up to 18 ind./m²), soybean codling moth (average percentage of bean damage is 9%), leaf-eating cutworms, root fly and spider mite (up to 10-12 ind./leaf) [12-14].

According to the phytosanitary monitoring data of the Russian Agricultural Center in Primorsky Krai and the Far Eastern Research Institute of Plant Protection in the past year (2022), the most common soybean pests were: soybean striped leaf beetle - 3.03 adults / m² (9 specimens / 10 swings of the net, crop damage 1.9%), polyphagous soybean leaf beetle - 1 larva / m² and 0.2 adults/m² (crop damage 0.11%), soybean codling moth (2–8 specimens/10 sweeps of the net, percentage of infested plants (organs) – 22.75%, damage – 1.42%), various types of bugs (1–5 specimens/10 sweeps of the net) (Figures 1-3) [15].

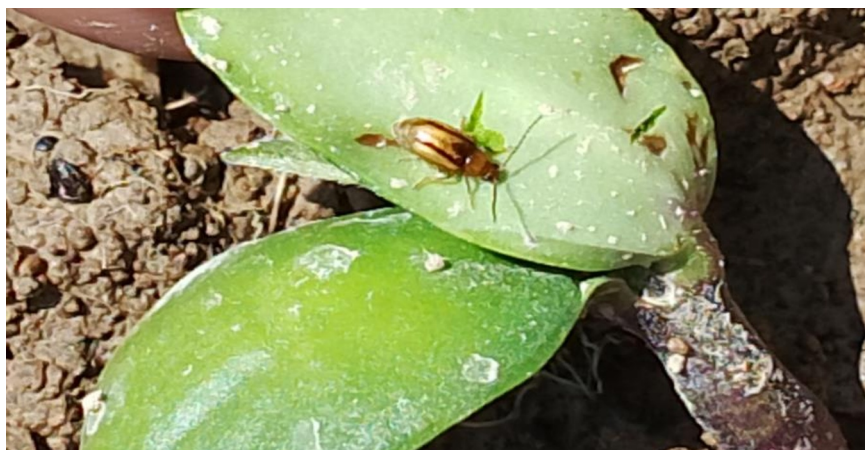


Fig. 1. Soy striped leaf beetle (authors photo).



Fig. 2. Damage to soybean by soybean striped leaf beetle (authors photo).



Fig. 3. Bed bug eggs (authors photo).

4 Conclusion

Thus, the most common phytophages that cause significant harm to soybeans in Russia are: soybean codling moth, soybean striped leaf beetle, soybean aphid, meadow moth, acacia moth, leaf-eating cutworms and spider mites.

To identify pests and make timely decisions on the implementation of protective measures, it is necessary to monitor soybean crops annually. Research allows you to estimate the number of pests and determine the species of insects.

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