

RESEARCH ON THE MANAGEMENT OF BACTERIAL BLIGHT AND THE COMMON RED MITE IN AN IRRIGATED SOYBEAN CROP

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Abstract

The aim of this work is to highlight an effective treatment scheme for combating bacterial blight of soybean (*Pseudomonas savastanoi* pv. *glycinea*) and common red spider mite (*Tetranychus urticae*) under conditions of natural infection and irrigated cultivation. Observations were carried out in 2023, in the experimental field arranged within I.I. Popescu Iulian, in the city of Ianca, Brăila county. The biological material used was the ES Palador variety. Bacterial blight attack was assessed visually, and mites were captured by shaking the leaves onto a white sheet of paper. The frequency of soybean plants attacked by bacterial blight varied between 4.0 and 82.33% in the experimental variants. The common red spider mite attack reduced soybean production by 16.85%. The highest production, of 4895 kg/ha, was obtained in the variants with two treatments against the two biotic factors. Following the research, it can be concluded that among the limiting biotic factors in soybean culture are both the bacterium *Pseudomonas savastanoi* pv. *glycinea* and the mite *Tetranychus urticae*.

Key words: soybean, bacterial blight, common red mite, management.

INTRODUCTION

Soybean -*Glycine max* (L.) Merr. is an important agricultural crop due to its multiple uses: human food (oil, tofu, soybean hamburger or soy milk, due to the quality of proteins, along with high concentrations of isoflavones, phytosterols and minerals), feed (soybean meal fed to farm animals, especially poultry and pigs) and industrial (biodiesel), which is why it occupies close to 6% of the world's arable land (Goldsmith, 2008; Rotundo et al., 2024).

Soybean consumption is beneficial for human health because it contributes to lowering cholesterol levels (Jenkins et al., 2010) and blood pressure, which is reflected in a lower incidence of heart attack and stroke (Yan et al., 2017).

Cultivation is successful in areas with average temperatures of 23-28°C; temperatures below 20°C and above 40°C significantly inhibit growth (Kado, 2010).

Although it has the ability to fix atmospheric nitrogen due to its symbiosis with the bacterium *Bradyrhizobium japonicum* (Kirchner) Jordan, for best yields, it is recommended to inoculate the seeds with bacteria before sowing.

The area cultivated with soybeans in Romania in 2023 was 142,000 ha, and in 2024 145,000 ha. The total soybean production in 2023 was 303,000 tons, which corresponds to an average production of 2,133.8 kg/ha, and in 2024 295,000 tons, the average production being 2,034.5 kg/ha (https://insse.ro/cms/sites/default/files/com_presa/com_pdf/prod_veg_r24.pdf). The area cultivated with soybeans in Brăila County, in the 2023-2024 agricultural year, was 19,276 ha (<https://probr.ro/din-cauza-secetei-pedologice-instalate-in-anul-agricol-2023-2024-in-judetul-braila-a-fost-calamitata-o-suprafata-totala-de-113-125-ha/>).

Climate change will cause soybeans to be affected by certain pathogens and pests in the growth process, which will be reflected in the qualitative and quantitative decrease in production.

Pseudomonas savastanoi pv. *glycinea* (Coerper) Gardan, Bollet, Abu-Ghorrah, Grimont & Grimont is a common pathogen in soybeans grown in Romania and can be found in most soybean fields every year.

Severe infections with *Pseudomonas savastanoi* pv. *glycinea* can cause yield losses of up to 40% (Williams and Nyvall, 1980).

The bacteria enter the plant through natural openings and wounds.

The pathogen overwinters in crop residue and can be seed transmitted.

The common red spider mite-*Tetranychus urticae* Koch, is an important pest of soybean crops in hot and dry areas.

Due to the high number of generations per year, 6-10 (Manolache et al., 1978 cited by Roșca et al., 2011), it can cause plant damage of 10-50% (Biliavska et al., 2025).

Spider mite infestation is recognized by the webbing present on the surface of the leaves and by the discoloration of the leaves.

The stability of global food systems increasingly depends on the resilience of cultivated plants to environmental stress. Yet the productivity of these plants is persistently threatened by a diverse spectrum of pathogens and pests whose development and dissemination are tightly regulated by climatic conditions in different areas worldwide (Cotuna et al., 2021; Cotuna et al., 2022; Paraschivu et al., 2021; Paraschivu et al., 2023; Păunescu et al., 2022; Velea et al. 2021).

MATERIALS AND METHODS

The objective of this research was to estimate the degree of attack of bacterial blight and red spider mite in soybeans grown under irrigation conditions in order to obtain the necessary information for making decisions regarding the application of phytosanitary treatments.

Ratings were based on visual inspection, a conventional method of detecting disease and mite attack based on symptoms induced by them (Zală et al., 2012; Zală et al., 2014).

As shown in Figure 1, the soybean variety of ES Palador cultivated in 2023 were planted and cultivated in the experimental field of II Popescu Iulian, in location Ianca (45°8'6"N 27°28'29"E), Brăila county. ES Pallador is a semi-late soybean variety, with indeterminate growth, adaptable to various soil and climatic conditions, suitable for all growing areas in Romania. It has a protein content of 41.3% and 20.3% oil. Recommended density on irrigated soils: 450-500,000 b.g/ha (<https://lidea-seeds.ro/products/soia-1-1>).

The preceding plant was corn.



Figure 1. Image from the experimental soybean field, ES Palador variety (source: C. R. Zală)

Applied agrotechnics:

- sowing 492000 b.g./ha, 70 cm row spacing + administered N:P:K type fertilizers - 20:20:0, on 20.04.2023;

- post-emergence herbicide against weeds Annual and perennial monocotyledonous and dicotyledonous weeds - 1 l/ha;

- a mechanical harrow;

- application of biostimulator Amino Start - 5l/ha + Wuxal® Boron SiCure - 1 l/ha, before flowering + insecticide Mospilan 20 SG - 0.2 kg/ha;

- application of fungicide Propulse® 250 SE - 1 l/ha + insecticide Coragen - 0.1 l/ha + Wuxal® Boron SiCure - 1 l/ha.

Abiotic factors (especially temperature and relative humidity) exert an important influence on the emergence and evolution of pathogens and pests (Bălașu et al., 2015; Gîdea et al., 2007; Lipianu et al., 2023; Zală et al., 2023).

Temperature and the presence of water on the leaves, from rainfall or sprinkler irrigation (Figure 2) were favorable for the occurrence of bacterial blight.

Also, high temperature values and low amounts of precipitation were favorable for the development of the red mite (Figure 3).

Four irrigations were applied by sprinkling: after sowing, after herbicide application, after mechanical weeding (Figure 4), and at the beginning of flowering, each 50 mm.

The attack value, in the case of bacterial blight, is represented by frequency (F%), intensity (I%) and attack degree (AD%). Frequency represents the percentage of plant attacked out of 100 soybean plants examined.

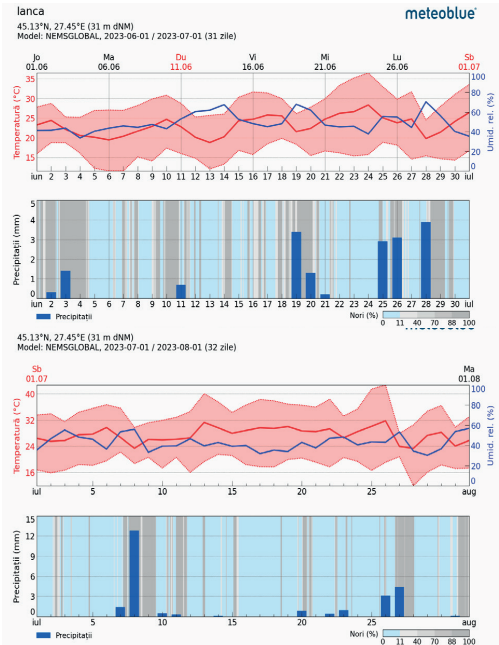


Figure 2. Temperature (°C), relative air humidity (%) and precipitation recorded in July and August 2023 in the Ianca area, Brăila (source:https://www.meteoblue.com/ro/vreme/historyclimate/weatherarchive/ianca_romania_675840)

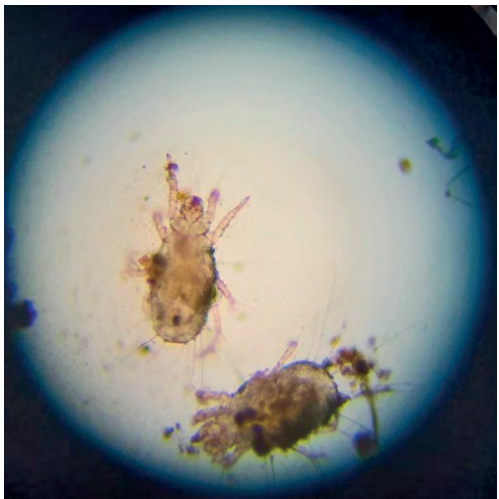


Figure 3. Two specimens of the common red mite through the lens of an optical microscope (source: R. Istratie)

Intensity indicates the degree to which the soybean plant is attacked. The attack degree was calculated using the formula:

$$AD\ (%) = \frac{F\ (%) \times I\ (%) }{100}$$



Figure 4. Irrigation of soybean crop after mechanical weeding (source: C. R. Zală)

Experimental variants:
V1 - control;
V2 - two treatments applied with Triumph 40 WG fungicide (40% metallic copper in the form of $Cu(OH)_2$ - 2.5 kg/ha against bacterial blight. The first treatment was applied in the R3 phenophase - beginning of pod formation (Fehr et al., 1971): a 5 mm long pod at one of the 4 upper nodes. The second treatment was applied in the R4 phenophase - fully developed pod: a 2 cm long pod at one of the 4 upper nodes.
V3 - two treatments with Nissorun 10 WP (hexitiazox 10%) acaricide - 0.8 kg/ha. The first treatment was applied in the R1-beginning of flowering phenophase: the first flower opened on any of the nodes of the main stem, 8 weeks after crop emergence. The second treatment was applied in the R5-beginning of grain filling phenophase: 3 mm long seed in a pod at one of the 4 upper nodes.
V4 - two treatments with fungicide and acaricide in the above mentioned phenophases.
The scoring of bacterial blight attack was performed 10 days after the application of the second treatment.
Research on the effect of plant protection products used provides data on the possibility of introducing them into crop management schemes (Chiriac and Cristea, 2021).

RESULTS AND DISCUSSIONS

Symptoms of bacterial blight

Bacterial blight occurred on leaves in the middle and upper canopy of soybean plants, because

young leaves are most susceptible. Infections started as small, angular, hydrous, yellow-green spots that turned yellow and then brown. The spots are surrounded by chlorotic halos, as a result of the production of the phytotoxin coronatin. The spots may coalesce and cover large areas of the leaves (Figure 5). The affected tissue may fall off, giving the leaves a perforated appearance. The infected leaves often remain on the plant.

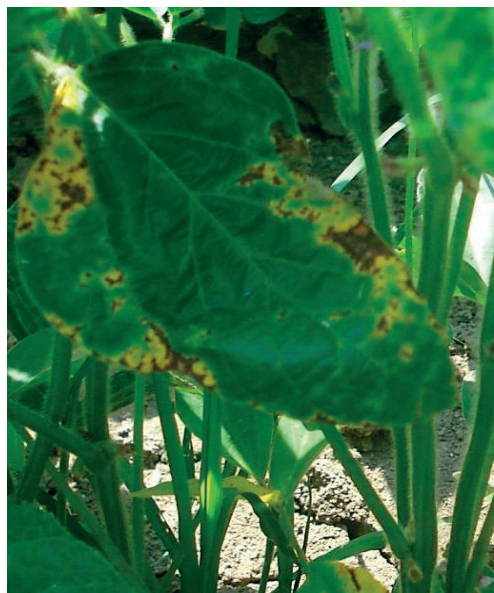


Figure 5. Symptoms of bacterial blight on a soybean leaf (source: C. R. Zală)

Scoring the bacterial blight attack

As can be seen from the data in Table 1, the frequency of bacterial blight attack varied from 4.0% in V2 to 82.33% in V1. The frequency value in V1 is higher than that in V3, because we can assume that in the control variant there were greater chances for infection with *Pseudomonas savastanoi* pv. *glycinea*, including through the holes resulting from the stinging of the leaves by mites. The intensity values of bacterial blight attack ranged from 2.7 to 23.1%. The lowest values were recorded in the variants in which the fungicide-bactericide Triumph 40 WG was applied. Regarding the degree of attack, it was 0.1% in V2, 0.16% in V4, 16.95% in V3 and 19.1% in V1.

Table 1. Scoring the frequency, intensity and calculating the degree of attack of soybean bacterial blight

Variant	Frequency (%)	Intensity (%)	Degree of attack (%)
V1	82.33	23.1	19.01
V2	4.0	2.7	0.1
V3	75.0	22.6	16.95
V4	5.66	2.9	0.16

The productions obtained

The average soybean production in the control variant was 3744.7 kg/ha (Table 2). The average soybean production in variant V2 was 4070.02 kg/ha, 323.32 kg/ha higher than in V1, which represents an increase of 8.7%. The average soybean production in variant V3 was 4569.95 kg/ha, 824.25 kg/ha higher than in V1, which represents an increase of 22.0%. The average soybean production in variant V4 was 4895.0 kg/ha, 1150.3 kg/ha higher than in V1, which represents an increase of 30.7%. If we refer to variants V4, it appears that production in V2, where two treatments were applied against soybean bacterial blight, is reduced by 16.85% as a result of the common red mite attack, and in V3, where two treatments were applied against the common red mite, production was reduced by 6.65% as a result of the bacterial blight attack. From the determinations carried out on 100 soybean leaves at 4 points in the control variant, a colonization of 18.5 specimens/leaf was observed.

Table 2. The influence of biotic factors on soybean production

Variant	Production (kg/ha)	Difference	
		(kg/ha)	(%)
V1	3744.7	-	100
V2	4070.02	325.32	108.7
V3	4569.95	824.25	122.0
V4	4895	1150.3	130.7

CONCLUSIONS

Among the main limiting factors of soybean cultivation, those of a biotic nature are found to a very large extent, in this case *Pseudomonas savastanoi* pv. *glycinea* and *Tetranychus urticae*. Abiotic factors, especially temperature and humidity, favored the emergence, growth, and development of soybean bacterial blight and common red mite during the 2023 growing season.

The biological material was represented by the ES Palador variety and the research was carried out in the experimental field in Ianca, Brăila County.

The typical symptoms of bacterial blight attack were manifested only on the leaves, namely those located on the upper floor of the infected soybean plants.

Copper-based fungicides are plant protection products effective in combating bacterial burn provided they are applied at the first symptoms appear.

Applying two treatments with the fungicide-bactericide Triumph 40 WG, at the appropriate time - the appearance of the first symptoms, contributed to reducing the degree of attack of soybean bacterial blight from 19.01% to only 0.1%.

The application of two treatments each against soybean bacterial blight and common red mite ensures, under irrigation conditions, a production increase of approx. 1150 kg/ha, which represents an increase of approx. 30.0% in production compared to the variants without these treatments.

Bacterial blight of soybean caused a 6.65% reduction in production in the present experiment.

The attack of the common red mite caused a 16.85% reduction in production in the experimental variants.

The application of sprinkler irrigation caused the mites to retreat to the lower areas of the infested plants.

The application of phytosanitary treatments is an extremely important link in the integrated fight to reduce the attack of bacterial blight and the common red mite, along with the other technological measures that must be respected.

The highest average production, of 4895 kg/ha, was recorded in the variants in which two treatments were applied against bacterial blight and common red mite with the fungicide-bactericide Triumph 40 WG and the acaricide Nissorun 10 WP.

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