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THE INFLUENCE OF IRRIGATION ON THE SOYBEAN CULTURE IN THE CONDITIONS OF DOBROGEA

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Abstract: *Due to the climatic conditions on the territory of Dobrogea, considered as one of the most favorable areas in Romania for growing soybean, obtaining high yields can only be achieved through irrigation.*
The experimental research aiming optimizing the water factor was carried out at the Teaching Station of the Faculty of Natural Sciences and Agricultural Sciences, Ovidius University of Constanța.
This paper presents the influence of irrigation water on the accumulation of epigean biomass and dry matter in the Procera variety, in the years 2022-2023 circumstances.
The accumulation of dry matter was determined by weighing the aerial part in fresh state, on components, stem, leaves, reproductive organs, and oven drying (60 ^{0} C to constant weight). The drying was done completely, when the size of the plant allowed, or on average samples of 100 g for each individual component, according to the vegetative growth of the plants.
The present paper presents the results obtained from a monofactorial experiment aimed at determining the elements of the irrigation regime for soybean crop in an ecological system.
Among the irrigation options, the highest grain production (3.625 t/ha) was recorded in the 50% IUA option at a depth of 75 cm, which had a significant growth, compared to the non-irrigated option (2.025 t/ha). Similar values were also recorded in the IUA of 70% irrigation option at 75 cm depth, i.e. 3.475 t/ha, a statistically guaranteed increase.
In these conditions, the application of irrigation can have a decisive role in increasing the average production, a fact proven by the results obtained in the experimental field.

• Introduction

Soybean (Glycine hispida) is a leguminous plant of great importance, planted worldwide with many uses. Soybeans contain elements with a higher nutritional and energy value, such as: 30-40 % protein, 13-26 % fat, 13-24 % non-nitrogen extractive substances, 16-25 % lecithin, vitamin B (B_1 - B_2 - B_6), as well as enzymes (lipases, amylases).
This crop benefits the environment, if good agricultural cultivation practices are followed, being able to fix atmospheric nitrogen, thus reducing mineral nitrogen fertilization and nitrogen leaching, contributing to a less polluting environment.
The positive impact of soy on the environment can be seen succinctly through some characteristics of this plant that we must take into account: it is a good first step. It plays an important role in crop rotation, which maintains soil fertility.
Soybeans are included in the organic farming system, starting from the conversion process and up to the actual production of organic soybeans.
In our country, the cultivated soybean area in 2020-2021 was - 140 thousand hectares, and in 2022 - 134 thousand hectares (BORCEAN, 2003).
Water stress, including drought, is considered a major threat, limiting plant growth and yield.
Drought is caused by insufficient rainfall and irrigation.
In water deficient conditions, a significant reduction in germination, fresh and dry weight of roots, and shoots were observed (PĂLTINEANU ET ALL, 2000).

• Material and method

The research was carried out in the Experimental Didactic Field of the Ovidius University, Constanța, over a period of two years (2022-2023).
The climate is temperate, continental, with an average annual temperature of 12-13°C. The amount of precipitation is the lowest in the country (below 350mm).
In the year 1 of soybean cultivation there were recorded 195 mm of vegetation precipitation (32.5 mm/month), and the average temperature was 19,3°C over the six months of vegetation.
In the year 2 there was extremely dry, with low precipitations (150 mm), and the average temperature recorded the value of 20,3° C throughout the soybean growing season.
The soil in the experimental field is of chernozem-carbonate type, with a loamy-clay texture.
The experience is of monofactorial type and this includes 6 levels of irrigation (unirrigated, irrigated at germination, irrigated in the critical phase, irrigated 50% IUA, irrigated 65% IUA, and irrigated 70% IUA) with 4 repetitions and one soybean variety. The area of the plot was 30 square meters.
The biological material used was the Romanian variety Procera 1020 SU, with Group 1 maturity.
The main objective pursued during the experimentation period, in the specific conditions of the Constanța area, where the Procera 1020 SU variety was tested, was to evaluate the performance of the soybean variety under different irrigation conditions.
Sowing was carried out in the second decade of April with a density of 50-60 germinating grains / sq m.
Grain yield was measured for each plot after harvest, and converted to t/ha.
Within the experimental perimeter, a series of observations and measurements were carried out to highlight the particularities of the formation of the soybean crop in different phases of vegetation: at budding, at the formation of pods and at maturity.
The research carried out on the soybean crop aimed to determine the accumulation of epigean biomass, expressed in plant, green mass and dry matter, but also grain production.
During the vegetation period, samples of stems, leaves, pods were collected and there was determined the gravimetric ratio between them.
The accumulation of dry matter was determined by weighing the aerial part fresh, on the components and dried in an oven at 60 ^{0} C until the weight remained constant.
The statistical interpretation of all the obtained data was done according to the variance analysis method in SPSS software to determine the effect of irrigation and variety on grain production.

• Results and discussions

Plant growth is a complex process consisting of quantitative and irreversible changes, completed by the increase in the number of cells, their size and mass, as well as the accumulation of dry matter. (BURZO ET ALL, 2004).
In the context of different water supply conditions, it is found that soybean changes its growth and development rate throughout the vegetation.

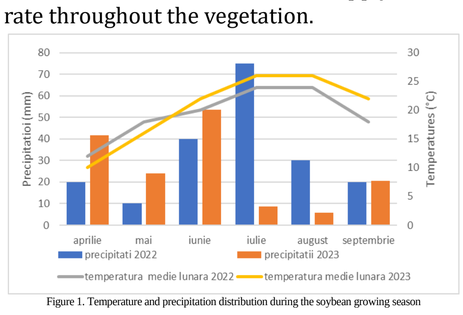

Figure 1. Temperature and precipitation distribution during the soybean growing season

During the experimental years, differences were observed in terms of the distribution of elements of climatic factors.
Precipitation amounts were recorded mainly during vegetative and early reproductive growth throughout the analyzed years.
The analysis of the average amounts of precipitation during the vegetation period highlights the fact that they are higher in 2022 (195 mm) and in 2023 they were 154.3 mm (Fig.1).

The water supply during the soybean vegetation period (April-September) was more favorable in 2022 compared to 2023.
The year 2023 was characterized as a highly atypical year for soybeans crops with high temperatures and severe drought conditions.
These climatic differences during the two crop seasons were reflected in the formation of soybean productivity elements (BÎLTEANU, 2003).
Under the influence of the irrigation level, in the Experimental Field, Constanța, it is observed that the leaves accumulate more dry matter in the year 2022 in the 50% IUA irrigated plot, and the lowest amount of dry matter accumulates in the leaves in the year 2023 in the control plot (unirrigated).
Under the conditions in which the research was carried out, soybean plants assimilate a significant amount of biomass in the stem, in the climatic conditions of the year 2022, in the irrigated plot 50% IUA.

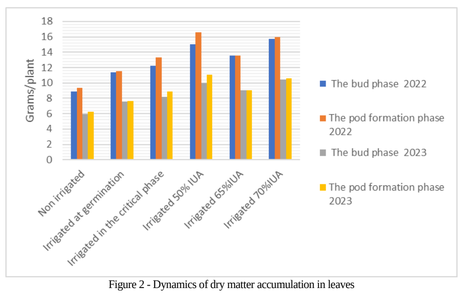

Figure 2 - Dynamics of dry matter accumulation in leaves

Further, we present the accumulation of biomass in different plant organs (leaves, stems, pods, and grains).
The average results from the two years of experimentation highlighted the effect of water on the accumulation of biomass in the foliar apparatus of soybean plants.
It is found that the organic substance accumulated in the leaves depends both on the amount of water applied through irrigation, as well as on the water from precipitation (Fig.2).

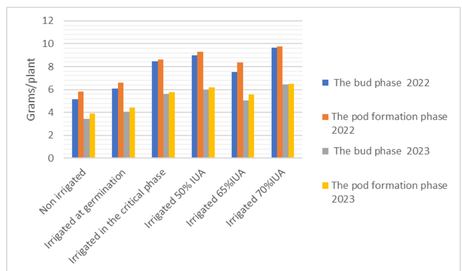

Figure 3 The dynamics of dry matter accumulation at the level of stems

At the same time, performing an average of this content in the year 2023, on each experimental option, it is observed that the lowest value is found in the non-irrigated plot (Fig.3).

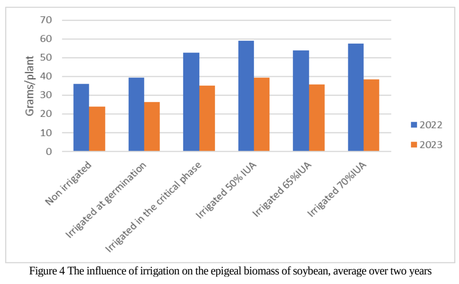

Figure 4 The influence of irrigation on the epigeal biomass of soybean, average over two years

As can be seen, in all cases, irrigation caused an increase in the content of organic matter as a result of achieving an optimal moisture regime in the soil at a depth of 75 cm (Fig. 4).

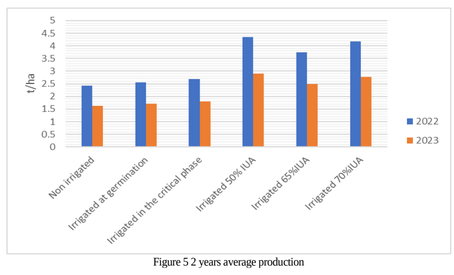

Figure 5 2 years average production

Regarding the level of production obtained in the soybean culture, planted on the carbonate chernozem at the Experimental Didactic Field of the Ovidius University, Constanța, it fluctuated depending on the pedoclimatic conditions and the irrigation options (Fig.5).

Analyzing the influence of irrigation on soybean production in 2022, it is found that the highest production, which was 4.35 t/ha, was recorded in the 50% IUA irrigated plot, followed by the 70% IUA irrigated plot; where a production of 4.17 t/ha was obtained. The lowest production was recorded in the non-irrigated plot in 2023, which was 1.62 t/ha.

Table 1

Synthesis of results in the randomized block experiment

Variants	Average production t/ha	Relative production	Differences t/ha	Signification
Irrigated 50% IUA	3.625	179	1.6	***
Irrigated 70%IUA	3.475	171.6	1.45	***
Irrigated 65%IUA	3.125	154.3	1.1	***
Irrigated at germination	2.237	110.49	0.212	0
Irrigated in the critical phase	2.132	105.3	0.107	0
No irrigated	2.025	100	Mt	

DL 5%=0.4047 t/ha
DL1% =0.609 t/ha
DL0.1 = 0.8418 t/ha

Analyzing the table above, it can be noticed that the average productions are good and very good, the variety Procera 1020 SU obtained the highest production of 3.625t/ha in the 50% IUA irrigated plot, being 79% higher than that of the control (2.025 t/ha).
Climatic and crop conditions have a very substantial influence on soybean production, the most important role being the water supply (DENCESCU, 1982).

• Conclusions

Irrigation led to the highest yields in the soybean crop. Therefore, production could be most profitable in the analyzed area if irrigation is available, not only because it achieves a higher grain production with less available water, but also because it has the possibility to take advantage of the soil resources and the thermal regime of the area.
However, the effect of irrigation on soybean yield and grain quality parameters is significant, depending on the specific environmental conditions of each growing season, indicating that long-term studies are needed to determine the most effective irrigation practice.

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