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# Productivity of Soybean varieties in Podillia

**Abstract.** The features of soybean varieties for cultivation in Podillia were studied based on the analysis of scientific sources. The study considers the key lines of increasing the productivity of soybean varieties. The advantages, main disadvantages, and challenges of growing soybean varieties in Podilia are presented and substantiated. The characteristics of soybean varieties, the impact of the inoculation process and the effectiveness of microfertilisers were studied, which made it possible to develop measures of cultivation technology accounting for plant biology and changes in climatic conditions. The processes of cultivation and development of soybean varieties: *Maxus*, *Cordoba*, *Saska*, depending on seed processing with insecticidal-fungicidal seed treatment Standak Top, inoculants *Hi Stack*, *High Cat Super*, *High Cat Super Extender* and seed treatment with microfertiliser *KoMo 15*, in addition to foliar fertilisation with microfertilisers *Vuksal Boron* and *Bosfoliar* during the growing season. The research on different maturity groups of soybean varieties such as *Maxus*, *Cordoba*, *Saska*, revealed positive performance results from the application of microfertilisers, inoculants, treatment of soybean seed with inoculants and microelement *Vuxal CoMo 15*. Moreover, seed treatment *Standak Top 1 l/t* also prevents the development of diseases such as Fusarium, anthracnose, seed mold, promotes rooting of plants in the soil due to accelerated development of the root system, increases of the assimilation surface of the leaf apparatus, promotes the activation of nitroreductase, which also activates photosynthesis, manifested in the so-called AgCelence effect. Plants have an intensely saturated dark green color, soil pests are effectively eliminated. Experiments on the impact of seed inoculation on soybean yields were conducted by combining the inoculant, *Vuxal CoMo*, and the insecticidal fungicidal preparation *Sandak Top* in a tank mixture with a sowing

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period of up to 5-7 days. One of the main requirements is the use of high-quality inoculants with a high content of viable nitrogen-fixing bacteria for soybean seed treatment, which is a necessity today, as it allows to fully reveal and realise the genetic and varietal potential of modern varieties. Moreover, this will contribute to high soybean yields with optimal costs and the fastest possible return on investment, especially in the current conditions. The study resulted in the development of new technological aspects of combining the inoculation process and the use of microfertilisers and insecticide-fungicide preparations in the cultivation technology, which gave significant results in increasing yields. The relative humidity of the air and the reserves of productive soil moisture should also be factored in. The findings of the research are aimed at solving urgent tasks in the technology of growing legumes, namely: developing a variant of soybean cultivation technology for the selection of varieties adapted to this climate zone, the use of inoculants and microfertilisers in the context of climate change in Podillia

**Keywords**: soy, variety, inoculation, microfertilisers, pre-sowing seed treatment, yield

## RELEVANCE

Soybean is one of the most valuable oilseeds. The nutritional value of food is determined by its protein content and quality. The problem of vegetable protein can be solved by growing leguminous crops (Petrichenko & Likhochvor, 2014).

Growing soybeans in the face of climate change in Podillia is a very complex topic. Cultivation technology must combine all aspects: choosing the proper zoned variety, soil preparation, moisture conservation, providing plants with moisture, and selecting appropriate protection systems with products recommended for the variety and the climate zone. These are the elements that will affect soybean yields and grain quality.

Lack of micronutrients reduces yields, causes disease, and impairs grain quality. Trace elements are extremely important for the growth and development of soybeans, as their availability in sufficient quantities is a prerequisite for the intensive assimilation of nitrogen from the air (Shevnikov & Koblay, 2015; Melnyk *et al.*, 2007). However, an important point that occupies one of the main places in the technology is the treatment of high-performance seeds with inoculants. Inoculation of legume seeds with bacterial preparations (inoculants) has the ability to restore the biological potential of soils, in particular due to legumes that form symbiotic relationships with microorganisms in the soil.

## ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Soybeans play a significant role in biological farming. It fixes nitrogen from the air, covering 60-70% of its needs, and leaves it in the soil along with plant residues after harvest. The introduction of scientifically based soybean cultivation technology allows for obtaining 2.5-3.0 t/ha of seeds (Petrichenko *et al.*, 2016; Singh, 2014).

The most important condition for high soybean yields is the availability of nutrients, nitrogen-fixing nodule bacteria, moisture and temperature levels in the soil. Therefore, it is important to determine and create optimal environmental conditions for the realisation of the potential nitrogen-fixing activity of soybeans of each variety in specific soil and climatic conditions (Babich & Babich-Berezhnaya, 2011;

Fedoruk, 2019). The analysis of the major studies and publications that addressed the problem demonstrates that trace elements also play a special role in improving the efficiency of mineral nutrition of plants (Likhochvor, 2008; Marchuk, 2009).

According to V.V. Moskalets & V.K. Shynkarenko (2004), mainly such trace elements as boron, molybdenum, copper, zinc, iron, manganese, cobalt, and magnesium. No plant can develop properly in their absence or deficiency, as they are part of the most important enzymes, vitamins, hormones and other physiologically active substances. Trace elements are involved in the synthesis of proteins, carbohydrates, fats, and vitamins. They increase the chlorophyll content in the leaves, enhance the assimilation activity of the plant, and boost the efficiency of the photosynthesis process. The purpose of the study was to examine the effect of seed inoculation and microfertiliser application on the formation of varietal productivity of soybean grain.

## RESEARCH RESULTS

Legumes are gradually gaining popularity in Ukraine and are changing and optimising the structure of sown areas. They also have a positive effect on the structure of the soil complex, replenishing it with plant residues, which, in the process of mineralisation, contribute to the enrichment of the soil with nutrients.

Increasing the production of soybean grain is possible only through the improvement of existing and development of new agrotechnical elements of soybean cultivation technology, considering the significant climate change (Bakhmat & Bakhmat, 2001; Bakhmat & Fedoruk, 2017).

The selection of soybean varieties for cultivation in Podillia has its own unique features, as the natural conditions of Ukraine have limited light and heat resources for growing medium- and late-ripening varieties (the growing season is 145 days), and varieties must also be adapted to climate change, be flexible to soil fertility, both in the main and pre-sowing soil preparation, and form yields, considering the nutrition system and inoculation processes.

In the process of climate change, when the accumulated temperature rises, precipitation decreases, and drought is spreading not only in the soil but also in the air, selection should be carried out in specific conditions of growing areas or by taking these conditions into account.

It is crucial to properly select the variety, not only based on the natural and climatic conditions of cultivation, but also on the chemical composition. It is also important to consider the optimal height of the beans so that the harvester does not damage the beans and seeds during harvesting, thus reducing yield losses. Having 2-3 seeds in a bean is essential, and 4 is already an indication of high productivity, as is the presence of 10-11 productive nodes. The plant must be compact, with a complete type of growth. A ripe and ready-to-harvest variety does not crack or drop off leaves.

The variety realises its yield potential only when the cultivation technique fully meets its biological requirements. Given that varieties react differently to agrotechnical measures, it is necessary to determine the optimal timing and methods of sowing, seeding rates, fertiliser doses, and so on for each variety. Without this, it is impossible to realise the genetic potential of the variety (Babich *et al.*, 2000; Babich, 1974). As a result of the greater realisation of the potential of new varieties, crop yields can be significantly increased.

The following soybean varieties were studied in the experiment: *Maxus*, *Cordoba*, and *Saska*.

Soybean variety *Maxus* by Prograin. The growing season is 100-110 days. The type of plant growth is intensive. The oil content is 20.7%.

The height of the plants is 85-115 cm, the height of the lower beans is 15-17 cm, and the protein content is 41%. The weight of a thousand seeds is about 197 g, which affects the yield potential – up to 50 c/ha. Resistant to diseases and pests. It does not lodge or drop of leaves. Resistant to stem damage. Beans do not crack during ripening.

Soybean variety Saska by Prograin. The growing season is 115-120 days. The height of the lower pod is 15-20 cm. Adapts to a variety of soil and climatic conditions. The height of plants is 135 cm. The protein content is 41 %. The weight of a thousand seeds is about 156 g. Resistant to diseases and pests. It does not lodge or drop of leaves. Resistant to stem damage. Beans do not crack during ripening.

The genetically determined varietal adaptability of these varieties to different soil and climatic regions of Ukraine provides the effectiveness of scientifically based varietal technologies and high yields in all soil and climatic regions of the Forest-Steppe of Ukraine.

*Cordoba* is a high-yielding soybean variety developed by *SAATBAU*. Mid-early ripening period. The growing season is 105-110 days. The potential yield declared by the manufacturer is 50 c/ha, but during the research, the best yield was 33.3 c/ha. It is cultivated for grain. The *Cordoba* soybean variety is recommended for growing in all areas of the country. It is resistant to adverse weather conditions. Resistant to diseases and pests. It does not lodge or drop of leaves. Resistant to stem damage. Beans do not crack during ripening. Crop height – 90 cm. The weight of 1000 seeds is 170-185 g. The grain is large and of high quality. The protein content is 40-44% and the oil content is 22%.

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The field experiment was conducted in the field crop rotation of field No. 2 of the agricultural enterprise LLC "Garant" of Kamianets-Podilskyi district, Khmelnytskyi Oblast, as a branch of the Department of Ecology, Quarantine and Plant Protection of Podilskyi State Agrarian and Technical University.

The experimental field was located in the southwestern forest-steppe part of the Khmelnytsky Oblast, which, according to the conditions of heat supply and moisture, belongs to the southern humid agroclimatic region of the Western Forest-Steppe.

The results obtained showed that the productivity of soybean grain depends on the cultivar, research factors (factor A – cultivar, factor B – microfertiliser, factor C – inoculation) and variants in the experiment, and climatic conditions of cultivation.

Analysis of the yield level of soybean varieties *Maxus*, *Cordoba*, *Saska* in the experiment revealed a composite index that included such components as genetic potential of the variety, soil fertility and availability of nutrients by periods of soybean growth and development, the formed nutrition regime based on mineral fertiliser rates, weather conditions during the vegetation period of the varieties, plant density, and quality of mechanised operations.

In view of the above, plants were selected and the structural analysis of the sheaf material was carried out. The structure of the crop was studied in sheaf samples, which were taken at full maturity, on 0.25 $m^2$ plots in four replications. The weight of the sheaf, the number of plants, branches, beans on the main and side branches, seeds per bean, the number and weight of seeds per plant, and the weight of 1000 seeds were determined. The harvest was calculated from the entire accounting area of each plot. The grain harvest was processed to 100% purity and 14% moisture content.

In the course of mathematical and statistical studies of the experimental data, the following were analysed: yield data (by the method of variance analysis of multifactorial complexes; correlation and regression analyses); quantitative plant traits (by the method of variation series, difference, correlation, regression, etc.).

The correlation and regression analysis showed a direct and close relationship between biometric parameters and soybean plant yield. It ranged from 0.81 to 0.99, depending on the variety. Out of these, the three most strongly correlated indicators were selected and a regression model of the linear dependence of these parameters was created. According to the regression equation, an increase in the number of beans per plant per unit resulted in an increase in soybean yield by 0.0428 t/ha in the *Maxus* variety, 0.1521 t/ha in the *Cordoba* variety, and 0.1034 t/ha in the *Saska* variety. An increase in the number of seeds per bean per unit resulted in an increase in soybean yield by 0.0205 t/ha in the *Maxus* variety, by 0.0732 and 0.0458 t/ha in the *Cordoba* and *Saska* varieties, respectively (Table 1).

**Table 1.** Mathematical models of correlation between actual yields and elements of soybean yield structure for 2015-2018

| Indicators | Regression equation | Correlation coefficient, R | Determination coefficient, D, % |
|---|---|---|---|
| ***Maxus*** | | | |
| Number of beans, pcs. | $y = 0.0428x + 1.619$ | 0.960 | 92 |
| Number of seeds, pcs. | $y = 0.0205x + 1.6689$ | 0.967 | 93 |
| Seed weight per plant, g | $y = 0.11x + 1.6569$ | 0.965 | 93 |
| ***Cordoba*** | | | |
| Number of beans, pcs. | $y = 0.1521x + 0.219$ | 0.953 | 91 |
| Number of seeds, pcs. | $y = 0.0732x + 0.4116$ | 0.955 | 91 |
| Seed weight per plant, g | $y = 0.3814x + 0.4035$ | 0.944 | 89 |
| ***Saska*** | | | |
| Number of beans, pcs. | $y = 0.1034x + 0.669$ | 0.950 | 90 |
| Number of seeds, pcs. | $y = 0.0458x + 0.9283$ | 0.905 | 82 |
| Seed weight per plant, g | $y = 0.1638x + 1.3667$ | 0.906 | 82 |

The increase in seed weight per plant per unit led to an increase in soybean yield by 0.11 t/ha in the *Maxus* variety, by 0.1638 in the *Saska* variety, and the largest increase of 0.3814 t/ha in *Cordoba*.

Analysis of the yield indicators of soybean variety *Maxus* (Table 2), shows in particular that the lowest values of the indicators were inherent in the control variant (water irrigation).

**Table 2.** The yield of soybean varieties *Maxus, Cordoba, Saska* in the years of research depending on microfertilisers and inoculation (average for 2015-2018), t/ha

| Study variant designations | Soybean grain yield by year | | | |
|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 |
| $A_0B_0C_0$ | 1.50 | 1.32 | 1.75 | 3.78 |
| $A_0B_0C_1$ | 1.78 | 0.96 | 2.4 | 4.14 |
| $A_0B_0C_2$ | 1.71 | 0.83 | 2.27 | 3.28 |
| $A_0B_0C_3$ | 1.65 | 1.35 | 1.97 | 4.03 |
| $A_0B_1C_0$ | 1.97 | 1.01 | 2.45 | 4.33 |
| $A_0B_1C_1$ | 1.93 | 0.85 | 2.36 | 3.44 |
| $A_0B_1C_2$ | 1.87 | 1.36 | 2.18 | 4.31 |
| $A_0B_1C_3$ | 2.03 | 1.03 | 2.63 | 4.52 |
| $A_0B_2C_0$ | 2.01 | 0.86 | 2.48 | 3.51 |
| $A_0B_2C_1$ | 2.07 | 1.44 | 2.27 | 4.08 |
| $A_0B_2C_2$ | 2.24 | 1.22 | 2.53 | 4.48 |
| $A_0B_2C_3$ | 2.25 | 0.89 | 2.59 | 3.46 |
| $A_1B_0C_0$ | 2.23 | 1.68 | 2.30 | 4.22 |
| $A_1B_0C_1$ | 2.70 | 1.41 | 2.67 | 4.61 |
| $A_1B_0C_2$ | 3.06 | 0.93 | 2.64 | 3.59 |
| $A_1B_0C_3$ | 2.12 | 1.80 | 2.63 | 4.72 |
| $A_1B_1C_0$ | 3.03 | 1.48 | 2.91 | 4.93 |
| $A_1B_1C_1$ | 3.16 | 1.05 | 2.73 | 3.85 |
| $A_1B_1C_2$ | 2.21 | 1.48 | 2.39 | 4.59 |
| $A_1B_1C_3$ | 2.39 | 1.26 | 2.47 | 4.79 |
| $A_1B_2C_0$ | 2.45 | 0.93 | 2.88 | 4.25 |
| $A_1B_2C_1$ | 2.32 | 1.79 | 2.48 | 4.69 |
| $A_1B_2C_2$ | 2.83 | 1.47 | 2.86 | 4.91 |
| $A_1B_2C_3$ | 3.15 | 0.98 | 2.95 | 4.13 |
| $A_2B_0C_0$ | 2.29 | 1.97 | 2.77 | 5.05 |
| $A_2B_0C_1$ | 3.14 | 1.59 | 3.15 | 5.19 |
| $A_2B_0C_2$ | 3.20 | 1.14 | 2.92 | 4.37 |
| $A_2B_0C_3$ | 2.33 | 1.55 | 2.58 | 4.41 |

Table 2, Continued

| Study variant designations | | Soybean grain yield by year | | | |
|---|---|---|---|---|---|
| | | 2015 | 2016 | 2017 | 2018 |
| $A_2B_1C_0$ | | 2.45 | 1.30 | 2.69 | 4.71 |
| $A_2B_1C_1$ | | 2.59 | 0.94 | 2.64 | 3.62 |
| $A_2B_1C_2$ | | 2.42 | 1.83 | 2.67 | 4.58 |
| $A_2B_1C_3$ | | 2.94 | 1.52 | 3.15 | 4.84 |
| $A_2B_2C_0$ | | 3.28 | 1.00 | 2.39 | 3.85 |
| $A_2B_2C_1$ | | 2.38 | 2.04 | 2.96 | 4.53 |
| $A_2B_2C_2$ | | 3.20 | 1.67 | 3.49 | 4.96 |
| $A_2B_2C_3$ | | 3.35 | 1.17 | 2.67 | 3.71 |
| **$LSD_{05}$** | **A** | 0.06 | 0.08 | 0.07 | 0.07 |
| | B | 0.06 | 0.08 | 0.07 | 0.07 |
| | C | 0.07 | 0.10 | 0.08 | 0.09 |
| | **AB** | 0.10 | 0.15 | 0.12 | 0.13 |
| | **AC** | 0.12 | 0.17 | 0.14 | 0.15 |
| | **BC** | 0.12 | 0.17 | 0.14 | 0.15 |
| | **ABC** | 0.03 | 0.05 | 0.04 | 0.04 |

The results of the analysis on variance revealed that the difference between the experimental and control variants was significant, as they exceeded the index of the least significant difference.

According to Table 2, the yield in 2015 is quite high, especially high in the variant of the experiment with seed inoculation with *High Kot* on *Saska* variety – 3.06 t/ha, also in the variant with seed inoculation with *Hi Stick + High Kot Super + High Kot Super Extender + Vuksal Boron* on *Cordoba* variety – 3.14 t/ha, *Saska* – 3.20 t/ha. High yields are achieved by the variant with seed treatment with the inoculant *High Kot Super + High Kot Super Extender + Vuksal Boron + Bosfoliar* on the varieties *Cordoba* – 2.94 t/ha, *Saska* – 3.28 t/ha, as well as the variant with the inoculant *Hi Stick + High Kot Super + High Kot Super Extender + Vuksal Boron + Bosfoliar* on the varieties *Cordoba* – 3.20 t/ha, *Saska* – 3.35 t/ha.

In the 2016 season, inoculants had a different effect on yields depending on the maturity group of the varieties. The *Maxus* variety compared to the control showed an increase of 0.72 t/ha in the variant *Hi Stick + High Kot Super + High Kot Super Extender + Vuksal Boron + Bosfoliar, Cordoba* showed a result of 0.71 t/ha in this variant, and the late-ripening variety Saska showed a yield increase of 0.34 t/ha in the variant *Hi Stick + High Kot Super + High Kot Super Extender + Vuksal Boron + Bosfoliar*.

The weather and climatic conditions in 2017 were more favourable for crop cultivation compared to the previous vegetation year (2016). Soybean yield formation in the *Maxus* and *Cordoba* varieties (bean setting, filling) proceeded with moderate moisture in the soil and air. In the late-ripening variety *Saska*, the processes of flowering, bean setting, and filling for the first to fourth tiers occurred under relatively favourable conditions.

The analysis of the table data shows that in the variant without inoculants, but with the use of *Vuksal Boron* microfertiliser, regardless of the maturity group of soybean varieties, a yield increase ranged from 0.05 t/ha to 0.22 t/ha, which was 2.0-12.5%, respectively. Repeated use of microfertilisers, viz: *Bosfoliar*, allowed to obtain an additional 0.11 t/ha to 0.21 t/ha, the maximum effect was achieved with the *Maxus* variety – 0.21 t/ha, while the *Saska* variety only provided an additional 0.11 t/ha.

The weather and climatic conditions in 2018 are more favourable for crop production compared to the previous vegetation period (2017).

In 2018, inoculants and *Vuksal Boron* proved to be effective solutions for soybeans. Thus, in the budding phase, the start of flowering, the introduction of *Vuksal Boron* gave the following positive results. The early-ripening variety *Maxus* reached 0.81 t/ha of control with the use of *Hi Stick*, and 0.91 t/ha with the use of *High Kot Super + High Kot Super Extender* inoculant. The mid-season variety *Cordoba* produced 0.65 t/ha and 0.77 t/ha respectively. Similarly, high yield results were obtained on the late-ripening variety *Saska*, whereby the use of *Hi Stick* resulted in 0.97 t/ha compared to the control, and 0.85 t/ha with the use of *High Kot Super + High Kot Super Extender* inoculant.

Spring tillage started with harrowing ("moisture infiltration"). Soybean seeds were fertilised in advance using insecticidal and fungicidal seed treatment with physiological impact *Standak Top* at a rate of 1 l/t and inoculants according to the experimental scheme (*Hi Stick, Hi Kot*), as well as microfertilisers *Vuksal CoMo*. Inoculation of soybean seeds with *Hi Stick* was carried out on the day of sowing.

The advantages of *Standak Top* insecticidal-fungicidal seed treatment are its excellent protection against soil pests and sprout flies. The use of this agent prevents the spread of pathogens such as fusarium, anthracnose, and seed mold. It stimulates the rooting of plants in the soil through accelerated development of the root system, an increase of the assimilation surface of the leaf apparatus, and also promotes activation of nitroreductase, which also intensifies photosynthesis, resulting in intensely saturated dark green colour of the plants.

Due to the moisture deficit, cultivation was carried out on the day of sowing to a depth of 3-5 cm, with row spacing of 35 cm.

For sowing, the *Maxus* variety was used at a rate of 750 thousand/ha, the *Saska* variety at a rate of 550 thousand/ha, and the Cordoba variety at a rate of 450 thousand/ha. After sowing, the soil was rolled with spur rollers. After rolling, the next day soil herbicides were applied (*Stomp 330 + Frontier Optima* – 2 + 0.7 l/ha, the so-called European experience, this operation involves factoring in the mechanical composition of the soil). In the phase of 2-3 leaves, the herbicide *Pulsar 40* (1 l/ha) was applied with a working solution consumption rate of 250 l/ha.

In the budding phase, the beginning of flowering, microfertilisers from *Unifer Vuksal Boron* were applied at a rate of 1 l/ha, following the study scheme the fungicide *Abacus* was applied for all varieties at a rate of 0.8 l/ha. In the bean filling phase, *Abacus* was re-applied (background) at a rate of 0.7 l/ha and an insecticidal-acaricidal mixture against leaf-eating pests and ticks *Fastak 10% + Masai 20%* was preventively applied at a rate of 0.15 l/ha + 0.5 kg/ha. *Basfoliar* 12-4 -6 + S at a rate of 2 l/ha was applied according to the study scheme.

## CONCLUSIONS

A large number of soybean varieties of different genetic character makes it impossible to distribute all the cultivation zones specified in the Register, and therefore soybean producers face a difficult choice of which variety to use in production, because the productivity traits that develop according to genetic potential are determined by the interaction of a set of traits with environmental conditions.

Analysis of the best variants in the study of cultivars, microfertilisers and inoculants of various formulae, along with optimisation of soybean cultivation technology elements is a topical issue for study in the Western Forest-Steppe. Especially relevant is the use of new foreign varieties and modern elements of soybean cultivation technology in specific soil and climatic conditions.

Having conducted research on different maturity groups of soybean varieties such as: *Maxus*, *Cordoba*, *Saska*, the results of using inoculants and microfertilisers proved to be positive. The optimal yield value on average for the years of research at 3.33 t/ha was provided by the variety Cordoba using the experimental variant *Hi Stick + High Kot Super + High Kot Super Extender + Vuxal Boron + Basfoliar*, exceeding the control by 43.5%, a similar variant of the experiment in the Maxus variety had an average of 2.97 t/ha, which exceeds the control by 42.8%, the *Saska* variety yielded 2.72 t/ha on the *Hi Stick + High Kot Super + High Kot Super Extender + Vuxal Boron + Bosfoliar* variant, which exceeds the control by 34.6%.

All of the soybean varieties studied had high productivity both in individual years and on average over three years of cultivation, with *Cordoba* being the most prominent, showing the best yield compared to *Maxus* and *Saska*. Soybean grain yields varied over the years depending largely on weather conditions and, above all, on the availability of moisture throughout the vegetation season.

The selection of varieties with good genetic potential recommended for the climatic conditions of Podillia, combined with the inoculation and applying microfertilisers in the cultivation technology, as shown by the results of the study, give significant results in increasing yields.

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## Продуктивність сортів сої на Поділлі

**Анотація.** На основі аналізу наукових джерел досліджено особливості сортів сої для вирощування в умовах Поділля. Розглянуто основні напрями підвищення продуктивності сортів сої. Представлено та обґрунтовано переваги, основні недоліки та проблеми вирощування сортів сої в умовах Поділля. Вивчено особливості сортів сої, вплив процесу інокуляції та ефективність мікродобрив, що дозволило розробити заходи технології вирощування з урахуванням біології рослин та змін кліматичних умов. Досліджено процеси вирощування та розвитку сортів сої: Максус, Кордоба, Саска залежно від обробки насіння інсектицидно-фунгіцидним протруйником Стандак Топ, інокулянтами Хай Стак, Хай Кет Супер, Хай Кет Супер Екстендер та обробки насіння мікродобривом КоМо 15, а також позакореневого підживлення мікродобривами Вуксал Бор і Бросфоліар протягом вегетації. Дослідження на різних групах стиглості сортів сої, таких як Максус, Кордоба, Саска, показали позитивні результати від застосування мікродобрив, інокулянтів, обробки насіння сої інокулянтами та мікроелементом Вуксал КоМо 15. Крім того, протруювання насіння Стандак Топ 1 л/т також запобігає розвитку таких хвороб, як фузаріоз, антракноз, пліснявіння насіння, сприяє укоріненню рослин у ґрунті завдяки прискореному розвитку кореневої системи, збільшенню асиміляційної поверхні листкового апарату, сприяє активації нітроредуктази, яка також активізує фотосинтез, що проявляється у так званому AgCelence-ефекті. Рослини мають інтенсивно насичений темно-зелений колір, ефективно знищуються ґрунтові шкідники. Досліди з вивчення впливу інокуляції насіння на врожайність сої проводили шляхом поєднання інокулянту Вуксал КоМо та інсектицидно-фунгіцидного препарату Сандак Топ в баковій суміші з терміном посіву до 5-7 днів. Однією з основних вимог є використання високоякісних інокулянтів з високим вмістом життєздатних азотфіксуючих бактерій для обробки насіння сої, що є необхідністю на сьогоднішній день, оскільки дозволяє повністю розкрити та реалізувати генетичний та сортовий потенціал сучасних сортів. Крім того, це сприятиме отриманню високих врожаїв сої з оптимальними витратами та максимально швидкою окупністю інвестицій, особливо в нинішніх умовах. Результатом дослідження стала розробка нових технологічних аспектів поєднання процесу інокуляції з використанням мікродобрив та інсектицидно-фунгіцидних препаратів у технології вирощування, що дало значні результати у підвищенні врожайності. Слід також враховувати відносну вологість повітря та запаси продуктивної вологи в ґрунті. Результати досліджень спрямовані на вирішення актуальних завдань у технології вирощування зернобобових культур, а саме: розроблення варіанту технології вирощування сої з урахуванням підбору сортів, адаптованих до даної кліматичної зони, застосування інокулянтів та мікродобрив в умовах зміни клімату на Поділлі

**Ключові слова:** соя, сорт, інокуляція, мікродобрива, передпосівна обробка насіння, урожайність