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Summary of the doctoral dissertation entitled:

**„Reaction of selected cultivars of soybean (*Glycine max* (L.) Merr.)
to different levels of nitrogen fertilization”**

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Soybean cultivation in Poland is becoming more and more popular every year, due to the high nutritional value of the seeds, relative resistance to pests and diseases, and enrichment of the soil in nitrogen thanks to *symbiosis* with the papillary bacteria *Bradyrhizobium japonicum*. In addition, recent years have seen rapid progress in breeding new soybean cultivars, with earliness adapted to cultivation under specific habitat and regional conditions. Soybean cultivars differing in earliness may show different responses to post-harvest nitrogen application due to differences in the number of days required to reach harvest maturity. The aim of this study was to evaluate the response of selected soybean cultivars to differentiated nitrogen doses and to assess the suitability of medium-early (Abelina, Sculptor) and very late (Coraline, Malaga, Petrina) cultivars for cultivation under the conditions of the Lubelskie voivodeship. The research hypothesis assumed that the application of a second nitrogen dose (post-harvest) would increase the yield potential of soybean and favourably influence the chemical composition of the seeds, while later soybean cultivars would make better use of mineral nitrogen, resulting in a higher seed yield with better quality parameters.

The research was based on a field experiment, carried out in 2017-2019, at the Experimental and Experimental Field belonging to the Lublin Agricultural Advisory Centre in Końskowola, located in Pożog II (Lubelskie Voivodeship, Puławy County). A two-factor field experiment was established in a randomized sub-block system (split-plot), in 4 replications. The first factor was the nitrogen dose ($\text{kg}\cdot\text{ha}^{-1}$): 0 (N0), 30 (N30), 60 (N60), while the second was the soybean cultivar (*Glycine max* (L.) Merrill): Abelina, Sculptor,

Coraline, Malaga, Petrina. The following indices were measured at developmental stages BBCH 61, 65, 70 and 77: chlorophyll fluorescence (Fv/Fm, PI), leaf area index (LAI) and leaf greenness index (SPAD). Plant biometric traits (plant height, height of setting of the lowest pod, number of pods and seeds per plant, pod and seed weight per plant, TSW) were determined before harvest. Seed yield at 14% moisture content was determined. The microbial properties of the soil at the flowering stage of the soybean were also assessed by analysing the abundance of *Azotobacter* and the enzymatic activity of the soil based on the activity of dehydrogenases and phosphatases (acid and alkaline). The collected results were statistically processed by analysis of variance (ANOVA) according to the experimental layout. A multiple confidence interval test (Tukey's test) at the significance level of $\alpha=0.05$ was used to compare differences between means for the main factors and interactions.

In 2019, a strict two-factor pot experiment was additionally carried out in the vegetation hall of IUNG-PIB in Puławy, in a completely randomised design, in 4 replications. The first research factor was the nitrogen dose ($\text{kg}\cdot\text{ha}^{-1}$): 0 (N0), 30 (N30), 60 (50% pre-sowing and 50% post-sowing at the BBCH 61 stage), while the second factor was the common soybean cultivar (*Glycines max* (L.) Merrill): Abelina, Sculptor, Coraline, Malaga, Petrina. The vases were watered daily to optimum conditions. During the conduct of the experiment, the relative chlorophyll content of soybean leaves (SPAD index) was measured at the following developmental stages: BBCH 61, 65, 71 and 77. At the flowering stage of soybean (BBCH 65), the following were determined: shoot and root length, aboveground and underground weight, and number and weight of papillae. At full maturity, the following measurements were taken: plant height, height of setting of the first pod, number of nodes on the main shoot, number of pods per plant, number and weight of seeds per plant, number of seeds per pod, dry weight of the stem and pods. The total protein and crude fibre contents of the seeds were also determined. The collected results were collated and statistically processed using the analysis of variance (ANOVA) method in Statgraphic Centurion XVI software.

The study showed that all soybean cultivars performed well under the conditions of the Lubelskie Voivodeship, with very late cultivars yielding better than medium-early cultivars, outperforming them in yield by an average of 21.8%. The yield level of soybean depended on the dose of nitrogen fertilisation and weather conditions. Under conditions of optimum soil moisture, the pre-sowing nitrogen dose (N30) increased seed yield by 23.8% compared to the control (N0), and the dose applied post-harvest (N60) by 10% compared to the N30 object. With soil water deficiency, mineral nitrogen fertilisation proved

ineffective. The very late cultivar Malaga showed the highest productivity, with a yield 33.2% higher than that of the medium-early cultivars (Abelina, Sculptor) and 14.7% higher than that of the other very late cultivars (Coraline, Petrina). The cultivar Sculptor showed the lowest yield. The effect of mineral nitrogen on plant biometric traits was demonstrated. Pre-sowing fertilisation (N30) increased plant height by an average of 9.5% and the height of setting of the lowest pod by an average of 10.2%. The pre-sowing and post-sowing dose (N60) had a favourable effect on the number and weight of pods and the number and weight of seeds per plant (increases of 19.7 and 22.9% and 20.5 and 16.2%, respectively), but decreased the thousand-seed weight (TSW) by an average of 5.8% compared to the N0 treatment. The effect of genetic factor on plant biometric traits was demonstrated. The Coraline cultivar was the tallest but had the lowest set pods, while the Sculptor cultivar had the most pods and seeds. In contrast, the Malaga cultivar had the highest TSW. The study showed that the physiological status of the plants depended significantly on nitrogen dose and weather conditions. Under conditions of drought and no nitrogen fertilization (N0), an increase in chlorophyll fluorescence indices (Fv/Fm and PI) was observed, suggesting photosynthesis disruption. In contrast, the lowest values of these indices were observed on N60 sites. The highest values of chlorophyll fluorescence indices were found in the Malaga cultivar and the lowest in the Sculptor cultivar. The relative chlorophyll content of the leaves was mainly determined by the cultivar factor. The lowest SPAD index was recorded in the medium-early cultivar Sculptor, while higher SPAD index was recorded in the late cultivars Malaga and Petrina. A significant positive correlation was found between seed yield and SPAD index. Mineral nitrogen fertilisation reduced the number and weight of root papillae. Cultivar differentiated the total protein content of soybean seeds, but had no significant effect on their fat content. Nitrogen dose had a significant effect on the abundance of free-living nitrogen assimilators in the soil. The highest abundance of *Azotobacter* was found in soil fertilised with a dose of N60, but enzymatic activity was lowest there. Significant differences in dehydrogenase activity were observed in both years of the study, while for acid and alkaline phosphatase there were differences only in 2019. The study showed that optimal use of nitrogen fertilisation requires consideration of weather conditions to maximise yield and photosynthetic efficiency without adversely affecting the soil and its microbial activity.

The study proved that the Malaga soybean cultivar performed best under the conditions of the Lubelskie Voivodeship. As a very late cultivar, it reached the highest yield level of 5.06 t ha⁻¹, which exceeded the yield of all other cultivars. It was also characterised

by a higher TSW. Due to its exceptional yield performance, it was referred to as the "pearl of the south" in the seed company catalogue.