Plant and Soil Science

Journal homepage: https://agriculturalscience.com.ua/en
Plant and Soil Science, 16(4), 24-33
Received: 22.05.2025 Revised: 22.10.2025 Accepted: 27.11.2025

UDC 547.572.1:542.943-92

DOI: 10.31548/plant4.2025.24

Dmytro Kyselov*
PhD in Agricultural Sciences
Private Enterprise "Zakhidnyi Buh"
80250, 39 Yunosti Ave., Pavliv Village, Ukraine
https://orcid.org/0009-0005-6771-8337

Influence of the predecessor on sugar beet yield in short-rotation crop rotations in the western forest-steppe of Ukraine

Abstract. Due to the intensification of sugar beet production in short-rotation crop rotations, the importance of optimal predecessor selection to ensure stable yields increases. Rational crop alternation was a key factor in maintaining soil fertility and reducing the risk of phytosanitary problems. The purpose of the study was to assess the influence of various predecessors on sugar yield and harvest, considering the type of soil in the western forest-steppe of Ukraine. The study used the method of comparative analysis of sugar beet productivity after different predecessors on soils of different genetic origin; statistical processing of the results was carried out by the method of variance analysis and regression modelling. Root crop yields, sugar content levels, and gross sugar yield were studied after such predecessors as winter wheat, winter barley, soybeans, and corn. It was found that the highest yield was provided by grain predecessors (winter wheat, barley), especially on highly productive soils. The relationship between soil type and predecessor efficiency was analysed: on carbonate and sandy soils, the yield after soybeans and corn decreased to 8.7-9.5 t/ha. It has been generalised that soil fertility mitigates the negative impact of less favourable predecessors. It was found that the effect of the predecessor significantly depends on the type of soil: on chernozems and forest soils, the effect of grain was most pronounced. The results obtained can serve as a basis for developing regionally adapted recommendations on the structure of crop rotations in beet farms. The results of the study can be used by agronomists, consultants and agricultural producers to improve crop rotations and optimise the technology of growing sugar beet in the western forest-steppe

Keywords: carbonate soils; soil type; productivity of agrocoenoses; structural and agrochemical properties; soil fertility

INTRODUCTION

In the current conditions of development of the agro-industrial complex of Ukraine, the issue of rational use of agricultural land and effective planning of crop rotations is becoming particularly relevant. Increased intensification of production, increased economic pressure on

Suggested Citation:
Kyselov, D. (2025). Influence of the predecessor on sugar beet yield in short-rotation crop rotations in the western forest-steppe of Ukraine. *Plant and Soil Science,* 16(4), 24-33. doi: 10.31548/plant4.2025.24.

*Corresponding author

agricultural enterprises, and high profitability of individual crops – in particular corn, soybeans, and winter wheat – led to the widespread use of short-rotation crop rotations, often with a limited number of crops and irrational alternation. Sugar beet is one of the main industrial crops of the western forest-steppe of Ukraine, and its placement in crop rotation plays a key role in ensuring stable yields, sugar content, and production efficiency. Simultaneously, this particular crop is extremely sensitive to re-seeding, monoculture, and to the presence of unsuitable predecessors.

L. Skivka & S. Hudz (2021) and M. Anar *et al.* (2021) conducted a study and analysed the effect of various crop rotation and tillage systems on sugar beet yield and nitrate dynamics in the soil using the RZWQM2 model (USA). The simulation covered long-term field data from three rotations: beets after wheat, corn, and perennial grasses. The results showed that crop rotation with wheat provided 3-6.5% higher beet yield and also reduced the accumulation of nitrates in the soil compared to other schemes. Research conducted in Iran by M. Orazizadeh *et al.* (2020), found that the introduction of cereals before beets improved growth parameters, reduced field contamination, and increased the sugar content of root vegetables.

Meta-analysis performed by Z. Gazdík *et al.* (2025) on sustainable sugar beet production pointed out the need for precision farming, integration of systems for reducing the intensity of tillage, optimisation of nutrition and plant protection systems within short-term crop rotations. The research by P. Götze *et al.* (2017) presented the results of a 45-year study of various links of crop rotation with sugar beet, and the impact on the yield, quality of raw materials, and stability of sugar production were analysed. It was found that compliance with the period of interstitial saturation (at least 3-4 years) reduces the risk of developing rhizoctoniosis and cercospores. Similar findings by H. Koch *et al.* (2018), based on a survey of farmers and stationary field studies, were published in the paper.

In a number of scientific studies, L. Hlushchenko *et al.* (2021), S. Arshad *et al.* (2022) considered the dynamics of yield changes in the cultivation of sugar beet monoculture in comparison with its cultivation in crop rotation. It was proved that in a monoculture, the yield significantly decreases, the pressure of diseases, and weeds increases, and the technological suitability of root crops for processing decreases.

Adaptive management of growing technologies, including compliance with crop rotations during climate changes, is essential for intensive beet farming. The paper by S. Bastaubayeva *et al.* (2022) presented the results of sugar beet cultivation in Central Asia, and the influence of each individual factor (droughts, temperature conditions, agrotechnical solutions) on the development of a strategy for sustainable sugar beet cultivation was considered in detail. One of the options for adaptive management of sugar beet cultivation technology can be considered the creation of digital crop rotations based on artificial intelligence and BigData analysis, which allows predicting the production of programmable yields based on predecessor matrices and accumulated local data, which forms the basis for managerial decision-making (Kluger *et al.*, 2025). A study on climate change forecasting for typical European crop rotations was conducted and it was found that adaptive planning and changes in crop structure can partially compensate for the negative impact of rising temperatures and moisture deficiency (Pohanková *et al.*, 2025).

The purpose of the study was to establish the dependence of sugar beet yield and quality indicators on its predecessor in short-rotation crop rotations in the western forest-steppe of Ukraine, and to determine the agrobiological and economic consequences of beet placement after various crops.

LITERATURE REVIEW

The problem of the influence of the predecessor on the yield of sugar beet in the conditions of short-rotation crop rotations was considered by a number of studies covering agrophysical, phytosanitary, and biological aspects of this phenomenon. The study by L. Zimny *et al.* (2005) and C. Guo *et al.* (2024) presented the results of a long-term experiment in Central Europe, predecessors from the group of cereals, in particular, wheat and barley, provided an increase in beet yield by 3-6% compared to soybeans or corn. Similar conclusions were also obtained by Ya. Tsymbal *et al.* (2022), O. Prysiazhniuk *et al.* (2022) in the conditions of Ukraine, where the effective use of moisture and mineral nutrition after grain crops was established, and the use of various agrotechnical measures, such as mulching, deep loosening, and compliance with crop rotation, facilitated stable cultivation of sugar beet. Conclusions in scientific research by D. Kluger *et al.* (2025), obtained using simulations in the United States, confirmed the feasibility of growing beets after wheat, where yields were higher by 3-6.5% due to better moisture supply. Instead, soybeans, which are often positioned as a favourable predecessor due to their symbiotic nitrogen fixation potential, were less effective in crop rotations with beets. The main limitations of its use were the allelopathic effect, residual herbicidal background and weak structure-forming effect, especially on soils with low moisture capacity. Positive impact of cereals in research by G. Bodner & M. Alsalem (2023), Y. Makukh *et al.* (2024) was explained by both an improvement in the water regime and a decrease in the phytosanitary load.

It is worth noting that not only the structure of crop rotation, but also its duration is of key importance. According to research by P. Götze *et al.* (2017) and H. Yan *et al.* (2024), it was found that extending rotation to three years or more stabilises beet yields, improves soil microbiological activity, and increases the adaptive potential of crops to climate stresses. The study by D. Kluger *et al.* (2025), based on satellite monitoring, found that the predecessor effect is significantly enhanced in years with high humidity, and the effectiveness of soybeans as a predecessor decreases in a warming climate.

In general, the results of the latest research indicate the advantage of cereals as predecessors for sugar beet in conditions of short-rotation crop rotations, especially on fertile and well-moistened soils. The studies by T. Hurisso *et al.* (2015) and Y. Makukh *et al.* (2025) established that a regional-adaptive approach to crop rotation planning is necessary, considering soil type, weather conditions, fertiliser history, and phytosanitary conditions.

Reviews by G. Bodner & M. Alsalem (2023) and Z. Gazdík *et al.* (2025) indicated that the integration of optimal sowing dates with the latest technologies of sustainable production (strip cultivation, cover crops, biostimulants) allows minimising the risks of climate stress and increasing the environmental sustainability of beet agrosystems.

Ukrainian researchers are actively investigating the features of sugar beet cultivation in the forest-steppe and Steppe of Ukraine, focusing on sowing dates, fertiliser systems, and crop rotations. L. Hlushchenko *et al.* (2021) in experiments on the right-bank forest-steppe found that the use of short-rotation crop rotations with sugar beet leads to a decrease in yield by 10-12%, but optimisation of sowing dates partially compensates for this negative impact, ensuring the stability of sugar collection from one hectare. The researchers emphasised that early sowing in combination with optimal predecessors can reduce the phytosanitary load. Ya. Tsymbal *et al.* (2022) proved that beet productivity varies significantly depending on the fertiliser system and sowing time. The highest yield indicators (more than 50 t/ha) were obtained with the organo-mineral fertiliser system at early sowing dates, while late sowing, even with optimal fertiliser, reduced productivity by 7-9%. Y. Makukh *et al.* (2025) in experiments on chernozems of the western forest-steppe, found that the timing of sowing significantly affects the efficiency of soil moisture use. Early sowing allowed beets to make better use of spring moisture, reducing the risk of summer droughts. This contributed to an increase in the water consumption rate by 12-15% compared to later dates.

The main problems of short-rotation crop rotations in beet farming, which are worth highlighting: soil fatigue – due to the frequent return of beets to the same field, there is a deterioration in the physico-chemical properties of the soil, a decrease in humus content, deterioration of the structure and water-air regime; accumulation of pathogens and pests – short rotations contribute to the reproduction of specialised pests (nematodes, wireworms) and pathogens (cercosporosis, root rot), especially when re-growing beets or sowing them after corn; reduced biological diversity – loss of crop diversity in crop rotation worsens the phytosanitary condition of the field, reduces the soil activity of the microbiota; violation of the nitrogen balance – the absence of legumes or green manure in the crop rotation leads to nitrogen deficiency and an increase in the need for mineral fertilisers; compaction of the soil – often in short crop rotations, beets are sown after corn, which is a poor predecessor due to the deep root system, which leaves coarse post – harvest plant debris, poorly decomposes, and causes compaction of the upper layers of the soil, depletion of the microelement composition – frequent beet cultivation reduces the content of boron, manganese, magnesium, and calcium, which affects the quality of the crop; crop instability – short crop rotation causes strong yield fluctuations depending on the year, which complicates planning and economic forecasting.

All this indicates the need for a reasonable choice of predecessor when growing sugar beet, especially in conditions of short crop rotation. The most important crops are those that can improve the agrochemical parameters of the soil, reduce pathogenic load, and help to preserve the soil structure. Thus, the study of the influence of predecessors on beet yield in short-rotation crop rotations is an important step towards improving the stability and efficiency of beet farming in the western forest-steppe of Ukraine.

MATERIALS AND METHODS

The research was conducted during 2018-2024 in the production conditions of the private enterprise "Zakhidnyi Buh", which is one of the leading agricultural farms in the Western Ukraine. The total area of the company's land bank is approximately 65,000 hectares, of which about 45,000 hectares are included in the beet crop rotation. The analysis used data on actual recorded yields within the divisions of the private enterprise (PE) "Zakhidnyi Buh". The farm operates on the territory of Lviv, Ternopil, Chernivtsi, and Volyn oblasts, which are part of the agroclimatic zone of the western forest-steppe of Ukraine. Growing areas are characterised by a temperate continental climate with sufficient moisture and a predominance of dark grey podzolic and grey soils, meadow-chernozem soils, and sod-podzolic soils in the northern part (Table 1). The analysis used 82,000 hectares of sugar beet crops, of which 68,900 hectares were on productive soils and 13,100 hectares on carbonate and sandy soils.

Table 1. Weather and climate conditions for cultivation in 2018-2024 studies

Division	2018		2019		2020		2021		2022		2023		2024	
	Precipitation, mm	Sum of active temperatures, °C	Precipitation, mm	Sum of active temperatures, °C	Precipitation, mm	Sum of active temperatures, °C	Precipitation, mm	Sum of active temperatures, °C	Precipitation, mm	Sum of active temperatures, °C	Precipitation, mm	Sum of active temperatures, °C	Precipitation, mm	Sum of active temperatures, °C
Zastavna	689	3,876	658	4,105	701	4,045	652	3,599	501	4,051	703	4,293	582	3,957
Chornyi Ostriv	741	3,581	701	3,765	803	3,716	782	3,257	675	3,580	844	3,863	749	3,552
Shymkivtsi	615	3,435	493	3,621	661	3,647	637	3,118	511	3,375	605	3,696	612	3,359
Rozvoriany	639	3,716	581	3,911	676	3,840	671	3,361	598	3,646	697	3,991	605	3,676
Byshiv	733	3,737	597	3,949	787	3,869	810	3,372	801	3,639	688	3,963	767	3,679
Zhvyrka	662	3,722	591	3,963	731	3,836	742	3,361	767	3,650	845	3,934	750	3,653

Source: developed by the author

The annual area of sugar beet crops within the enterprise ranges from 14,500-15,500 hectares, which ensures a stable presence of the crop in short-rotation crop rotations. The duration of the growing season ranged from 100 to 160 days, proportional within each location to ensure continuous harvesting and crop rotation. The seeding rate of sugar beet was 120,000 seeds/ha, row spacing was 45 cm, sowing depth was 2 cm. The research involved fields after various predecessors – winter wheat, corn for grain, soybeans. Of the analysed acreage, the predecessors were winter wheat on an area of 41,000 hectares, 29,000 hectares, and grain corn of 13,000 hectares. Agrofones were aligned according to the main agrotechnical measures, the fertiliser system (nitrogen – 125 kg/ha in dry matter; phosphorus – 50 kg/ha in dry matter; potassium – 150 kg/ha in dry matter). The sugar beet protection scheme is generally accepted in the region (Table 2).

Table 2. Sugar beet cultivation technology

BBCH	Herbicides	Fungicides	Insecticides	Trace elements	Basic fertilisers
Autumn, under the main tillage					Potassium chloride 250 kg/ha; Ammophos 150 kg/ha
00					Urea 150 kg/ha
9-10	Betanal expert 1.0 l/ha; Goltix Gold 1.0 l/ha		Bradby 0.3 l/ha		
12	Betanal Max Pro 1.5 l/ha; Goldix Titanium 1.5 l/ha			Magnesium sulphate 1.0 kg/ha	
16	Betanal expert 1.5 l/ha; Goltix Gold 1.5 l/ha		Bombardier Duo 0.2 l/ha	Monocalium phosphate 1.5 kg/ha	Ammonium nitrate 130 kg/ha
18	Steptrel 0.3 l/ha; Goltix Gold – 1.5 l/ha; Betanal Max Pro – 1.5 l/ha		Bombardier Duo 0.2 l/ha	Boron 1.0 l/ha Monocalium phosphate 1.5 kg/ha	
31-39	Agil 0.8 l/ha	Stark 0.4 l/ha		Manganese 2.0 l/ha Boron 1.0 l/ha	
49		Medyan Extra 1.8 l/ha Rex Plus 1.3 l/ha		Boron 1.5 l/ha	
49 (18 days from the previous one)		Rex Duo 0.7 l/ha, Manzat 1.5 kg/ha		Boron 1 l/ha	
49 (18 days from the previous one)		Split 0.5 l/ha; Dot 1 l/ ha; Medyan Extra 2 l/ha			

Source: developed by the author

The study used a method of comparative analysis of sugar beet productivity after different predecessors on soils of different genetic origin. Statistical processing of the results was performed using variance analysis (ANOVA) and the construction of second-order regression models. Microsoft Excel 365 spreadsheets (*Analysis ToolPak* package) were used to process empirical data, and the Statistica 10 software environment to refine variation parameters and verify the significance of factors. Graphs, trend lines, and results were plotted in Excel. This approach provided a comprehensive analysis of the relationships between the predecessor, soil type, and yield level. The study was conducted in accordance with the ethical standards of Convention on Biological Diversity (1992) and Convention on the Trade in Endangered Species of Wild Fauna and Flora (1976).

RESULTS AND DISCUSSION

During 2018-2024, the sugar beet yield was generalised within the production crops of PE "Zakhidnyi Buh", depending on the main groups of its predecessors. Accounting was carried out without differentiating fields by soil type, which helped to obtain an integral assessment of the average influence of the predecessor in the conditions of a farm with a large spatial variability of soil indicators. Figure 1 shows the relative yield of sugar beet (% to the average level), grouped by three main types of predecessors: corn per grain – 104%; cereals (wheat, barley) – 104%; soybeans – 96%.

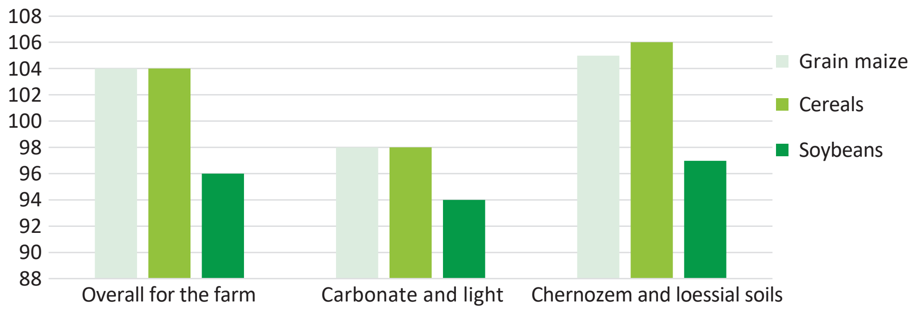

Figure 1. Relative yield of sugar beet in 2018-2024 in the conditions of the PE "Zakhidnyi Buh" after different predecessors on different types of soils
Source: developed by the author

The data obtained indicate that there is no statistically significant difference in beet yield after corn for grain crops. In both cases, there was a 4% increase in yield compared to the baseline average. This may be due to the best phytosanitary condition of the field, the structure of the soil after grain crops, and the technological compatibility of the terms of the main cultivation and sowing. But after soybeans, the yield was 4-8% lower compared to other predecessors. The decrease may be conditioned by the following factors: increased phytopathogenic load after soy; rapid depletion of available nitrogen; suboptimal structure of post-harvest residues; potential influence of the previous herbicide background. In the case of differentiation by soil type, in particular, on carbonate and light loamy sandy soils with low moisture capacity and low organic matter content, a different pattern of influence of the predecessor on sugar beet yield was observed. According to the analysis of data for 2018-2024, the relative yield of the crop in these conditions was: grain corn – 98%; cereals (wheat, barley) – 98%; soybeans – 94% (Table 2).

Compared to the integral average (100%), there was a slight decrease in yield in all variants. However, the most significant decline was observed after soybeans (-6%), which was probably conditioned by the following factors: weak structure-forming effect of soybeans in sandy and carbonate soils does not provide sufficient soil density and water retention, which is critical in conditions of low moisture capacity; crop residues of soybeans have a high C:N ratio that slows down their mineralisation and temporarily blocks nitrogen in the soil; a low supply of moisture in the arable layer after soybeans can be a consequence of less deep root penetration and a weak mulching effect in the summer; the phytosanitary situation on these soils after soybeans is potentially worse – rapid drying contributes to root rot damage. After cereals and corn, the relative yield of sugar beet on grain was the same (98%), which indicates a neutral or slightly positive effect of these predecessors in light soil conditions. Conditionally unfavourable water supply on these types of soils probably negates the potential benefits of the leguminous predecessor.

The results obtained indicate an increased sensitivity of beets to the structure and moisture storage capacity of the soil, which should be taken into consideration when planning crop rotation for carbonate and sandy areas. As a result of the differentiation of results by agricultural production groups of soils, it was found that on the most fertile soils of the PE "Zakhidnyi Buh" – chernozems and loessieal loams – the reaction of the crop to the predecessor was clearly positive, with a tendency to increase the yield after grain.

Based on data for 2018-2024, it was found that the relative yield of sugar beet for the main groups of predecessors was: cereals (wheat, barley) – 106%; grain corn – 105%; soybeans – 97%. Thus, after grain crops, there was the greatest increase in yield – 6% above the average level, which was conditioned by the favourable soil structure after these crops, good residual humidity, a developed root system, and less damage by soil pests. Grain corn, despite its shortcomings as a predecessor (high level of post-harvest residues, potential compaction of the soil), also showed an increase in yield (+5%), which can be explained by the high structure-forming ability, and the ability of corn to effectively use and accumulate nutrients from deeper horizons in crop residues. Soybeans, which are usually considered a good predecessor, provided the lowest results under these conditions – 97% relative yield, that is, 8-9% lower than after cereals. This decrease may be conditioned by the following factors: potential moisture deficiency at the initial stages of beet development due to insufficient mulching effect of soybean plant residues; high sensitivity of beet to herbicide residues used in soybean cultivation technology; lower soil loosening depth due to a weaker soybean root system. The results obtained indicate a mixed influence of the predecessor on the yield of sugar beet, which depends on the type of soil and the adaptive ability of the crop to the conditions of a particular agroecosystem. In the conditions of the PE "Zakhidnyi Buh", the general trend indicates an increase in the relative yield after grain crops (wheat, barley) and grain corn – 104% on average for 2018-2024, which confirms the results of previous studies by P. Deumelandt *et al.* (2010) and P. Götze *et al.* (2017), who also found a positive effect of these predecessors on the yield and quality of root crops.

The decrease in yield after soybeans (-4-8%) was not consistent with established ideas about legumes as valuable predecessors, which can be explained by phytosanitary risks, low residual moisture content, and possible exposure to herbicides with a long soil half-life (Prysiazhniuk *et al.*, 2022; Kluger *et al.*, 2025). A particularly significant decrease in yield after soybeans was observed on light soils with low buffering capacity, which confirms the high dependence of beets on the structural and agronomic state of the soil (Bodner & Alsalem, 2023). Analysis of agricultural soil groups showed that chernozems and loessial loams provide a steady increase in yield after grain – up to 106%, while on sandy and carbonate soils the positive effect of the predecessor was weaker or was levelled by water scarcity. Similar patterns were found in the studies by T. Hurisso *et al.* (2015), where it was proved that in conditions of limited water supply, the physical and chemical properties of the soil significantly affect the level of yield even with the same agrotechnical measures. After corn, and after grain, there was an increase in yield even despite possible competition with beets for moisture and a high amount of crop residues. This is consistent with data by H. Koch *et al.* (2018), who indicated the positive effect of corn, provided that soil compaction is controlled and the seed layer is properly prepared. Despite the general recognition of soybeans as a good predecessor, in the conditions of short-rotation crop rotation with high saturation with industrial crops, its efficiency was lower. This result was consistent with conclusions of C. Guo *et al.* (2024), who indicated the limited structural capacity of soybeans and the risks for subsequent crops in arid zones.

Thus, the results obtained did not confirm the expected advantage of leguminous predecessors, in particular soybeans, in short-rotation crop rotations, which indicates the need for further research considering individual soil and climatic zones, technological operations, and fertiliser systems. In general, on highly productive soils, the positive effect of grain predecessors was most fully manifested, which serves as an argument in favour of their priority use in short-rotation crop rotations in appropriate soil and climatic conditions.

CONCLUSIONS

In the course of long-term production studies conducted in 2018-2024 on the farm of PE "Zakhidnyi Buh", it was established that the predecessor is one of the key agrotechnical factors that determines the level of productivity of sugar beet in the conditions of short-rotation crop rotations in the western forest-steppe of Ukraine. A comparative analysis of the effectiveness of the three main groups of predecessors: cereals, grain corn, and soybeans showed a clear preference for cereals, in particular, winter wheat and barley. On average, over the years of the study, these crops provided the highest relative yields (104-106%) compared to the baseline level, which confirms their agronomic feasibility as predecessors in beet crop rotations. Soy, which is traditionally considered a valuable predecessor due to its ability to fix nitrogen, did not confirm its effectiveness under the analysed conditions. The yield of beets after soybeans remained 6-9% lower than after cereals, and in some years reached only 94% of relative productivity. The decrease in yield was explained by a number of negative factors: a weak mulching effect of post-harvest residues, potential exposure to residual herbicides, a high level of damage by soil pathogens, and a reduced supply of moisture in the arable layer after growing soybeans. The effect of the predecessor on yield was significantly modified by the type of soil. On highly productive soils – chernozems and loessial loams, the positive effect of cereals and corn was most pronounced – an increase in beet yield by 5-6%. On the other hand, on carbonate and sandy soils with low moisture capacity, the differences between the variants were less pronounced, and the overall beet yield decreased. In such conditions, soy was particularly ineffective, which indicates a restriction of its use in low-buffer areas with an increased risk of moisture deficiency.

Thus, the results obtained did not confirm the generally accepted preference of soybeans as a predecessor in short-rotation crop rotations in the conditions of the western forest-steppe of Ukraine. This requires a review of approaches to planning crop rotations in intensive agricultural systems and considering the complex influence of the predecessor, soil type, and microclimatic conditions. To increase the adaptability of crop rotations, it is recommended to apply a differentiated approach, in which cereals are priority predecessors on fertile soils, and soybeans should be excluded from beet predecessors on light, low-moisture soils. The prospects for further research consist in a detailed study of the interaction between the predecessor, fertiliser systems, and structural and agronomic properties of the soil, to create adaptive agricultural technologies for growing sugar beet in the context of climate change and the intensification of agriculture.

ACKNOWLEDGEMENTS

None.

FUNDING

Production programmes of PE "Zakhidnyi Buh".

CONFLICT OF INTEREST

None.

REFERENCES

[1] Anar, M.J., Lin, Z., Ma, L., & Chatterjee, A. (2021). Modeling the effects of crop rotation and tillage on sugarbeet yield and soil nitrate using RZWQM2. *Transactions of the ASABE*, 64(2), 461-474. doi: 10.13031/trans.13752.

[2] Arshad, S., Rehman, T., Saif, S., Rajoka, M.S.R., Ranjha, M.M.A.N., Hassoun, A., Cropotova, J., Trif, M., Younas, A., & Aadil, R.M. (2022). Replacement of refined sugar by natural sweeteners: Focus on potential health benefits. *Heliyon*, 8(9), article number e10711. doi: 10.1016/j.heliyon.2022.e10711.

[3] Bastaubayeva, S.O., Tabynbayeva, L.K., Yerzhebayeva, R.S., Konusbekov, K., Abekova, A.M., & Bekbatyrov, M.B. (2022). Climatic and agronomic impacts on sugar beet (*Beta vulgaris* L.) production. *SABRAO Journal of Breeding and Genetics*, 54(1), 141-152. doi: 10.54910/sabrao2022.54.1.13.

[4] Bodner, G., & Alsalem, M. (2023). Sugar beet rooting pattern mediates stomatal and transpiration responses to progressive water stress. *Agronomy*, 13(10), article number 2519. doi: 10.3390/agronomy13102519.

[5] Convention on Biological Diversity. (1992, June). Retrieved from https://www.cbd.int/doc/legal/cbd-en.pdf.

[6] Convention on the Trade in Endangered Species of Wild Fauna and Flora. (1976, March). Retrieved from https://surl.lt/kcxmpr.

[7] Deumelandt, P., Christen, O., & Hofmann, B. (2010). The influence of different cultivation concentrations and cultivation breaks on soil properties and yields in the sugar beet crop rotation experiment in Etzdorf Effect of various rotations and fallow periods on soil quality parameters and yield in the sugar beet rotation experiment in Etzdorf. *Archives of Agronomy and Soil Science*, 56(4), 393-404. doi: 10.1080/03650340.2010.490778.
[8] Gazdík, Z., Koprna, R., Lojková, L., & Cerkal, R. (2025). Overview of techniques for sustainable sugar beet production. *International Journal of Plant Production*. doi: 10.1007/s42106-025-00354-2.
[9] Götze, P., Rücknagel, J., Wensch-Dorendorf, M., Märländer, B., & Christen, O. (2017). Crop rotation effects on yield, technological quality and yield stability of sugar beet after 45 trial years. *European Journal of Agronomy*, 82, 50-59. doi: 10.1016/j.eja.2016.10.003.
[10] Guo, C., Yang, C., Fu, J., Song, Y., Chen, S., Li, H., & Ma, C. (2024). Effects of crop rotation on sugar beet growth through improving soil physicochemical properties and microbiome. *Industrial Crops and Products*, 212, article number 118331. doi: 10.1016/j.indcrop.2024.118331.
[11] Hlushchenko, L.D., Olepir, R.V., Len, O.I., & Samoilenko, O.A. (2021). The yield of sugar beet in constant sowing and crop rotation. *Bioenergy*, 2, 34-37. doi: 10.47414/be.2.2020.225004.
[12] Hurisso, T.T., Norton, J.B., Mukhwana, E.J., & Norton, U. (2015). Soil organic carbon and nitrogen fractions and sugar beet sucrose yield in furrow-irrigated agroecosystems. *Soil Science Society of America Journal*, 79(3), 876-888. doi: 10.2136/sssaj2015.02.0073.
[13] Kluger, D.M., Tommaso, S.D., & Lobell, D.B. (2025). Evaluating crop rotations around the world using satellite imagery and causal machine learning. *arXiv:2506.02384*. doi: 10.48550/arXiv.2506.02384.
[14] Koch, H.J., Trimpler, K., Jacobs, A., & Stockfisch, N. (2018). Crop rotational effects on yield formation in current sugar beet production – results from a farm survey and field trials. *Frontiers in Plant Science*, 9, article number 231. doi: 10.3389/fpls.2018.00231.
[15] Makukh, Y., Remeniuk, S., Moshkivska, S., Riznyk, V., Zatserkovna, N., Remeniuk, Y., Dubova, O., & Atamaniuk, O. (2025). Dynamics of productive moisture reserves, and water consumption use in short-rotation grain-sugar beet crop rotations in the forest-steppe depending on the fertilization system and soil potential fertility. *Ecological Engineering & Environmental Technology*, 26(6), 261-274. doi: 10.12912/27197050/204338.
[16] Makukh, Y.R., Tkalich, Y.I., Remeniuk, S.O., Buzynnyi, M.V., Senchuk, S.M., & Atamaniuk, O.M. (2024). Decrease in fertility of typical chernozem due to long-term anthropogenic pressure in grain-beet crop rotations. *Agrology*, 7(1), 27-33. doi: 10.32819/202404.
[17] Orazizadeh, M.R., Hosseinpour, M., & Fasahat, P. (2020). The effect of crop rotation on performance and qualitative characteristics of sugar beet. *Notulae Scientia Biologicae*, 12(3), 711-718. doi: 10.15835/nsb12310755.
[18] Pohanková, E., *et al.* (2025). Climate change impacts on two European crop rotations via an ensemble of models. *European Journal of Agronomy*, 164, article number 127456. doi: 10.1016/j.eja.2024.127456.
[19] Prysiazhniuk, O.I., Zaryshniak, A.S., Kostyna, T.P., Sinchenko, V.M., Muzyka, O.V., Svystunova, I.V., Slobodianiuk, V.V., Borysenko, B.M., Lukianchuk, O.V., & Kalatur, K.A. (2022). Patterns of changes in the yield and quality of sugar beet roots under the application of measures increasing tolerance to water deficit in the Right Bank Forest Steppe of Ukraine. *Advanced Agritechnologies*, 10(1), 1-11. doi: 10.47414/na.10.1.2022.281385.
[20] Skivka, L., & Hudz, S. (2021). Dynamics of phytotoxicity of soil under different fertilizer systems. *Scientific Reports of the National University of Life and Environmental Sciences of Ukraine*, 17(1), 15-25. doi: 10.31548/dopovidi2021.01.002.
[21] Tsymbal, Ya.S., Boiko, P.I., Martyniuk, I.V., & Bakumova, M.V. (2022). Productivity of sugar beet in various crop rotations of the left bank forest-steppe with organo-mineral fertilizer. *Agriculture and Plant Sciences: Theory and Practice*, 4, 12-18. doi: 10.54651/agri.2022.04.02.

[22] Yan, H., Wu, S., Li, P., Jin, X., Shi, D., Tu, D., Zeng, W., & Tan, L. (2024). Tobacco crop rotation enhances the stability and complexity of microbial networks. *Frontiers in Microbiology*, 15, article number 1416256. doi: 10.3389/fmicb.2024.1416256.
[23] Zimny, L., Gandecki, R., Waclawowicz, R., & Sniady, R. (2005). Productivity of crop rotation: Sugarbeet-spring wheat-winter barley under different organic fertilizer treatments and increasing nitrogen rates. *AGRIS – International System for Agricultural Science and Technology*, 60, 237-248.

Дмитро Кисельов
Кандидат сільськогосподарських наук
ПП «Західний Буг»
80250, просп. Юності, 39, с. Павлів, Україна
https://orcid.org/0009-0005-6771-8337

Вплив попередника на врожайність цукрового буряка в короткоротаційних сівозмінах в умовах Західного Лісостепу України

Анотація. У зв'язку з інтенсифікацією виробництва цукрового буряка в умовах короткоротаційних сівозмін зростає значення оптимального вибору попередника для забезпечення стабільної врожайності. Раціональне чергування культур є ключовим фактором підтримання родючості ґрунтів та зниження ризику фітосанітарних проблем. Метою роботи було оцінити вплив різних попередників на урожайність і збір цукру з урахуванням типу ґрунтів у Західному Лісостепу України. У дослідженні використано метод порівняльного аналізу продуктивності цукрового буряка після різних попередників на ґрунтах різного генетичного походження; статистичну обробку результатів проведено методом дисперсійного аналізу та регресійного моделювання. Було досліджено урожайність коренеплодів, рівень цукристості та валовий збір цукру після таких попередників, як озима пшениця, озимий ячмінь, соя та кукурудза. Було встановлено, що найвищу врожайність забезпечували зернові попередники (озимі пшениця, ячмінь), особливо на високопродуктивних ґрунтах. Було проаналізовано взаємозв'язок між типом ґрунту і ефективністю попередника: на карбонатних і піщаних ґрунтах урожайність після сої та кукурудзи знижувалась до 8,7-9,5 т/га. Було узагальнено, що родючість ґрунту пом'якшує негативний вплив менш сприятливих попередників. Було встановлено, що дія попередника істотно залежить від типу ґрунту: на чорноземах і лісових ґрунтах ефект зернових був найбільш вираженим. Отримані результати можуть слугувати основою для розробки регіонально адаптованих рекомендацій щодо структури сівозмін у бурякосіючих господарствах. Результати роботи можуть бути використані агрономами, консультантами та аграрними виробниками для удосконалення сівозмін та оптимізації технології вирощування цукрового буряка в умовах Західного Лісостепу

Ключові слова: карбонатні ґрунти; тип ґрунту; продуктивність агроценозів; структурно-агрохімічні властивості; родючість ґрунтів