YIELD OF SOYBEANS DEPENDING ON PREDECESSORS AND FERTILIZATION SYSTEMS IN THE CONDITIONS OF THE NORTHERN STEPPE OF UKRAINE

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Introductions. The productivity of soybeans largely depends on the technology of its cultivation. In Ukraine, the average soybean yield is no more than 1.5 t/ha, while globally it is 2.3 t/ha. One of the measures to achieve maximum soybean productivity is a properly planned fertilization system and the selection of the best predecessor.

Proper placement of soybeans in crop rotation allows for increased yield not only by avoiding diseases and pest damage but also due to the soil's water-physical regime and more rational use of nutrients.

A rational fertilization system provides optimal nutrition for agricultural crops throughout the vegetation period with nitrogen, phosphorus, and potassium compounds. The most effective fertilization system in crop rotations is the organic-mineral system. Application rates of mineral fertilizers on the background of manure are regulated based on the level of soil nutrient supply, which helps reduce fertilizer costs per unit of yield and their non-productive use.

Legume crops under the organic-mineral fertilization system are grown after applying fertilizers, and sometimes the fertilization system for these crops is supplemented with a starter dose recommended for a specific moisture zone.

In conditions of a severe manure deficit, an alternative may be plowing green mass from post-harvest crops as green manure and using by-products as fertilizer:

straw from grain crops, corn stalks for grain, etc. Growing post-harvest crops for green manure (such as white mustard, oil radish) after harvesting grain crops provides the soil with organic matter in the amount of 30-40 t/ha, which improves soil agrochemical indicators and mineral nutrition of agricultural crops during mineralization.

In conditions of exacerbation of economic and environmental problems in agriculture, an important direction in increasing and stabilizing soybean grain production is a more complete use of the biological factor, namely – rational placement of soybeans after the best predecessors.

However, increasing the productivity of agricultural crops and stabilizing soil fertility is impossible without using fertilizers.

Thus, selecting the best predecessors and fertilization systems for soybeans involves, on one hand, the correct selection of predecessors favorable for crop cultivation, and on the other hand, an optimal fertilization system to ensure high productivity and quality indicators.

Aim. To study the influence of predecessors and the level of fertilizer application and crop residues on soybean productivity.

Materials and methods. Field, laboratory, and statistical research methods were used. Field studies were conducted in 2023 at the «Viko» Farm owned by Voznyak V.V. on southern chernozem soils. The sowing rate was 800 thousand/ha. For the organic-mineral fertilization system, by-products from the predecessor with mineral fertilizers were used at a rate of $N_{40}P_{40}K_{40}$, while for mineral fertilization-only fertilizers at the specified rate.

The study used the Medea soybean variety, which belongs to the early ripening group. It is grown for food, feed purposes, as well as for planting material. The variety is extremely versatile, showing resistance to drought, lodging, and shedding. It is tolerant to many diseases and pests.

Results and discussion. Based on the results of our research, it was established that the choice of predecessor significantly determined the level of soybean crop yield (Table 1).

Table 1

Soybean yield depending on predecessors and fertilization systems, t/ha

Previous culture, factor A	System fertilization, factor B	Yield	Difference, factor A	Difference, factor B
Buckwheat	Without fertilizers	1,39	-	-
	Mineral	1,99	-	0,60
	Organo-mineral	2,07	-	0,68
	Average	*1,81*	-	-
Corn for grain	Without fertilizers	1,47	0,08	-
	Mineral	1,79	-0,20	0,32
	Organo-mineral	2,17	1,10	0,70
	Average	1,81	-	-
Soybean	Without fertilizers	1,77	0,38	-
	Mineral	2,14	1,15	0,37
	Organo-mineral	2,27	0,20	0,50
	Average	*2,06*	-	-
Winter wheat	Without fertilizers	2,08	0,69	-
	Mineral	2,41	1,02	0,33
	Organo-mineral	2,61	1,22	0,53
	Average	*2,36*	-	-
LSD_{05}	Factor A	0,15	-	-
	Factor B	0,13	-	-
	Factors AB	0,25	-	-

For instance, the yield of soybeans after buckwheat as a predecessor was at the level of 1.39 t/ha, while growing soybeans after soybeans and winter wheat resulted in an increased yield for the Medea variety by 0.38 t/ha and 0.69 t/ha, reaching 1.77 t/ha and 2.08 t/ha, respectively.

The placement of soybean crops after corn for grain did not significantly affect the yield level compared to the variant with buckwheat as the predecessor, despite corn being considered one of the best predecessors for soybeans. The yield increase was at the level of 0.08 t/ha, which was within the margin of significant difference (LSD_{05} = 0.15 t/ha).

Thus, under the minimal fertilization system, the best predecessor for cultivating the Medea variety of soybeans on southern chernozem soils was winter wheat (yielding 2.08 t/ha). Repeated sowings of soybeans resulted in a harvest of 1.77 t/ha of soybean seeds. The placement of soybean crops after buckwheat and corn

for grain did not significantly affect the yield difference, resulting in yields of 1.39-1.47 t/ha of soybeans.

Due to the factor of fertilization system, an increase in soybean yield was observed in all research variants. The highest additional crop growth under the mineral fertilization system was recorded in soybean crops after buckwheat-+0.60 t/ha with a yield level of 1.99 t/ha, while for other predecessors, this indicator was within the range of 0.32-0.37 t/ha.

Under the organic-mineral fertilization system, the greatest increase in soybean yield was obtained after corn for grain as a predecessor – +0.70 t/ha, while organic substances of the soil were less intensively utilized in repeated sowings of soybeans-+0.50 t/ha, but the difference in yield was also significant (LSD_{05}=0.13 t/ha).

Thus, the greatest increase in soybean yield was obtained under the organic-mineral fertilization system (0.70 t/ha), and under the mineral system-0.68 t/ha. The use of the mineral fertilization system determined the level of soybean yield depending on the predecessor factor.

For instance, for soybeans and winter wheat as predecessors, the application of mineral fertilizers contributed to an increase in the yield of the Medea variety of soybeans by 1.15 t/ha and 1.02 t/ha, respectively. It is worth noting that repeated sowings of soybeans most intensively utilized additional nutrients from the soil under the mineral fertilization system, while growing this crop after corn for grain led to a significant yield loss – a decrease of 0.20 t/ha (LSD_{05} = 0.25 t/ha) compared to the variant where soybeans were grown after buckwheat.

The response of the Medea variety of soybeans to the organic-mineral fertilization system was different. The highest amount of additional raw material was obtained for growing soybeans after winter wheat and corn – 1.22 t/ha and 1.10 t/ha, respectively. Placing soybean crops after soybeans resulted in an increase in yield by only 0.20 t/ha, but this increase was within the range of significant difference.

On average, the yield of soybeans varied depending on the predecessor factor, with a yield of 1.81 t/ha when growing the crop after buckwheat and corn for grain,

and 2.06 t/ha for repeated sowings of soybeans. The best yield was obtained when soybeans were grown after winter wheat – 2.36 t/ha.

Conclusions. Therefore, the highest level of soybean yield for the Medea variety in our research was obtained under the organic-mineral fertilization system-2.61 t/ha, with slightly lower yields under the mineral fertilization system-2.41 t/ha after winter wheat as a predecessor. Repeated sowings of soybeans had yields at the level of 2.27 t/ha and 2.14 t/ha, respectively. Growing soybeans after buckwheat and corn for grain did not show a significant difference in yield, except for the use of the mineral fertilization system after corn, which resulted in a significant decrease in soybean yield.