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**IMPACT OF NITROGEN FERTILIZERS AND FOLIAR PLANT
NUTRITION ON SOYBEAN GROWTH AND DEVELOPMENT UNDER
DIFFERENT SOIL CULTIVATION METHODS**

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***Abstract.** Presented experiments results of influence of tillage minimization on growth and development of soybeans. It was founded that norm of $N_{60}P_{60}K_{60}$ with co-application of foliar nutrition of micro fertilizers “Rostoc bobovyi” influences on plant growth stronger whatever soil tillage method is applied. Because of higher soil density in variants with minimal tillage and direct seeding it was recorded plants lag in growth and development, compared to tillage.*

***Key words:** soybeans, direct seeding, minimal tillage, traditional tillage, Nitrogen fertilizer, foliar nutrition.*

Introduction. It is known that formation of up ground plant part is result of different physiological processes. Growth and development of plants could be reached only in conditions when number of heat, light and nutrition elements will be optimal. Regulation of nutrition regime is one of the main methods to increase yield and agriculture efficiency. It is proved that efficiency of microelements that were contributed on leaves is higher compared to soil application.

Soybean plants are characterized with bunk accommodation of soy beans on stem. Therefore, height of lower level of soy beans on plant stem is important, it

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influences loss of soybeans when yield harvest is conducted. This is determined by sowing method, plant stand density, conditions of mineral nutrition and soil tillage.

Edwards A.C. results show that soil tillage minimization or its non-use increases humid accumulation, increases differentiation of soil layers for nutrition elements and changes activity of microbiota, compared to traditional tillage. This influences on number and availability of nutrients. Research of soil tillage minimization and fertilization on soybean plant growth gives possibility to open reserves that facilitate formation of its productivity.

Aim of the study. Define optimal biometrical soybean characteristics under tillage minimization and mineral fertilizers nutrition.

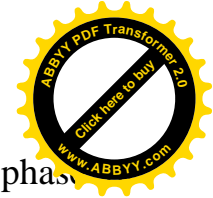
Methods of research: Experiments were conducted in 2013-2014 on the experiment field of department of agrochemistry and quality of crop production named after O. Dushechkin of NULES of Ukraine (Kyiv region, Boryspil district). Area of sowing experiment plot was 100 m², accounting area was 54 m², triple recurrence.

Soil of experiment plot was Dark Gray Podzolic rough dusty easy loam on loess soil. It was characterized by light acid reaction, low level of mineral Nitrogen, high level of mobile phosphorus and potassium, middle level of exchangeable calcium and magnesium.

Research optimum biometric indicators soybean was conducted under application of different dozes of nitrogen fertilizer on the background of P₆₀K₆₀ and direct sowing and traditional soil tillage methods. Fertilizers dozes increased from N₂₀P₆₀K₆₀ to N₈₀P₆₀K₆₀ with fold increase of N₂₀ in the variants.

Tillage variant included: precursor stubble peeling (10–12 cm), autumn plowing (25–27 cm), preplant cultivation (10–12 cm). Minimal tillage included precursor stubble peeling (10–12 cm), preplant cultivation (10–12 cm). Direct seeding included only fertilizers mixing on the depth of 3–4 cm with Vaderstad Carrier 400.

Sowing of seed of Merlin variety was performed with SuperWalter W1770 seeder.



Foliar nutrition with microfertilizer “Rostok bobovi” was done in phase branches growth with 3 liters/ha. Next mineral fertilizers were applied: NH_4NO_3 , $\text{NH}_4\text{H}_2\text{PO}_4$, KCl.

Soybean sampling, laboratory analysis and biometrical dimensions were conducted according to current methods. Soil density was defined according to Kachynskyi method.

Research results and its analysis.

It was defined that soil density in variants with minimal tillage and direct seeding compared to traditional technology was higher (Graph 1). Traditional tillage includes stubble peeling, ploughing and pre-seeding tillage. In variant with application of minimal tillage soil density level was lower, compared to direct seeding because discs application for 10-12 cm depth. In variants with application of traditional ploughing in emergence phase soil density (0-30 cm layer) was lower for 3,74% under minimal tillage and for 8% under direct seeding. Gradually up to phase of technical maturity, soil density was $1,36 \text{ g/cm}^3$. Minimization of soil tillage made physical parameters worse. Growth of soil density in 0-30 layer detained soybean plant growth and influenced its productivity.

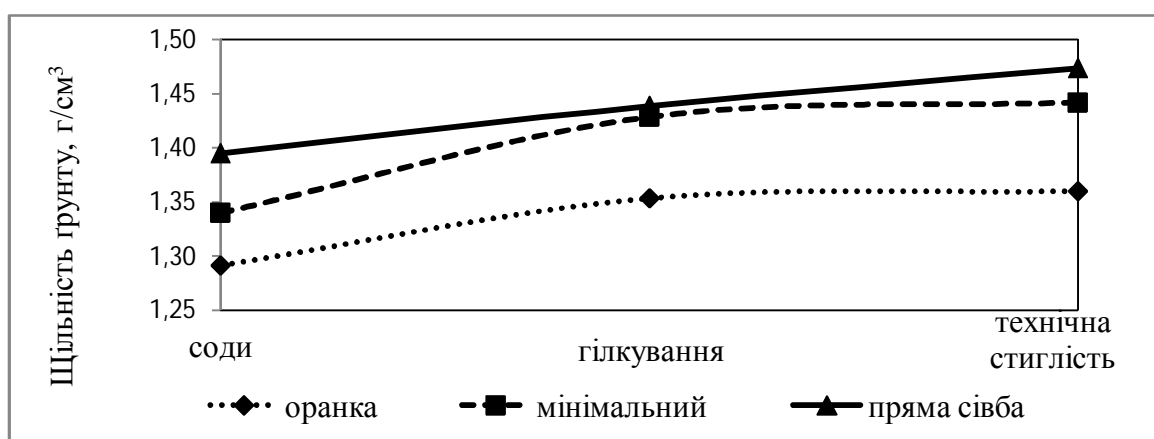


Fig. 1. Soil density dependence (0-30 cm layer) on tillage method and soybean plant growth phase, average for 2013-2014

Biometrical plant parameters are integral expression of processes of plant metabolism. Using soybean plant height information, we can make conclusions about



changes in conditions of mineral nutrition. As a rule, high grown plants leaves are bigger and it use sun energy more intensively, creates better microclimate near soil surface.

Mechanical tillage facilitates good plants emergence and quick plant growth in primary phases of development. Traditional tillage method has advantages in preparation of soil surface to seeding. It was set that under minimization of soil ploughing, soybean plants were lower in phase of technical maturity than under traditional ploughing application (Table 1).

1. Fertilizers influence on soybean biometrical parameters in phase of technical maturity under allocation of different tilling methods, 2013 – 2014

Tilling method	Experiment variant	Without foliar nutrition		With foliar nutrition	
		Plant height, cm	Height of first husk, cm	Plant height, cm	Height of first husk, cm
Ploughing (control)	P ₆₀ K ₆₀ (control)	66,6	6,76	70,3	7,08
	N ₂₀ P ₆₀ K ₆₀	69,1	8,25	72,3	8,53
	N ₄₀ P ₆₀ K ₆₀	69,7	8,66	72,8	9,20
	N ₆₀ P ₆₀ K ₆₀	71,5	9,64	78,0	9,97
	N ₈₀ P ₆₀ K ₆₀	70,4	9,65	75,6	9,85
Average		69,4	8,59	73,8	8,92
Minimal	P ₆₀ K ₆₀ (control)	46,5	6,00	52,7	6,46
	N ₂₀ P ₆₀ K ₆₀	48,2	6,52	55,1	6,84
	N ₄₀ P ₆₀ K ₆₀	52,4	7,69	57,8	8,08
	N ₆₀ P ₆₀ K ₆₀	55,7	8,69	61,2	9,18
	N ₈₀ P ₆₀ K ₆₀	52,6	8,23	59,7	8,49
Average		51,1	7,42	57,3	7,81
Direct seeding (without tillage)	P ₆₀ K ₆₀ (control)	35,6	5,45	42,0	6,82
	N ₂₀ P ₆₀ K ₆₀	41,4	6,81	44,4	7,60
	N ₄₀ P ₆₀ K ₆₀	43,9	7,09	47,0	8,42
	N ₆₀ P ₆₀ K ₆₀	45,6	8,54	48,7	9,20
	N ₈₀ P ₆₀ K ₆₀	44,9	7,45	45,4	8,49
Average		42,3	7,07	45,5	8,10



In variants with application of traditional ploughing, plant height was 69,7 cm that for 18,3 cm higher than minimal tillage and for 27,1 cm higher than under direct seeding. This influences on height of first husk. With ploughing it was 8,59 cm that for 1.17 and 1.52 cm higher than under minimal tillage and direct seeding.

Nitrogen fertilizers with application of Phosphorus-Potassium fertilizers influenced on growth and plant development in all ploughing variants. It was defined correlative dependency on plant height and first husk height ($r^2 = 0,64$).

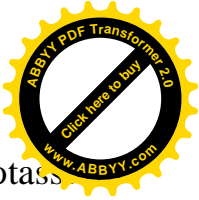
It should be noted that highest soybean plant biometrical parameters were with $N_{60}P_{60}K_{60}$. Under traditional tillage height was 71,5 cm that was for 15,8 cm higher than under minimal tillage and for 25,9 cm higher for direct seeding. This tendency was formed also for height of first husk. In $N_{80}P_{60}K_{60}$ variant it was lower compared to $N_{60}P_{60}K_{60}$. We think that this amount of Nitrogen fertilizer had negative impact on growth and soybean plant development.

It was defined that foliar nutrition with micro fertilizer “Rostok bobovi” of 3 liters/ha positively influenced on growing processes. Without difference of tillage methods, height of plants was higher than in variants with application of only mineral fertilizers. Under application of traditional ploughing it was higher for 5,96%, under minimal for 10,8%, under direct seeding – for 7,03%. We think that microelements and Molybdenum especially that is present in this fertilizer, facilitates Nitrogen nutrition and can facilitate growth of plant vegetative parts.

It was defined that traditional tillage facilitated better soybean development because of less dense 0-30 cm soil layer in experiments. In variant of $N_{60}P_{60}K_{60}$ and foliar nutrition application it was obtained the highest yield capacity of 4,71 t/ha, under minimal tillage – 4,35 t/ha, under direct seeding – 3,88 t/ha that was for 1,49, 1,09, 0,87 t/ha higher than in control variant ($P_{60}K_{60}$).

Conclusions

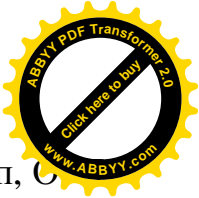
Under minimization of soil tillage, plants lag behind in growth compared to ploughing because of higher soil density in 0-30 cm layer. This influenced on plants height and height of first husk. With ploughing application plants were higher, under direct seeding – lower. Under minimization of tillage, yield was lower compared to



traditional tillage. Application of nitrogen fertilizers with Phosphorus-Potassium fertilizers and foliar nutrition in 3 liters/ha of “Rostoc bobovi” facilitated growth of plant height and height of first husk.

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ВПЛИВ АЗОТНИХ ДОБРИВ ТА ПОЗАКОРЕНЕВИХ ПІДЖИВЛЕНЬ НА РІСТ ТА РОЗВИТОК СОЇ ЗА РІЗНИХ СПОСОБІВ ОБРОБІТКУ ҐРУНТУ

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***Анотація.** Висвітлено результати досліджень щодо впливу удобрення на ріст і розвиток сої за мінімізації обробітку ґрунту. Встановлено, що норма $N_{60}P_{60}K_{60}$ із сумісним застосуванням позакореневого підживлення мікродобривом «Росток бобовий» більш суттєво впливає на рослини сої незалежно від способу обробітку. Проте через підвищену щільність ґрунту у варіантах із мінімальним обробітком і прямою сівбою рослини децю відставали у рості та розвитку порівняно з оранкою.*

***Ключові слова:** соя, пряма сівба, мінімальний обробіток, традиційний обробіток, азотні добрива, підживлення*

ВЛИЯНИЕ АЗОТНЫХ УДОБРЕНИЙ И ВНЕКОРНЕВЫХ ПОДКОРМОК НА РОСТ И РАЗВИТИЕ СОИ ПРИ РАЗЛИЧНЫХ СПОСОБАХ ОБРАБОТКИ ПОЧВЫ

А. В. Быкин, А. Л. Козачок, Н. П. Щербинина

***Аннотація.** Представлены результаты исследований влияния удобрения на рост и развитие сои при минимизации обработки почвы. Установлено, что норма $N_{60}P_{60}K_{60}$ с совместным применением внекорневой подкормки микроудобрения «Росток бобовый» более существенно влияет на растения сои независимо от способа обработки. Однако из-за повышенной плотности почвы в вариантах с минимальной обработкой и прямым севом растения несколько отставали в росте и развитии по сравнению со вспашкой.*

***Ключевые слова:** соя, прямой сев, минимальная обработка, традиционный обробіток, азотные удобрения, подкормки*