MODERN CHALLENGES OF AGRARIAN TRANSFORMATIONS IN UKRAINE: AGRICULTURE, FORESTRY AND HORTICULTURE

Monograph

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The monograph contains the results of research conducted by scientists of Sumy National Agrarian University, Ukrainian Research Institute of Forestry and Agroforestry and Land Reclamation named after GM Vysotsky, Henan Institute of Science and Technology in the framework of the state research "Study of the state of green plantations of populated cities of the North-Eastern part of the Forest-Steppe in order to establish ways to optimize the natural environment "(state registration number 0109U000346);".
The monograph is devoted to the theoretical and practical foundations of modern challenges of agrarian transformation in Ukraine: agriculture, forestry and horticulture, which are formed by integration and globalization challenges. The influence of environmental determinants on the level of sustainable agricultural sector in the short and long term is determined; cost-effective methods of growing planting material of forest and ornamental species of the nursery; improvement of existing and development of new technologies for growing planting material of fruit and ornamental crops.
For researchers, teachers, graduate students and students, business leaders and governing bodies of different levels, entrepreneurs and anyone interested in agriculture, forestry and horticulture speere.

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SYMBIOTIC ACTIVITY AND PRODUCTIVITY OF SOYBEAN PLANTS FOR TREATMENTS WITH GROWTH REGULATORS WITH ANTI-STRESS ACTION

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Introduction. Soybeans are one of the most valuable crops in world agriculture. The universality of the culture is due to the unique chemical composition, which combines 38−42% protein, 18−23% oil, 25−30% carbohydrates, enzymes, vitamins, minerals. It is impossible to overestimate its importance in the biologization of agriculture. Growing soybeans has a positive effect on humification processes, physical and physicochemical properties of soils, water and nutrient regimes, improves the nitrogen balance of crop rotation and increases the yield of other crops (Babych, 2004; Kolisnyk. 2009).

The latest trends in climate change, scientists are faced with the task of developing cultivation technologies that can increase yields and improve quality. An important component of increasing the yield and improving the quality of soybean seeds is the use of optimal nutrition, the use of modern highly effective plant growth regulators (Melnyk, Akuaku, Makarchuk, 2018; Mikheev, 2019). The mechanism of the effect of foliar feeding with growth regulators with anti-stress effect on photosynthetic, symbiotic activity and productivity of plants has not been studied, which makes research in this area relevant.

An important feature of plants is the ability to symbiotic nitrogen fixation. Among field crops, legumes have the highest potential for nitrogen fixation. World and domestic studies have shown that legumes in symbiosis with nodule bacteria are able to fix a large amount of nitrogen: clover - 180-670 kg/ha, alfalfa - 200-460, beans - 100-550, soybeans - 90-240, peas - 70 -160, lupines - 150-450, pastures with legumes - 100-260 kg/ha (Franche, 2008; Kalenska, 2009). Soybeans with a grain yield of more than 3.0 t/ha are absorbed by no more than 6.0 t/ha of nitrogen. At the same time, with such a grain harvest, plants use twice as much nitrogen from the soil for its formation, ie such crops do not create a positive balance of this element in the soil (Drobitko, 2001; Melnyk, Romanko, 2015).

Materials and Methods. The task of the experiment is to identify the effect of growth regulators with anti-stress effect on the productivity of soybean plants. The field research was conducted in the research field of ERPC (educational, research, and production complex) of the Sumy National Agrarian University during 2018–2020 in Ukraine. The experimental plots of Sumy NAU are located within the city of Sumy (latitude 50º52.742N, 34º46.159E Longitude, and 137.7 m above sea

level) and belong to the northeastern part of the Forest Steppe. Experiments were carried out on black soil characteristics for the coarse-medium loam.

On the topic of the master's research work, the field research was conducted according to the following scheme.

Experimental scheme Factor A - application period: in the microstage of development according to BBCH (61, 69 and 61 + 69). Factor B - the use of growth regulators with anti-stress effect: control (without regulators), Albite TPS (40 ml/ha); X-site (1.5 l/ha); Atonic Plus (0.2 l/ha); Megafol (1.0 l/ha); Bioforge (1.5 l/ha); Vermistim D (6.0 l/ha); Stimulate (0.75 l/ha).

Experiment parameters 1: la = 3, lв= 8; n = 4, the area of the accounting area of 30 m^2. The plots are arranged by the method of organized repetitions in four tiers. The method of sowing is the row method with a row spacing of 45 cm. The seeding rate is 0.5 million pieces of seeds per hectare.

Assessment of photosynthetic activity was performed on the following indicators: leaf surface area was determined by phases of soybean development by the method of cuttings and calculated by the formula. Also used the analytical method of determining the leaf surface area of soybean plants, which was developed by Babich A. O. and Makarov O.V. by one-parameter equations. The duration of general and active symbiosis and the number and mass of nodules on soybean roots were calculated on 20 plants according to the method of G. S. Posipanov.

Results. To identify the influence of the application phase and the type of growth regulators with anti-stress effect on symbiotic activity, the number and weight of nodules on the studied soybean plants were determined (Table 1).

It was found that for the introduction of PPP in the 61st microstage , maximum value received for use Atonic Plus (499 pcs. bubbles general weighing 31.04 d) that on 193 pcs. and 15.14 g more than in the control . High efficiency also detected by processing Megafol (444 pcs. bubbles weighing 24.05 d) that almost 30% more comparatively with control. Decrease symbiotic activity plants soybeans was determined for making X-site (273.5 pieces of bubbles weighing 11.18 g), which is 11% less than in the control . Calculated mass one nodules averaged 0.053 g and varied from 0.041 to 0.062 g. For making plant growth regulators in BBCH 69 in on average was formed less in number bubbles comparatively with processing in phase 61 (297.06 pcs.) and insignificant increase their general mass up to 19.72 g (Duncan test = 2.05 g).

Table 1 - Symbiotic activity of soybean plants depending on the phase of application and the type of growth regulators with anti-stress effect (average for 2018-2020 yy.)

Phase for BBCH (factor A)	Options for treating plants with growth regulators (factor B)	The number of bubbles, pcs.	Mass of bubbles, d	Average weight 1 bubble, d
BBCH 61	Control	306.5	15.90	0.052
	Albite TPS	329.9	17.32	0.053
	X-site	273.5	11.18	0.041
	Atonic Plus	499.0	31.04	0.062
	Megafol	444.0	24.05	0.054
	Bioforge	302.0	17.34	0.057
	Vermistim D	334.0	17.91	0.054
	Stimulate	378.0	17.50	0.048
	Average	***358.4***	***19.03***	***0.053***
BBCH 69	Control	282.5	21.36	0.076
	Albite TPS	242.5	16.30	0.067
	X-site	251.5	15.20	0.060
	Atonic Plus	394.0	29.60	0.075
	Megafol	243.5	18.67	0.077
	Bioforge	284.0	18.33	0.065
	Vermistim D	332.5	17.81	0.054
	Stimulate	346.0	20.52	0.059
	Average	***297.1***	***19.72***	***0.066***
BBCH 61 +69	Control	307.5	16.50	0.054
	Albite TPS	357.0	18.81	0.053
	X-site	300.5	16.18	0.054
	Atonic Plus	423.0	32.50	0.077
	Megafol	397.5	29.80	0.075
	Bioforge	357.0	18.87	0.053
	Vermistim D	298.5	18.22	0.060
	Stimulate	369.8	18.40	0.050
	Average	***348.7***	***21.55***	***0.060***
Duncan test $_{0.05}$		**22.54**	**2.05**	**0.006**

In incision growth regulators identified growth symbiotic activity plants soybeans for use Atonic Plus (394 pcs. bubbles weighing 29.6 g), Stimulant (346 pieces of bubbles) weighing 20.5 g) and Vermistim D (332.5 pieces of bubbles) weighing 17.8 g). Available inhibitory effect on symbiotic activity from making Albite TPS (242.5 pieces of bubbles weighing 16.3 g) that lower by 14% compared to control em . Trace to note weight gain one nodules for use regulators for more

late 69th BBCH microstage . Calculated mass one nodules on average by factor A was 0.066 g and varied from 0.054 to 0.077 g

Double foliar feeding with plant growth regulators in the 61st and 69th microstages led to the formation of the same number of tubers as in a single application in the 61st phase. The average factor A factor (348.7 units) was higher than the use of growth regulators in phase 69 (297.1 units). At the same time, it should be noted the increase in the total mass of nodules. On average, for BBCH $_{61 + 69}$ this indicator was at the level of 21.55 g, which is significantly higher than for a single application in BBCH $_{61}$ (19.03 g) and BBCH $_{69}$ (19.72 g). The above indicators led to the formation of bubbles weighing from 0.050 to 0.077 g. Factor B revealed the greatest manifestation of symbiotic activity when applying Megafol and Atonic (397.5-423.0 pieces of bubbles weighing 29.8-32.5 g, respectively), which with control by 22.7–27.4%. The average weight of the tubers was also the maximum and was 0.075–0.077 g. A positive effect was also obtained with the introduction of Bioforge and Stimulate (557.0 - 397.5 g of tubers weighing 18.4 - 18.87 g).

The main indicators of individual productivity are the number of beans, the number and weight of grain. The above indicators directly determine the realization of the biological potential of the crop and affect the formation of yields (Table 2).

On average, according to the research options, the maximum number of fruits (15.74 pcs.) By factor A (term of application) was detected by double use of growth regulators in the 61st and 69th microstages according to BBCH. On the variants for the introduction of PPP in BBCH 61 an average of 14.78 pieces were formed, and in BBCH 69 - 13.14 pieces. beans. According to factor B, the greatest effectiveness was found with the introduction of Megafol and Stimulate. On average, 15.14–15.15 pieces were formed on the above-mentioned variants. fruits . It should be noted the significant influence of growth regulators with anti-stress action, which provided the formation of more than 14.6 pieces. beans (Duncan test = 0.32 pcs.), except for Albite TPN, where only 13.61 pcs. fruits.

According to the indicator of grain weight from one plant in relation to the influence of application terms, the maximum parameters were found for application in BBCH 61 and double application of BBCH 61 + BBCH 69 . Another important indicator of plant productivity Is the amount of grain from one plant. According to the results of research, it was found that a greater impact on this indicator (28.33 pcs.) Was obtained with the use of growth regulators in the early phase of BBCH 61 (table. 3).

Treatment of plants in the next phase of BBCH 69 provided an average of 26.47 pieces. grains from plants. On the variants with double use of drugs, an average of 26.67 pieces were obtained. grains from plants. Factor B revealed a significant difference in the options for the use of growth regulators (over 26.88 units) compared to the control (24.6 units).

Table 2 - Number of beans and grain weight per soybean plant depending on the application phase and type of growth regulators with anti-stress effect (average for 2018-2020 yy.)

Phase for BBCH (factor A)	Options for treating plants with growth regulators (B)	Number of beans, pcs.	Mass of grain from the plant, g
BBCH 61	Control	13.70	4.29
	Albite TPS	13.95	4.51
	X-site	14.81	4.91
	Atonic Plus	15.03	5.25
	Megafol	15.50	5.17
	Bioforge	14.97	4.68
	Vermistim D	14.92	5.00
	Stimulate	15.40	4.95
	Average	*14.78*	*4.85*
BBCH 69	Control	12.16	4.26
	Albite TPS	12.36	4.48
	X-site	13.33	4.82
	Atonic Plus	13.37	4.56
	Megafol	13.55	5.10
	Bioforge	13.50	4.42
	Vermistim D	13.06	4.89
	Stimulate	13.78	4.89
	Average	*13.14*	*4.74*
BBCH 61 +69	Control	14.26	4.31
	Albite TPS	14.52	4.66
	X-site	15.67	5.03
	Atonic Plus	15.74	5.29
	Megafol	16.38	5.18
	Bioforge	15.84	4.83
	Vermistim D	15.77	4.72
	Stimulate	16.28	4.99
	Average	*15.74*	*4.87*
Duncan test $_{0.05}$	***AND***	***0.19***	***0.09***
	IN	***0.32***	***0.15***
	AB	***0.55***	***0.26***

The weight of 1000 grains is an important indicator of both the structure of the crop and its quality. It characterizes the grain size and is mainly a varietal trait. At the same time, elements of technology, in particular plant nutrition, have an impact on this parameter. It is quite logical that a well-developed plant, characterized

by high photosynthetic and symbiotic activity, is able to form a well-filled grain with a high weight of 1000 pcs. seeds.

Table 3 - Quantity and weight of 1000 pcs. seeds depending on the phase of application and the type of growth regulators with anti-stress effect (average for 2018 - 2020 yy.)

Phase for BBCH (factor A)	Options for treating plants with growth regulators (factor B)	Number of grains, pcs.	Weight 1000 pcs. seeds, g
BBCH 61	Control	25.39	168.93
	Albite TPS	26.48	170.96
	X-site	29.12	168.97
	Atonic Plus	29.53	178.10
	Megafol	29.85	173.51
	Bioforge	28.04	166.90
	Vermistim D	28.93	173.39
	Stimulate	29.26	169.93
	Average	*28.33*	*171.34*
BBCH 69	Control	24.62	173.39
	Albite TPS	25.10	179.08
	X-site	27.65	174.34
	Atonic Plus	25.56	179.17
	Megafol	28.80	177.61
	Bioforge	25.88	171.08
	Vermistim D	27.19	180.04
	Stimulate	26.94	181.39
	Average	*26.47*	*177.01*
BBCH 61 +69	Control	23.79	181.22
	Albite TPS	25.17	184.95
	X-site	27.93	180.05
	Atonic Plus	28.81	183.52
	Megafol	28.11	184,70
	Bioforge	26.73	181.19
	Vermistim D	25.74	183.74
	Stimulate	27.12	184.28
	Average	*26.67*	*183,20*
Duncan test $_{0.05}$	***AND***	***0.51***	***2.05***
	IN	***0.83***	***3.35***
	AB	***1.44***	***5.81***

According to the results of our calculations, it was found that the most effective influence on the formation of the mass of 1000 pcs. grains (183.20 g) were obtained by double treatment of plants in BBCH $_{61}$ and BBCH $_{69}$. The average value

(177.01 g) was calculated for treatments in the 69th microstage by BBCH. Early application of drugs had less effect on grain size (171.34 g), but it should be recalled that this period of application of growth regulators contributed to the formation of more grain.

Factor B revealed the effectiveness of Albit TPS, Atonic Plus, Megafol, Vermistim and Stimulate. On these variants the largest grain with a weight of 1000 pieces was formed. (178.33–180.26 g). Without the use of drugs (control) was obtained grain weighing 1000 pcs. - 174.51

Conclusions. The content of chlorophyll was 42.95 Spad - units when introducing growth regulators in BBCH $_{61}$. The highest rates were obtained in the options for plant treatment Atonic Plus (43.9) and Bioforge (44.9), which is higher compared to the control of 2.3 and 3.3 Spad - units in accordance. The introduction of the X-site (0.4) had a minimal effect. With the introduction of PPP in the 69th microstage, the highest rate was found in the variants Megafol (44.1) and Atonic Plus (43.8). The minimum values (42.0) were obtained from the analysis of soybean leaves treated with Albit TPS and Vermistym D. It was found that the introduction of plant growth regulators in BBCH $_{69}$ on average formed a smaller number of tubers compared to the treatment in the phase BBCH $_{61}$ (297.06 pcs.) and a slight increase in their total weight to 19.72 g. An increase in the symbiotic activity of soybean plants with the use of Atonic Plus (394 pcs. tubers weighing 29.6 g.), Stimulant (346 pcs. tubers) weighing 20.5 g) and Vermistim D (332.5 pieces of bubbles) weighing 17.8 g). There is an inhibitory effect on symbiotic activity from the introduction of Albite TPS (242.5 pcs. bubbles weighing 16.3 g), that lower by 14% compared to control em. It should be noted the increase in the weight of one tuber with the use of regulators at a later 69th microstage . Calculated mass one nodules on average by factor A was 0.066 g and varied from 0.054 to 0.077 g. The maximum number of fruits (15.74 pcs.) Was found with double use of growth regulators in BBCH 61 $_{and}$ BBCH $_{69}$. The greatest effectiveness was found with the introduction of Megafol and Stimulant (15.14-15.15 pcs.). On average, the weight of grain from one plant was maximum for the application of drugs in BBCH $_{61}$ and double application of BBCH $_{61}$ + BBCH $_{69}$. The highest efficiency on the amount of grain from one plant (28.33 pieces) was found with the use of growth regulators in BBCH $_{61}$.

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