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**THE PRODUCTIVITY OF PEA
VARIETIES DEPENDING ON THE
SEEDS TREATMENT, SYSTEM OF
DEFENCE AND NUTRITION**

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It is developed the growing technology model, which provides for the growing pea varieties under compatible presowing seeds treatment by bacterial preparations Rizoline and Groundfix, and duplex using of foliar fertilizing by complex fertilizers in the phase of third real leaves – “Gumat-list”+“Lf-ultrafit” and in the phase of budding “Gumat-list”+“Lf-ultrafit”+“Lf-Bobovi”+“Lf-Bor” in the background of fertilization $N_{30}P_{60}K_{60}$, which provided grain yield formation on the level of 4.20 t/ha in class Ataman and 4.62 t/ha in class Gregor, where collection of crude protein was 1.12 t/ha and 1.15 t/ha.

It is established the dependence between the pea yield size and weather conditions during the growing period.

It is created the optimal conditions of mineral nutrition for pea plants due to using of bacterial fertilizers and foliar fertilizers, which promoted not only great yield formation, but also significantly increasing of biochemical indexes and, as a result – the increasing of crude protein content till 24.97-25.55 %.

Keywords: *pea, presowing seeds treatment, foliar fertilizing, yield, seed quality.*

Табл. 2. Лит. 7.

Introduction. The main task of modern agriculture in Ukraine is increasing of grain cultures productivity, which will be promote the formation of plants recourses stock, the providing of livestock by high-quality fully feed, and population – by food products.

The pea is taking the important place in solving of this task. Its grain have got approximately 50 % of carbohydrates and 26 % saturated of essential amino acids, minerals and vitamins protein, that’s why it is widely using in mixed fodder production for manufacturing of balanced concentrated feed [1].

The short growing period and ability to fixation of atmospheric nitrogen makes pea like the best predecessor for winter wheat. Besides, that the plants ensure themselves on 2/3 by nitrogen, they leave 50-110 kg of easily accessible nitrogen for subsequent culture [2]. By using compatible bacterization by biofertilizing preparations on the basic of specific kinds of rhizobia and phosphate mobilization bacteria is ability to increase the efficiency of symbiotic nitrogen fixation on 15-35 % and formation high-yield pea plantings.

The wheat field doesn’t get approximately 1 million ha of the greatest predecessor – pea in Ukraine’s crop rotations, that’s why the implementation of new high-productive pea varieties of intensive type, which are suitable for direct harvesting will provide the expansion of its acreages. Hence is arise the necessity of

conducting the deep investigations with these varieties, to estimate their reaction on using of bacterial preparations on the base of nitrogen-fixing strains and phosphate mobilization bacteria, and complex fertilizers with content of macro- and microelements for foliar fertilizing.

Besides, it is extremely important to determine how these methods of cultivation technology of pea under conditions of right-bank Forest-Steppe will influence on the processes of symbiotic and photosynthetic activity and realization of moustaches peas varieties genetically potential and grain productivity in general. Marked questions are quite relevant and require proper scientific justification for the conditions of the region.

Analysis of recent research and publications. The using of biological bacteria compositions in combination with microelements while seeds processing stimulates the metabolic processes, is directing change the speed of initial growth reactions, provides intensive development of root system [3,4]. The newest investigations shown, that beside the plants roots nutrition there is air nutrition. That's why the plant foliar fertilizing by microelements became a widespread agricultural method. It allows to optimize the plant macro- and microelements nutrition in some vegetations periods and in the final result – to increase the yield, and improve the quality of crop production [5].

In the studies is established that pea growing with fertilizing of nitrogen till sowing on the background of the integrated plant protection system and presowing seeds treatment by growth, is forming the highest yield indexes – 3.5–5.5 t/ha, raw crude protein content – 22.35–24.02 %.

The aim of investigations consisted of productivity formation of intensive pea varieties type depending on the influence of presowing seeds treatment and system of defence and nutrition under conditions of right-bank Forest-Steppe.

Material and methods. The investigations were conducted during 2016–2017 years in field crop rotation of the department of plant production, breeding and bioenergy crops on the gray forest medium loam soils with humus content (by Tyurin) in the arable layer 2.11 %. The reaction of soil solution pH_{salty} – 5.4, hydrolytic acidity of 3.7 mg eq. / 100 g soil, the sum of absorbed bases 18.7 mg eq. / 100 g soil. The content of easily hydrolyzed nitrogen (by Kornfil'd) – 6,9 mg eq. / 100 g soil, mobile forms of phosphorus and exchangeable potassium (by Chirikov) – 10.8 and 8.3 mg eq. / 100 g soil respectively.

The research envisaged the study of the action and interaction of three factors: A – variety; B – system of defence and nutrition; C – presowing seeds treatment. The ratio of these factors is $2 \times 5 \times 4$. The repeated in experiment is a quadruple, the placement of options is systematic in two storey. The square of sown area is 40 m^2 , of accounting area – 25 m^2 .

We were studied two pea varieties of without leaves type – Ataman and Gregor. The sowing was conducted by ordinary row kind in the first decade of april with sowing seeds norm – 1.2 mln. pcs./ha of approved seeds.

The presowing seeds treatment were conducted by biological preparations was done in the same with sowing day. It was used Rizoline (*Rhizobium leguminosarum*), 3.0 l/ha seeds norm and Groundfix (*Bacillus subtilis*, *Bacillus megaterium* var. phosphaticum, *Paenibacillus polymyxa* KB), 2.0 l/ha seeds norm for seeds bacterization. The system of defence and nutrition were carried out by soluble complex fertilizers “Gumat-list” at a dose 1 l/ha and “Lf-ultrafit” at a dose of 5 l/ha and “Lf-Bobovi”, which contains macro- and micronutrients (N – 44.0-48.0 g/l; P₂O₅ – 50.0-52.0 g/l; K₂O – 52.0-55.0 g/l; B – 3.5-4.0 g/l; Cu – 6.0-6.5 g/l; Fe – 7.0-7.6 g/l; Mn – 5.5-6.0 g/l; Mo – 1.9 g/l; Zn – 7.0-7.6 g/l; S – 81.0 g/l; Co – 0.03-0.05 г/л; Ni – 0.006 g/l and “Lf-Bor” (B – 140-141 g/l; N-62-650 g/l; Mo – 05-0,1 g/l).

The determination of biochemical seeds quality indexes of pea were carried out according to the methodologies “The estimation quality and animal husbandry analysis of forage” [6] and “The biochemical methods for plants analysis” [7]. The yield quantity had been determine by gathering grain from each plot with grain combine harvester and by weighting of each variety.

Results and Discussion. It should be noted, that on the variants by the years of investigation (2016-2017 years) the yield of pea grain of variety Ataman was changing from 2.36 t/ha till 4.20 t/ha, in the variety of Gregor it was from 2.75 t/ha till 4.62 t/ha (Table 1).

Table 1

Grain yield of peas depending on the impact of presowing seeds treatment and system of defence and nutrition, t/ha, average 2016-2017

System of defence and nutrition	Presowing seeds treatment			
	Without treatment	Rizoline	Rizoline + Groundfix	Rizoline + Groundfix
Variety Ataman				
Without treatment	2.36	2.40	2.52	2.70
N ₃₀ P ₆₀ K ₆₀ (Background)	3.31	3.40	3.51	3.74
Background + A*	3.52	3.65	3.75	4.01
Background + B**	3.51	3.68	3.77	3.98
Background + A+B+C***	3.66	3.78	4.04	4.20
Variety Gregor				
Without treatment	2.75	2.84	2.97	3.08
N ₃₀ P ₆₀ K ₆₀ (Background)	3.42	3.50	3.66	3.86
Background + A*	3.65	3.88	3.92	4.05
Background + B**	3.80	3.95	4.10	4.28
Background + A+B+C***	4.00	4.20	4.36	4.62

Note:* A* – the phase of third real leaves – “Gumat-list”+“Lf-ultrafit”;

B** – the phase of budding “Gumat-list”+“Lf-ultrafit”+“Lf-Bobovi”+“Lf-Bor”;

C*** – A+B.

HIP_{0,05} t/ha; A- Variety; B – presowing seeds treatment; C – system of defence and nutrition. 2016-2017 years. A - 0,24; B - 0,27; C - 0,07; AB - 0,45; AC-0,42; BC – 0,59; ABC - 0,86

Source: formed on the basis of own research results

The improvements of nitrogen and phosphorus nutrition of pea plants was occurred of simultaneous presowing seeds treatment by Rizoline and Groundfix, increased pea grain yield of Ataman till 2.70 t/ha or on 0.34 t/ha, or 14.4 %, in a variety of Gregor till 2.70 t/ha or on 0.33 t/ha, or 12.0 %, compared with control. The application of this method in combination with system of defence and nutrition by complex fertilizers “Gumat-list”+“Lf-ultrafit” on the background of fertilizing $N_{30}P_{60}K_{60}$ increased the grain yield on 0.40–0.49 t/ha and “Gumat-list”+“Lf-ultrafit”+“Lf-Bobovi”+“Lf-Bor” increased the grain yield on 0.47 t/ha.

A similar pattern marked increase grain productivity in a variety of Gregor, while it exceeds the variety Ataman to yield to 0.10-0.45 t/ha.

However, the maximum grain yield of peas 4.20 t/ha in the Ataman variety and in the Gregor variety – 4.62 t/ha was obtained by growing with using presowing seeds treatment by composition Rizoline + Groundfix on the background of mineral fertilizing $N_{30}P_{60}K_{60}$ and carrying out the duplex foliar fertilizing of crops in the phase of third real leaves – “Gumat-list”+“Lf-ultrafit” and the phase of budding “Gumat-list”+“Lf-ultrafit”+“Lf-Bobovi”+“Lf-Bor”.

The carrying out of system of defence and nutrition was provided the formation of 59 % of peas grain yield.

By the results of correlation analysis of average for the years 2016-2017 research, it is determine the dependence of peas yield from the average air temperature ($r = 0.877$ for Ataman and $r = 0.848$ for Gregor), precipitation ($r = 0.899$; $r = 0.877$), the sum of active temperatures ($r = 0.987$; $r = 0.986$), which is authentically at 1 % significance level.

There is debating question: is there the inverse relationship between harvest and protein content in grain. With the improvement of mineral nutrition and optimal provision of heat and moisture the protein content in the grain is increasing at once with the increase of harvest. This pattern confirms our studies where indicators of chemical composition increase with increasing of productivity.

The value of grain pea is that it contains a significant amount of crude protein. It is determined, that at using presowing seeds treatment and foliar fertilizing by complex fertilizers, and its content was increasing significantly in connection with optimization of mineral nutrition of plants during growing season. So, on the control variant on the background of mineral nutrition $N_{30}P_{60}K_{60}$ without seeds treatment, the crude protein content of variety Gregor in average for 2016-2017 was 22.09 %.

On the plots with background fertilizing $N_{30}P_{60}K_{60}$ and with presowing seeds treatment, this index was increased till 22.65–23.03 %. The increasing of crude protein on 1.6–2.2 % occurred by the effect of foliar fertilizing, but the greatest amount of crude protein (24.97 %) was accumulated on the variant, where was used the full rate of mineral nutrition $N_{30}P_{60}K_{60}$, presowing seeds treatment by Rizoline and Groundfix and two foliar fertilizations (Table 2).

It is observed the trend, under analysis of collecting peas crude protein, which is same for yield, as this index combines two values - grain yield and content of crude

protein. The studied factors were significantly influenced on collection of crude protein. So, presowing seeds treatment increased collection of crude protein on 0.06–0.13 t/ha, foliar fertilizing on 0.21–0.30 t/ha during growing season, which is authentic at the five percent significance level.

The biggest collection of crude protein in variety Ataman – 1.12 t/ha, in variety Gregor 1.15 t/ha was obtained on the variant with mineral nutrition $N_{30}P_{60}K_{60}$, the using of the presowing seeds treatment by Rizoline and Groundfix and two foliar fertilizations in average of two years 2016-2017, which is bigger than control variant on 0.37 t/ha and 0.40 t/ha, accordingly.

Table 2

Quality indexes of pea seeds of the variety Ataman depending on the impact of pre-seed treatment and system of defence and nutrition, % (average for 2016-2017)

System of defence and nutrition	Presowing seeds treatment	Crude protein	
		content, %	gathering, t/ha
Without treatment	Without treatment	22.09	0.72
	Rizoline	22.34	0.77
	Groundfix	22.65	0.77
	Rizoline + Groundfix	23.03	0.83
$N_{30}P_{60}K_{60}$ (Background)	Without treatment	22.65	0.80
	Rizoline	23.34	0.86
	Groundfix	22.96	0.87
	Rizoline + Groundfix	23.71	0.94
Background +A*	Without treatment	23.21	0.87
	Rizoline	23.53	0.93
	Groundfix	23.84	0.94
	Rizoline + Groundfix	24.34	1.02
Background +B**	Without treatment	23.90	0.92
	Rizoline	24.21	0.98
	Groundfix	24.53	1.01
	Rizoline + Groundfix	24.94	1.10
Background + A+B+C***	Without treatment	24.00	1.97
	Rizoline	24.27	1.05
	Groundfix	24.66	1.06
	Rizoline + Groundfix	24.97	1.12
<i>LSD</i> 0.05		1.53	0.07

Note:* A* – the phase of third real leaves – “Gumat-list” + “Lf-ultrafit”;

B** – the phase of budding “Gumat-list” + “Lf-ultrafit” + “Lf-Bobovi” + “Lf-Bor”;

C*** – A+B.

Source: formed on the basis of own research results

The using of presowing seeds treatment and foliar fertilizations resulted in the optimization of mineral nutrition and the appropriate changes in indicators content of

phosphorus and potassium in pea grain, which were studied, ensuring their increase when imposition of studied factors.

Conclusions and prospects for further research. The maximum yield of pea grains 4,20 t/ha in the variety Ataman and 4,62 t/ha in the variety Gregor was formed by using Rizoline and Groundfix inoculating of seeds and conducting foliar fertilizing in the phase of third real leaves – “Gumat-list”+“Lf-ultrafit” and the phase of budding “Gumat-list”+“Lf-ultrafit”+“Lf-Bobovi”+“Lf-Bor”, which is bigger on 1,84 and 1,87 t/ha in comparison to the control. The biggest crude protein output in the variety Ataman – 1,12 t/ha and in the variety Gregor – 1,15 t/ha is obtained on the same variant.

The sufficient attention is given to increasing crop yields through the use of micronutrients in scientific workshops and conferences. Investigations of scientific institutions confirm the necessity of foliar fertilizing field crops by complex fertilizers, which containing stimulants, amino acids, micronutrients. However, these agricultural practices are causing a lot of questions, that’s why we were conducted the research of optimization the mineral nutrition of pea, systematized the results of microbiological interaction and complex fertilizers on the yield and its quality with recommendations for agricultural producers. To carry out the further research is appropriate, as there is a renewing of varietal composition and emergence of new biological preparations for seeds inoculation and fertilizers.

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АНОТАЦІЯ

ПРОДУКТИВНІСТЬ СОРТІВ ГОРОХУ ЗАЛЕЖНО ВІД ОБРОБКИ НАСІННЯ, СИСТЕМИ ЖИВЛЕННЯ ТА ЗАХИСТУ

Розроблено модель технології, яка передбачає вирощування сортів гороху посівного за сумісної передпосівної обробки насіння бактеріальними препаратами Ризолайн та Граундфікс, а також застосуванням двох позакореневих підживлень комплексними добривами у фазі 3-х справжніх листків – Гумат Лист + Ультрафіт та у фазі бутонізації – Гумат Лист + Ультрафіт + LF-Бобові + LF-Бор, на фоні основного мінерального удобрення $N_{30}P_{60}K_{60}$, що забезпечило формування урожайності зерна на рівні 4,20 т/га у сорту Отаман та у сорту Грегор – 4,62 т/га, де збір сирого протеїну становив 1,12 т/га та 1,15 т/га.

Встановлено залежність між величиною врожаю гороху посівного та погодними умовами посівів гороху посівного.

Створено оптимальні умови мінерального живлення для рослин гороху посівного за рахунок використання бактеріальних добрив та позакореневих підживлень сприяло не тільки формуванню високої урожайності зерна, але й суттєвому покращанню біохімічних показників і, як наслідок – підвищення вмісту сирого протеїну у зерні до 24,97–25,55 %.

Ключові слова: *горох посівний, передпосівна обробка насіння, позакореневі підживлення, урожайність, якість насіння.*

Табл. 2. Літ. 7.

АННОТАЦИЯ

ПРОИЗВОДИТЕЛЬНОСТЬ СОРТОВ ГОРОХА В ЗАВИСИМОСТИ ОТ ОБРАБОТКИ СЕМЯН, СИСТЕМЫ ПИТАНИЯ И ЗАЩИТЫ/

Разработана модель технологии, которая предусматривает выращивание сортов гороха посевного по совместной предпосевной обработке семян бактериальными препаратами Ризолайн и Граундфикс, а также применением двух внекорневых подкормок комплексными удобрениями в фазе 3-х настоящих листьев – Гумат Лист + Ультрафит и в фазе бутонизации – Гумат Лист + Ультрафит + LF-Бобовые + LF-Бор, на фоне основного минерального удобрения $N_{30}P_{60}K_{60}$, что обеспечило формирование урожайности зерна на уровне 4,20 т / га у сорта Атаман и у сорта Грегор – 4,62 т / га, где сбор сырого протеина в составил 1,12 т/га и 1,15 т/га.

Установлена зависимость между величиной урожая гороха посевного и погодными условиями посевов гороха посевного.

Созданы оптимальные условия минерального питания для растений гороха посевного за счет использования бактериальных удобрений и внекорневых подкормок способствовало не только формированию высокой урожайности зерна, а также существенному улучшению биохимических показателей и, как следствие – повышение содержания сырого протеина в зерне до 24,97-25,55 %.

Ключевые слова: *горох посевной, предпосевная обработка семян, внекорневые подкормки, урожайность, качество семян.*

Табл. 2. Лит. 7.

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