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ІНСТИТУТ БІОЕНЕРГЕТИЧНИХ КУЛЬТУР І ЦУКРОВИХ БУРЯКІВ

НАУКОВІ ПРАЦІ ІНСТИТУТУ БІОЕНЕРГЕТИЧНИХ КУЛЬТУР І ЦУКРОВИХ БУРЯКІВ

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INDIVIDUAL GRAIN YIELD INDICES FORMATION BY THE PEA INTENSIVE VARIETIES

This paper presents the results of studies on the effects of pre-sowing pea seeds with the treatment of the composition biopreparations Ryzohumin + Polimiksobakteryn and the mineral fertilizer $N_{45}P_{60}K_{60}$ along with the foliar nutrition "Coda" on the performance and productivity of crop yield. The results indicate a strong correlation between the seed yield of the peas and the individual elements of plant productivity.

Keywords: *Pisum sativum L., individual productivity, seed treatment, foliar nutrition, crop yield*

Introduction. In the current situation, solving the protein problem has highlighted the importance of using legumes as a source of cheap and environmentally friendly proteins because of their balanced amino acid [1]. Compared to cereals, legumes contain anywhere from 1.5 times to 2 and even three times as many proteins and provide a higher yield of protein and amino acids per unit [2].

The most common legume grown in the forest-steppe regions of Ukraine are peas, which are widely used both for industrial purposes, and are an essential component of animal feed. Peas have high nutritional value, with 25% protein content and more than 50% starch and vitamin content. The biological nitrogen fixation process that occurs due to pea cultivation helps to restore and maintain soil fertility and prepare the land for the following winter wheat crop [3].

One of the main conditions is to improve production efficiency and increase the gross pea yield, which can be realised by the introduction of advanced techniques and the development of improved agricultural practices for them, which is a vital and actual problem.

Thus, research in the department of plant breeding legumes Uladovo-Lyulynetska experimental breeding station the results indicate on the influence of weather conditions on the performance and productivity of pea [4]. At length the impact of the fertile does precipitation ($r_s = 0,71$), and the number of fertile nodes - the amount of rainfall ($r_s = 0,54$) and average daily air temperature ($r_s = - 0,55$). What affects the individual performance indicators such as the number of pea plants seeds per plant, pods per plant, fertile nodes beans fertile node in the bean seeds, the total number of nodes, the length of the fertile parts of the plant and weight of 1000 seeds. The results of studies provide evidence that due to fertilization systems of pea in the cultivar Vinnytchanin [5] provide evidence of productivity at the level of 4.54-4.89 t/ha with integrated protection system, triple applications of the foliar micronutrition Ekolist under the influence of mineral fertilizer $N_{60-90}P_{20-30}K_{30-45}$ in the background aftereffect manure 8 t/ha c.p. and by-products. Previous studies I.M. Didur and A.S. Chynchyk, have found that the formation of productive elements depend on the varietal characteristics of pea plants and the improvement of technological processes. Thus, seed treatments using Ryzohumin and Kristalon Special increased individual productivity by optimising the conditions of bacterial and mineral nutrition which leads to a significant increase in the number of pods and seeds per plant and weight of 1000 seeds [6, 7].

In this regard, it is necessary to find out whether it is possible that due to technological approaches, such as bacterization and foliar nutrition and form a stable agrophytocenoses. This helps realize the genetic potential of seed productivity of intensive pea cultivars grown in conditions of the right-bank Forest-Steppe.

The goal of the study is to identify of peculiarities of formation parameters of individual productivity of intensive varieties of peas depending on the influence of seed treatment and foliar nutrition in the right-bank Forest-Steppe.

Materials and methods. Studies on the formation of productive "leafless" pea varieties influenced by seed treatment and foliar nutrition in conditions of the right-bank Forest-Steppe of Ukraine were conducted during 2011-2013, at the experimental field of the Institute of Feed Research and Agriculture of Podillya of NAAS. The experimental field is grey forest sandy clay loam on loess. The humus content and available nitrogen is a low 2.2% and 4.7-5.4 mg eq. per 100 g of soil. Agrochemical survey data indicate high availability of mobile forms of phosphorus - 10-12 mg eq. per 100 g of soil and potassium - 12-14 mg eq. per 100 g of soil, with a soil acidity level of (pH 5,1-5,3).

Studying the interaction of three factors: A – varieties; B - foliar nutrition; C – seed treatment, was in the basis of the scheme of field experiment. Correlation of factors studied is 2:4:4. Repetition of the experiment is four times. The arrangement of options is systematic.

We studied two varieties of peas: Ulus developed by the Institute of Bioenergy Crops and Sugar Beet of the National Academy of Agrarian Sciences of Ukraine and Tsarevich developed by The Plant Production Institute nd. a. V. Ya. Yuryev of National Academy of Agrarian Sciences of Ukraine.

The technology of cultivation and tillage used is common for Forest-Steppe zone of Ukraine. The peas were sown by conventional drill seeder method CH-16A in early April to a depth of 4-5 cm with a seeding rate of 1.3 million seeds per hectare.

The pre-treatment of seed protectant Vitavacks 200 FF was performed two week before planting and the biological agents were applied on the day of sowing. The bacterization of seeds used Ryzohumin (Rhizobium leguminosarum 31) - 300 grams per hectare of seed rate and Polimiksobakteryn (Paenibacillus polymyxa KB) - 150 ml per hectare of seed rate. The biological drugs were developed at the Institute of Agricultural Microbiology and Agricultural Production NAAS.

Foliar nutrition was performed using complex fertilizers under the auspice of the experiment. Coda Foul 7-21-7 was used during the budding phase (2 l / ha) and the formation of green legumes, and Coda Complex was used (1 l / ha) during the ripening stage.

The area of land used was 25 m^2. Selective harvesting and simultaneous weighing of each accounting area was performed with the help of combine harvester Sampo-130. The research was conducted according to the methodology of research in agronomy [8].

Research results. The use of seed treatment and foliar nutrition in our study confirms the improvement in the performance of individual varieties of intensive pea cultivars (Table 1).

Analysis of the structure of the pea crop averaged over three years showed that the use of seed treatment increased the number of pods in both cultivars from 4.2 % to 11.4 % compared with the control. After the application of the seed treatment Ryzohumin + Polimiksobakteryn, the number of pods were 3.71 units in the cultivar Tsarevich and 4.30 units in the cultivar Ulus. The use of foliar nutrition Coda Foul 7-21-7 during the budding phase helped increase the amount of pods per plant by 0.21 units and 0.24 units respectively. After double and triple applications of the foliar nutrition Coda Foul 7-21-7 during the budding phase, the quantity of green pods and ripening seeds was increased by 0.43-0.50 units for Tsarevich and 0.32-0.38 units for Ulus with respect to the untreated cultivars.

Proven, that plants fertilized with the seed treatment Ryzohumin + Polimiksobakteryn and influenced by $N_{45}P_{60}K_{60}$ of the cultivar Tsarevich had a mass of seed per plant of 3.41 g, an increase of 0.27 g or 8.6% compared with the control. The application of foliar nutrition increased processing efficiency by 0.30-0.41 g, which is 8.7-10.7%.

Cultivar Ulus under pre-treatment of seeds with Ryzohumin + Polimiksobakteryn displayed an increase in the weight of seeds per plant by 0.36-0.51 g or 10.0-12.7%.

One of the main indicators characterising the fullness of peas is the weight of 1000 seeds. The weight of 1000 seeds also shows growth in biometric parameters depending on the seed treatment and foliar nutrition.

Table 1

Effect of seed treatment and foliar nutrition on the yield of pea crops (the average of 2011-2013)

Variant		The average of pods per plant, units		Weight of seeds per plant, g	Weight of 1000 seeds, g
Foliar nutrition	Seed treatment	pods	seeds		
Tsarevich					
$N_{45}P_{60}K_{60}$ (Fon).	No treatment	3,33	12,92	3,14	243,4
	Polimiksobakteryn	3,47	13,56	3,24	238,9
	Ryzohumin	3,50	13,84	3,32	239,8
	Ryzohumin + Polimiksobakteryn	3,71	14,46	3,41	236,2
Fon +I*	No treatment	3,57	14,36	3,43	238,8
	Polimiksobakteryn	3,80	15,18	3,55	234,2
	Ryzohumin	3,79	15,43	3,64	235,7
	Ryzohumin + Polimiksobakteryn	3,92	15,98	3,73	233,2
Fon +I+II*	No treatment	3,75	15,24	3,62	237,5
	Polimiksobakteryn	3,91	15,93	3,76	235,7
	Ryzohumin	3,99	16,18	3,82	236,3
	Ryzohumin + Polimiksobakteryn	4,14	16,79	3,99	237,5
Fon + I+II+III*	No treatment	3,75	15,00	3,84	256,1
	Polimiksobakteryn	3,77	15,36	3,99	259,6
	Ryzohumin	3,85	15,64	4,08	261,1
	Ryzohumin + Polimiksobakteryn	4,03	16,30	4,25	260,6
Ulus					
$N_{45}P_{60}K_{60}$ (Fon).	No treatment	3,86	15,30	3,31	216,1
	Polimiksobakteryn	4,03	16,07	3,41	212,1
	Ryzohumin	4,06	16,46	3,51	212,9
	Ryzohumin + Polimiksobakteryn	4,30	17,27	3,62	209,7
Fon +I	No treatment	4,14	16,91	3,59	212,0
	Polimiksobakteryn	4,40	17,97	3,74	207,9
	Ryzohumin	4,40	18,29	3,83	209,3
	Ryzohumin + Polimiksobakteryn	4,54	19,05	3,95	207,1
Фон+I+II	No treatment	4,35	17,95	3,79	210,9
	Polimiksobakteryn	4,53	18,90	3,94	208,4
	Ryzohumin	4,63	19,31	4,05	209,8
	Ryzohumin + Polimiksobakteryn	4,80	20,08	4,24	210,9
Fon + I+II+III	No treatment	4,35	17,67	4,02	227,3
	Polimiksobakteryn	4,37	18,13	4,18	230,5
	Ryzohumin	4,47	18,80	4,33	230,1
	Ryzohumin + Polimiksobakteryn	4,68	19,58	4,53	231,3

** I - foliar nutrition phases of budding Coda Foul - 7-21-7;*
II - foliar nutrition phases of green pods - Coda Foul 7-21-7;
III - foliar nutrition phases of ripening seeds - Coda Complex.

Thus, in the control areas of cultivar Tsarevich the mass of 1000 seeds was 243.4 g, and the corresponding control of cultivar Ulus was 27.3 grams less. In areas where the seed treatment Ryzohumin + Polimiksobakteryn was applied in three rounds of foliar nutrition, the mass of 1000 seeds for Tsarevich was 260.6 grams, while Ulus measured 231.3 grams.

Thus, the largest number of pods grew in Tsarevich under the variant Fon+I+II*, and presented at 3.75-4.14 units per plant. These variations were seen in the maximum number of seeds per plant - from 15.24-16.79 units. The greatest weight of seeds per plant were obtained with the application of Fon+I+II+II* and the seed treatment Ryzohumin + Polimiksobakteryn – 4.25 g. The greatest weight of 1000 seeds using Fon+I+II+III* with different types of seed treatments saw an increase of 12.7-24.4 g or 5.2-10.3% compared to variations in $N_{45}P_{60}K_{60}$ (Fon). Cultivar Ulus also showed similar responses to the factors studied in the experiment. However, the quantity of of pods and seeds per plant and the seed weight were higher by 0.60-0.66 units and 0.28 g respectively, compared to Tsarevich. The weight per 1000 seeds was 231.3 g, 29.3 g and 11.2% less than Tsarevich.

The results of our studies provide evidence that due to technological approaches, such as bacterization and foliar nutrition, which gives the opportunity to manage future levels of pea harvests through improved pea and seed yields, seed weight, and etc.

On average, during the years of research it was found that the amount of pods, seeds and weight of 1000 seeds were largely depended on factors that were placed on the study (Table 2). Accordingly, the quantity of seed yield increased by increasing the individual productivity of plants.

Table 2

Pea cultivar yields depending on seed treatments and foliar nutrition, t / ha (2011-2013)

Foliar nutrition	Seed treatment			
	No treatment	Polimiksobakteryn	Ryzohumin	Ryzohumin + Polimiksobakteryn
Tsarevich				
$N_{45}P_{60}K_{60}$ (Fon)	2,97	3,08	3,15	3,27
Fon+I*	3,26	3,37	3,46	3,60
Fon +I+II*	3,44	3,58	3,66	3,84
Fon +I+II+III*	3,55	3,69	3,80	4,01
Ulus				
$N_{45}P_{60}K_{60}$ (Fon)	3,15	3,27	3,36	3,50
Fon+I*	3,44	3,58	3,67	3,84
Fon +I+II*	3,63	3,78	3,91	4,11
Fon +I+II+III*	3,74	3,90	4,05	4,31

HIP_{05} t / ha; A – variety; B – foliar nutrition; C – seed treatment.
2011 A - 0,03; B - 0,04; C - 0,04; AB - 0,06; AC-0,06; BC – 0,09; ABC - 0,12
2012 A - 0,03; B - 0,05; C - 0,05; AB - 0,07; AC-0,07; BC – 0,09; ABC - 0,13
2013 A - 0,03; B - 0,04; C - 0,04; AB - 0,06; AC-0,06; BC – 0,10; ABC - 0,12

** I - foliar nutrition phases of budding Coda Foul - 7-21-7;*
II - foliar nutrition phases of green pods - Coda Foul 7-21-7;
III - foliar nutrition phases of ripening seeds - Coda Complex.

Thus, the maximum seed yield of peas for cultivars Tsarevich and Ulus were 4.01 t / ha and 4.31 t / ha respectively, which were observed when grown with the use of seed treatment Ryzohumin + Polimiksobakteryn, and under the influence of mineral fertilizer $N_{45}P_{60}K_{60}$. Three applications of the

fertilizer “Coda” during the flowering, green pea, and seed ripening stage increased the yield by more than 1.04 t / ha and 1.16 t/ha compared with the control (no treatments).

Improved nitrogen and phosphorous nutritional content of pea plants occurs simultaneously with pre-treatment of seeds with Ryzohumin + Polimiksobakteryn and increased the seed yield of Tsarevich to 3.27 t/ha - by 0.30 t/ha or 10.0% under the influence of fertilizer $N_{45}P_{60}K_{60}$ when compared to controls.

The use of this method in conjunction with the foliar fertilizer Coda Foul yielded a seed increase of 0.34-0.46 t/ha or 10.3-13.0%. Similar increases were observed in cultivar Ulus though Ulus exceeded yields of Tsarevich by 0.13-0.30 t/ha.

The following regression model (table 3) was described by the strong correlations found during the research between pea seed yield, plant density, and individual productivity.

Table 3

Regression model, found during the research between pea seed yield, plant density, and individual productivity (the average of 2011-2013)

Crop yield Tsarevich (У), t / ha	$Y = 0{,}2461 + 0{,}1899 \cdot X_1 + 0{,}8337 \cdot X_2 - 0{,}0022 \cdot X_3$ (R = 0,998)
	$У = -2{,}3134 + 0{,}0265 \cdot X_4 + 0{,}7805 \cdot X_5$ (R = 0,993)
Crop yield Ulus (У1), t / ha	$Y_1 = 1{,}0804 + 0{,}0049 \cdot X_1 + 0{,}9935 \cdot X_2 - 0{,}0058 \cdot X_3$ (R = 0,997)
	$У_1 = -2{,}7971 + 0{,}0314 \cdot X_4 + 0{,}7745 \cdot X_2$ (R = 0,994)

X_1 – The amount of pods per plant, units; X_2 – Weight of seeds per plant,g;
X_3 – Weight of 1000 seeds, g; X_4 – plant density, units;
R – the coefficient correlation.

The indicator that provided the greatest correlation for individual productivity was the seed yield paired with the seed mass per plant - the coefficient r was r=0.988 for both cultivars. There was also a strong correlation between the seed yield and the number of pods per plant - r = 0.911 for Tsarevich and r = 0,915 for Ulus.

At the same time, the quantity of the seed yield depended on the density of plants during the harvest. However, there was a more tangible impact between the yield level and individual productivity - r = 0.998 - than the correlation of plant density per harvest - r = 0,851 for Tsarevich; r = 0,866 for Ulus, although the correlation between parameters was strong enough.

Conclusions. The individual productivity of instensive pea cultivars in the forest-steppe region of Ukraine’s influenced by the normal application of mineral fertilizer $N_{45}P_{60}K_{60}$ and the seed treatment Ryzohumin + Polimiksobakteryn, along with the triple application of foliar fertilizer “Coda” during the flowering, green pod, and seed ripening stages provided for the high performance of individual pea plants - 4.03-4.68 pcs. pods per plant; 16.30-19.58 pcs. seeds per plant; and a mass of 1000 seeds of 260.6-231.3 g. We found a strong correlational relationship between the individual performance of pea plants and seed yield of R = 0.99, which allows for the generation of maximum seed yield varieties of peas Tsarevich (4.01 t / ha) and Ulus (4.31 t / ha).

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Анотація

Телекало Н.В.

Формування показників індивідуальної продуктивності зерна інтенсивних сортів гороху

В статті наведено результати досліджень з вивчення впливу передпосівної обробки насіння гороху посівного композицією біопрепаратів Ризогумін+Поліміксобактерин на фоні мінерального удобрення $N_{45}P_{60}K_{60}$ та позакореневих підживлень добривом "Кода" на показники структури урожаю та урожайність. Встановлено, що між урожайністю зерна гороху посівного та елементами індивідуальної продуктивності рослин існує сильний кореляційний зв'язок.

Ключові слова: *горох посівний, індивідуальна продуктивність, обробка насіння, позакореневі підживлення, врожайність*

Аннотация

Телекало Н.В.

Формирование показателей индивидуальной продуктивности зерна интенсивных сортов гороха

В статье приведены результаты исследований по изучению влияния предпосевной обработки семян гороха посевного композицией биопрепаратов Ризогумин + Полимиксобактерин на фоне минерального удобрения $N_{45}P_{60}K_{60}$ и внекорневых подкормок удобрением "Кода" на показатели структуры урожая и урожайность. Установлено, что между урожайностью зерна гороха посевного и элементами индивидуальной продуктивности растений существует сильная корреляционная связь.

Ключевые слова: *горох посевной, индивидуальная продуктивность, обработка семян, внекорневые подкормки, урожайность*