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СОВМЕСТНОЕ ИСПОЛЬЗОВАНИЕ БИОПРЕПАРАТОВ И РЕГУЛЯТОРОВ РОСТА ДЛЯ ПОВЫШЕНИЯ УРОЖАЙНОСТИ СОИ И ТОМАТОВ

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Приведены результаты исследований влияния средств защиты растений на культуры томата и сои в условиях Приморья. Изучение препаратов производили на районированных сортах томата Новичок и сои Приморская 86. Оценена эффективность различных комбинаций биопрепаратов на основе штаммов бактерий *Bacillus subtilis* Бактофит, Гамаир и регуляторов роста Циркон, Мивал-Агро. Препараты применяли для обработки семян и опрыскивания вегетирующих растений. Комплексная обработка Бактофитом обеспечивала снижение проявлений септориоза на томате на 3,9%, биологическая эффективность составила 22,1%. Регулятор роста Мивал-Агро (обработка семян и растений) обеспечил эффективность против фитофтороза на 36,8%. Наибольшая урожайность томата отмечена при обработке семян и растений препаратом Гамаир (20,0 т/га), прибавка к контролю составила 4,9 т/га. Максимальная эффективность (29,7%) против септориоза на сое зафиксирована в варианте Гамаир + Мивал-Агро. По вариантам опыта биологическая эффективность против пероноспороза составила от 21% (комплексная обработка Гамаиром) до 25,4% (Бактофит + Мивал-Агро). Применение всех препаратов положительно сказалось на росте и развитии растений сои. Самый большой прирост высоты растений в фазу полной спелости отмечен в варианте с применением Бактофита и Мивал-Агро (73,1 см), в контроле – 61,8 см. При использовании биопрепаратов и регуляторов роста масса 1000 семян достоверно увеличивалась по сравнению с контролем (176,2 г) на 13,5–22,0%. Высокие показатели урожайности по сравнению с контролем (1,8 т/га) достигнуты в варианте Бактофит с Мивал-Агро (2,7 т/га), прибавка составила 0,9 т/га.

Ключевые слова: томаты, соя, биопрепараты, регуляторы роста, болезни, структура урожая, урожайность

COMBINED USE OF BIOPREPARATIONS AND GROWTH REGULATORS TO IMPROVE SOYBEAN AND TOMATO YIELDS

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The results of research on the effect of crop protection agents on tomato and soybean crops under Primorye conditions are presented. The study of preparations was carried out on zoned varieties of tomato Novichok and soybean Primorskaya 86. The effectiveness of different combinations of biological preparations based on *Bacillus subtilis* strains Bactofit, Gamair and growth regulators Zircon, Mival-Agro was evaluated. The preparations were used for seed treatment and spraying of vegetative plants. Complex treatment with Bactofit provided a 3.9% reduction of septoriosis manifestation on tomato, the biological efficiency was 22.1%. Growth regulator Mival-Agro (seed and plant treatment) provided 36.8% effectiveness against late blight. The highest tomato yield was observed with the treatment of seeds and plants with Gamair (20.0 t/ha) with an increase of

4.9 t/ha compared to the control. The maximum efficiency (29.7%) against septoriosis on soybeans was recorded in the variant Gamair + Mival-Agro. The biological efficacy against peronosporosis ranged from 21% (Gamair complex treatment) to 25.4% (Bactofit + Mival-Agro). The application of all preparations had a positive effect on the growth and development of soybean plants. The largest increase in plant height in the phase of full ripeness was noted in the variant with the use of Bactofit and Mival-Agro (73.1 cm), in the control - 61.8 cm. Thousand-kernel weight increased with certainty by 13.5 – 22.0% in comparison with the control (176.2 g) after the usage of biopreparations and growth-regulating chemicals. High yield was achieved in the Bactofit + Mival Agro variant (2.7 t/ha), in comparison the control was 1.8 t/ha, the addition amounted to 0.9 t/ha.

Keywords: tomato, soybean, biological products, growth regulators, diseases, crop structure, productivity

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INTRODUCTION

Intensive farming is gradually leading to environmental degradation. Fertilizer and pesticide transformation products, which have mutagenic and toxic effects on living organisms, are accumulating in soil and water [1].

The demand for organic products is now increasing everywhere. The term 'ecological products', i.e. products produced according to ecological agricultural environmental management standards, has been adopted worldwide. The products must be inspected and labelled in accordance with established rules. The production of organic products is based on biological farming methods. This implies the reduction or complete rejection of synthetic mineral fertilizers and chemical plant protection agents with the maximum use of biological factors to increase soil fertility, suppression of diseases, pests and weeds that do not have a negative impact on the state of the natural environment. In this connection, interest in the use of microbiological advances in agriculture has increased [2, 3].

The use of growth regulators can increase the plant's resistance to negative factors. These include natural and synthetic organic compounds that in small doses actively affect plant metabolism, resulting in visible changes in growth and development [4, 5].

The use of biological plant protection agents is one of the main elements of modern technologies for phytosanitary optimisation of vegetable agrocenoses. Bacteria belonging to the genus *Bacillus*, especially *Bacillus subtilis* strains, are effective for biological control of many plant diseases caused by soil pathogens. Preparations based on *Bacillus* strains are characterized by high activity against phytopathogenic fungi, do not have a negative impact on the environment, contribute to the conservation and development of beneficial soil microbiota. The antagonistic activity of *Bacillus subtilis* is shown against a large number of pathogens, which allows to protect agricultural crops, especially those for which there are practically no effective means of protection, such as vegetable crops, as they are used mainly in raw form [6–9].

The use of biopreparations and growth regulators is an environmentally friendly method of increasing yields and product quality.

The purpose of the work is to obtain experimental data on testing biological preparations against diseases and growth regulators for presowing treatment of seeds and vegetative plants of soybeans and tomatoes, to determine the effect on productivity and yield.

MATERIAL AND METHODS

The research was conducted in 2018, 2019 on zoned varieties of tomato Novichok and soybean Primorskaya 86. Employees of the Biomethod Department of the Far Eastern Research Institute of Plant Protection (DVNIIZR) studied the effectiveness of bacterial preparations based on *Bacillus subtilis* bacteria strains (Bactofit, Gamair) and growth regulators (Zircon and Mival-Agro).

Bactofit is a microbial preparation (fungicide and bactericide) containing spores and cells of *Bacillus subtilis* culture, strain IPM-215. Bacteria of this species synthesize substances with antibiotic properties as well as growth-regulating components that enhance plant growth[1].

Gamair is a biological bactericide based on natural bacterium Bacillus subtilis, strain M-22 VIZR, has antibacterial and antifungal effect. It suppresses root rot pathogens, protects from mass manifestation of tracheomycosis wilt, various leaf and stem diseases. It reduces pesticide stress in plants [10].

Mival-Agro is a complex preparation containing an analogue of phytohormones from the auxin group in addition to a biologically active organosilicon compound. It has properties of cryoprotector and adaptogen. It effectively stimulates protein and nucleic acid synthesis. It stimulates root formation, reduces the degree of root rot. It does not interact with fertilizers and pesticides [11, 12].

Zircon (natural mixture of hydroxycinnamic acids and their derivatives) is a disease resistance inducer, seed germination activator, flowering stimulator. It reduces susceptibility to stress factors, increases crop yields. The active ingredient of the product belongs to plant phenols, isolated from the medicinal plant Echinacea purpurea [13].

In the experiment on tomatoes the seeds were soaked in the working solution of the preparations for 2 hours, in the variant with Zircon - 3 hours. The working fluid consumption was 1 l/kg of seeds. Vegetation spraying with biopreparations was carried out three times during the season. The first one was done 10 days after seedling planting in the open ground, the next ones were done with 10 days interval. The working solution consumption rate was 400 l/ha. Growth regulators spraying was carried out 1-2 days before seedlings planting in the ground, in the phases of the beginning of budding and flowering of 1, 2 brushes. The consumption rate of the working solution is 300 l/ha.

The soil of the experimental plot was meadow-brown podzolized with humus content of 2.4%, N-NO_3 - 8.2 mg/kg, P_2O_5 - 21.2 mg per 100 g of soil, K_2O - 55 mg per 100 g of soil, pH of the salt extract 4.5. The plot area was 5,6 m^2. Five variants of the experiment were carried out; triple replication, systematic placement. The sowing was carried out manually.

All records and observations in the field experiments were carried out according to the current methods and guidelines[2–4]. Tomato harvesting was carried out separately for each plot and the fractional composition of the crop was determined. In the soybean experiment, the preparation was processed one day before sowing by hand in a semi-dry method. For this purpose, the preparation was diluted in clean water (at the rate of 10 l/t) and, without letting the suspension settle, applied it to the seeds, which were then thoroughly mixed until the preparation was evenly distributed. The spraying was carried out during the phase of full sprouts and during the phase of budding - the beginning of flowering.

The soil of the experimental plot is meadow-brown, heavy loam by texture. Agrochemical characteristics of the soil are as follows: humus content 3.08-3.13%, easily hydrolyzable nitrogen - 9.5 mg/100 g, P_2O_5 - 14.12 mg/100 g, pH of the salt solution - 5.3. Tillage: autumn plow-

[1]List of pesticides and agrochemicals permitted for use in the Russian Federation. M., 2018. 1117 p.

[2]Basic methods of phytopathological research / Edited by Chumakov A.E. Moscow: Kolos, 1974. 187 p.

[3]Guidelines for state testing of fungicides, antibiotics and seed protectors for agricultural crops / Edited by K.V. Novozhilov, Corresponding Member of VASKhNIL, 1985. 380 p.

[4]Dospekhov B.A. Methodology of field experience (with the basics of statistical processing of research results). 5th edition, revised and enlarged. Moscow: Agropromizdat, 1985. 351 p.

ing to a depth of 22 cm, early spring harrowing, two tillage and pre-sowing tillage. Grain was the forecrop. No fertilizer was applied. Sowing of soybeans was carried out by SKS 6-10 seeder. Seed rate was 90 kg/ha.

There were five variants in the experiment, repeated four times, and the area of the plot was 10 m^2. The arrangement was randomized. Agronomic techniques of soybean cultivation in the experiment were common for Primorsky Territory (see footnote 4). Harvesting was done manually by variants in one pass. Sheaf samples were collected from two 0.25 m^2 (0.35 × 0.71 m) plots on each plot. The yield structure was determined under laboratory conditions.

All records and observations in the field experiments were carried out according to the current methods and guidelines, preparations were used according to the instructions, and the results were processed by analysis of variance (see footnote 4)[5,6].

RESULTS AND DISCUSSION

The weather conditions in the years of study were contrasting. The summer months of 2018 were characterized by an abundance of precipitation, with an uneven distribution over ten-day periods. August was the wettest. Summer temperatures were in line with the long-term average. The weather conditions in 2019 were unfavorable for crops in terms of precipitation. Particularly low rainfall occurred in June and July, when crop formation took place, which affected crop yields. August was the wettest, with 226.5 mm of precipitation during the month, which resulted in waterlogging of land. Temperatures were 0.6-3.8°C above the long-term average for each month.

The phytosanitary situation of the experiment allowed the efficacy of biopreparations and growth regulators to be observed. During the work, such tomato diseases as septoriosis, or white spot disease (*Septoria licopersici Speg.*), phytophthorosis (*Phytophthora infestans De Bary*) were identified. Septoriosis turned out to be the most harmful; its development in the variants was from 13.7 to 15.1%, while in the control it was 17.6% (see Table 1).

It was found that the complex treatment with Bactofit biopreparation provides a 3.9% reduction of septoriosis manifestation on tomato, the biological efficiency was 22.1%. Phytophthora development by variants was from 6.0 to 6.9%. The most effective treatment of seeds and spraying of plants with growth regulator Mival-Agro, where the biological efficiency was 36.8% while the development of the disease in the control was 9.5%.

The research revealed a growth-stimulating effect of the preparations. The treatment of seeds with biopreparations and growth regulators resulted in 3 days earlier emergence of seedlings and 4 days earlier formation of buds compared to the control.

The main indicator for the effectiveness of any agricultural practice is yield. The application of biopreparations and growth regulators had an impact on the productivity of tomato plants. When growth regulators were used, the increase was 3.7 t/ha (LSD_{05} = 2.5). The highest yield was observed when seeds and plants were treated with the biological preparation Gamair (20.0 t/ha), while the yield of the control was 15.1 t/ha (see figure). The increase with the use of biological preparations was 4.1 to 4.9 t/ha.

The effect of biopreparations and growth regulators on soybean plants showed that the preparations have a positive effect on soybean growth and development, duration of phenophases, productivity and yield. The soybean plants grew more quickly in leaf mass, and the duration of the interphase periods was reduced by 2-3 days.

According to the results of analysis of the experiment data, treatment of seeds and spraying of vegetative plants with biological preparations and growth regulators had a positive effect on the main indicators determining plant productivity. There was a significant (7-12 cm) difference in plant height in the phase of full ripeness compared to the control (61.8 cm) (see Table 2). All experimental variants gave a

[5]System of agricultural production in the Primorsky Territory. Edited by Chaika A.K. Novosibirsk, 2001. 364 p.

[6]James B. Sinclair. Compendium of Souben Diseases. Published by The American Phytopathological Society, 1982, 104 p.

Табл. 1. Влияние обработок препаратами на фитосанитарное состояние томата (среднее за 2018, 2019 гг.), %

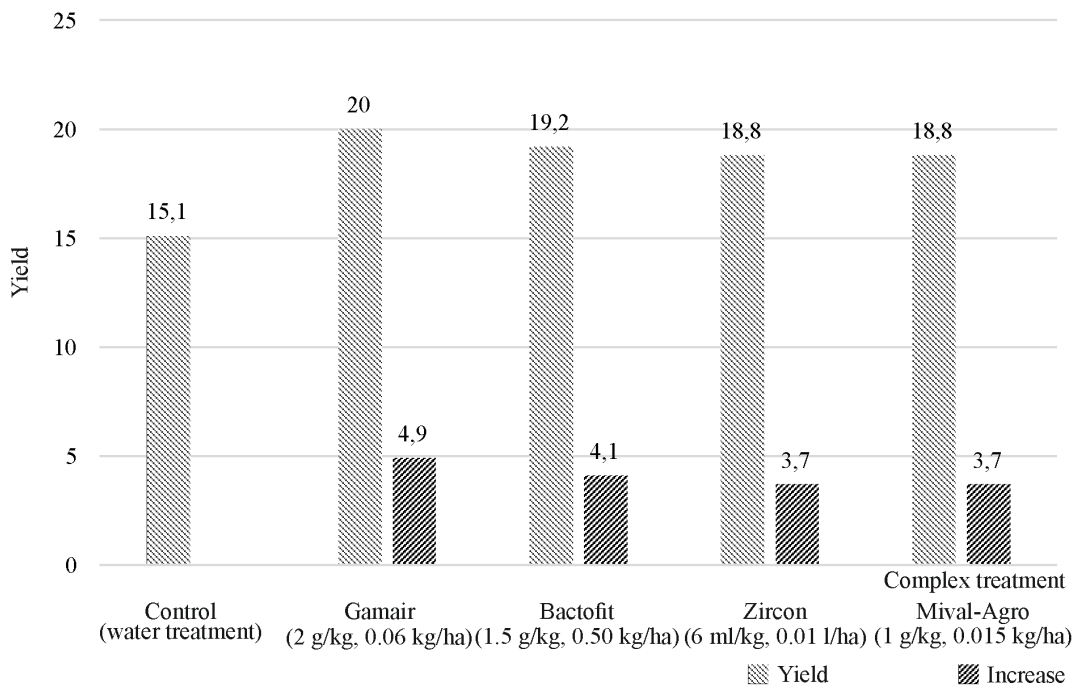
Table 1. The influence of preparation usage on phytosanitary state of tomato (mean value for 2018, 2019), %

Experiment option	Septoriosis		Phytophthora	
	Disease progression	Biological effectiveness	Disease progression	Biological effectiveness
Control (no treatment)	17,6		9,5	
Seed treatment (2 g/kg) and plant spraying with Gamair (0.06 kg/ha)	14,8	15,9	6,9	27,4
Seed treatment (1.5 g/kg) and plant spraying with Bactophyt (0.5 kg/ha)	13,7	22,1	6,3	33,7
Seed treatment (6 ml/kg) and plant spraying with Zircon (0.01 l/ha)	15,1	14,2	6,1	35,8
Seed treatment (1 g/kg) and spraying of plants with Mival-Agro (0.015 kg/ha)	14,1	19,8	6,0	36,8
LSD_{05}	1,5	2,0	1,7	0,9

significant increase in the number and weight of seeds compared to the control variant. The complex treatment with Bactofit stimulated an increase in the number of seeds per plant by 23 units and seed weight per plant by 2.0 g.

The 1000 seeds weight in all variants of the experiment reliably exceeded the indicator of the variant without treatment by 13.5-22.0% (LSD_{05} = 16.0 t/ha). The maximum weight was recorded in the variant with treatment of seeds with Bactofit and spraying of vegetative plants with Mival-Agro (215.0 g).

Simultaneously with the study of the effect on productivity, the preparations were evaluated for their ability to reduce the infestation of soybean plants with septoriosis (*Septoria gly-*



Урожайность томата при применении препаратов (среднее за 2018, 2019 гг.), т/га
Yield of tomato with preparation usage (mean value for 2018, 2019), t/ha

cines Hemmi) and peronosporosis (*Peronospora manshurica* (Naum.) Syd.) Treatment of soybean seeds with Gamair and spraying of Mival-Agro plants contributed to the reduction of septoriosis infestation by 8% (29.7% biological efficiency). Against peronosporosis the greatest biological efficacy had Bactofit + Mival-Agro (25.4%).

The yield record showed a significant increase in seed productivity of soybean in all variants of the experiment. The studied growth regulators and biological preparations provided increase of soybean yield due to increase of indicators of elements of yield structure and reduction of disease infestation. The increase of the soybean yield in comparison with the control amounted to 0.6-0.9 t/ha (see Table 3). The maximum soybean yield (2.7 t/ha) was obtained on the variant of complex application of Bactofit biopreparation with growth regulator Mival-Agro.

CONCLUSION

In the course of the research carried out under the conditions of Primorsky Territory, it was found that the use of biopreparations and growth regulators is promising for use on soybean and tomato plants. All the studied preparations inhibit the development of leaf spot disease during the growing season, have a positive effect on plant growth and development and significantly increase the crop yield. The highest yield of tomatoes was observed with the treatment of seeds and plants with the biological preparation Gamair (20.0 t/ha). The combined application of Bactofit with Mival-Agro promoted active plant growth and increased elements of structural analysis of soybean yield. The high indices of the yield were observed in the variant of treatment of the seeds with Bactofit with the spraying of the vegetative plants with the growth regulator Mival-Agro (2.7 t/ha) in comparison with the control (1.8 t/ha). The high efficiency of biological preparations was noted both when used together with growth regulators and when used separately.

СПИСОК ЛИТЕРАТУРЫ

1. *Головина Е.В., Зотиков В.И., Агаркова С.Н., Гришечкин В.В.* Эффективность экологически безопасных агроприемов при возделывании сои // Земледелие. 2015. № 4. С. 21–23.
2. *Беляева Р.А., Каракчиева Е.Ф., Лобанов А.Ю., Регорчук Н.В., Шершунова О.Н.* Влияние биологических препаратов и минеральных удобрений на продуктивность естественных сенокосов поймы реки Сысола // Аграрная наука Евро-Северо-Востока. 2016. № 4. С. 44–48.DOI: 10.30766/2072-9081.2016.53.4.

Табл. 2. Результаты структурного анализа продуктивности сои (среднее за 2018, 2019 гг.)
Table 2. The results of structural analysis of soybean productivity (mean value for 2018, 2019)

Experiment option	Plant height, cm	Number of seeds per one plant, pcs.	Seed weight per one plant, g	Weight of 1000 seeds, g
Control (no treatment)	61,8	43,3	4,4	176,2
Seed treatment (2.0 kg/t) and plant spraying (2 kg/ha) with Bactofit	70,4	65,7	6,3	213,7
Seed treatment with Bactofit (2.0 kg/t) and plant spraying with Mival-Agro (15 g/ha)	73,1	58,7	6,0	215,0
Seed treatment (30 g/t) and plant spraying (60 g/ha) with Gamair	68,8	60,1	6,0	208,7
Seed treatment with Gamair (30 g/t) and plant spraying with Mival-Agro (15 g/ha)	68,3	53,2	5,4	213,7
LSD_{05}	4,3	4,6	0,5	16,0

Табл. 3. Влияние биопрепаратов и регуляторов роста на урожайность сои (среднее за 2018, 2019 гг.)
Table 3. The influence of biopreparations and growth-regulating chemicals on soybean yield (mean value for 2018, 2019)

Experiment option	Yield, t/ha	Increase, t/ha
Control (no treatment)	1,8	
Seed treatment (2.0 kg/t) and plant spraying (2 kg/ha) with Bactofit	2,5	0,7
Seed treatment with Bactofit (2.0 kg/t) and plant spraying with Mival-Agro (15 g/ha)	2,7	0,9
Seed treatment (30 g/t) and plant spraying (60 g/ha) with Gamair	2,4	0,6
Seed treatment with Gamair (30 g/t) and plant spraying with Mival-Agro (15 g/ha)	2,5	0,7
LSD_{05}	0,1	

3. *Гужвин С.А., Кумачева В.Д., Турчин В.В.* Эффективность применения минеральных удобрений и бактериальных препаратов на посевах сои в условиях Ростовской области // Polish Journal of Science. 2018. № 9. С. 8–10.
4. *Вакуленко В.В.* Регуляторы роста растений повышают стрессоустойчивость культур // Защита и карантин растений. 2015. № 2. С. 13–14.
5. *Байрамбеков Ш.Б., Валеева З.Б., Дубровин Н.К., Корнева О.Г., Полякова Е.В.* Регуляторы роста // Приложение к журналу "Защита и карантин растений". 2015. № 2. С. 72 (20)–74 (22).
6. *Замана С.П., Кондратьева Т.Д.* Влияние биопрепарата Агроактив на систему "Почва – растение" в опыте с кукурузой // Агрохимический вестник. 2014. № 1. С. 18–19.
7. *Орлова О.Н.* Биофунгициды против корневых гнилей огурца // Картофель и овощи. 2015. № 11. С. 20–21.
8. *Сырмолот О.В., Байделюк Е.С., Кочева Н.С.* Применение биопрепаратов и стимуляторов роста при возделывании сои в Приморском крае // Достижения науки и техники АПК. 2020. Т. 34. № 8. С. 19–24.
9. *Саенко Г.М., Бушнева Н.А.* Эффективность предпосевной обработки семян сои против болезней и вредителей всходов // Масличные культуры. 2017. № 1 (169). С. 75–82.
10. *Сырмолот О.В., Кочева Н.С.* Оценка влияния бактерий родов *Bacillus* и *Pseudomonas* на продуктивность сои // Международный научно-исследовательский журнал. 2019. № 10 (88). Ч. 2. С. 35–39. DOI: 10.23670 IRJ.2019.88.10.029.
11. *Ситало Г.М., Бельтюков Л.П.* Экономическая и биоэнергетическая эффективность применения биопрепаратов при возделывании гороха // Зерновое хозяйство России. 2018. № 2. С. 54–57.
12. *Васильев А.А.* Влияние Мивал-Агро на фитосанитарное состояние и продуктивность картофеля // Защита и карантин растений. 2015. № 8. С. 17–19.
13. *Вакуленко В.В.* Эпин-Экстра и Циркон на защите урожая гороха // Картофель и овощи. 2016. № 4. С. 11–12.

REFERENCES

1. Golovina E.V., Zotikov V.I., Agarkova S.N., Grishechkin V.V. Efficiency of environmentally benign agricultural practices at soybean cultivation. *Zemledelie*, 2015, no. 4, pp. 21–23. (In Russian).
2. Belyaeva R.A., Karakchieva E.F., Lobanov A.Yu., Regorchuk N.V., Shershunova O.N. Effect of biological preparations and mineral fertilizers on productivity of natural grasslands of the Sysola river floodplain. *Agrarnay nauka Evro-Severo-Vostoka = Agricultural science of the Euro-North-East*, 2016, no. 4, pp. 44–48. (In Russian). DOI: 10.30766/2072-9081.2016.53.4.
3. Guzhvin S.A., Kumacheva V.D., Turchin V.V. Efficiency of application of mineral fertilizers and bacterial preparations on soybean crops in the conditions of Rostov Region. *Polish Journal of Science*, 2018, no. 9, pp. 8–10. (In Russian).
4. Vakulenko V.V. Plant growth regulators increase crop stress tolerance. *Zashchita i karantinras-*

teniy = Board of Plant Protection and Quarantine, 2015, no. 2, pp. 13–14. (In Russian).
5. Bairambekov Sh.B., Valeeva Z.B., Dubrovin N.K., Korneva O.G., Polyakova E.V. Growth Regulators. *Prilozhenie k zhurnalu "Zashchita i karantin rastenii" = Board of Plant Protection and Quarantine,* 2015, no. 2, pp. 72 (20) – 74(22). (In Russian).
6. Zamana S.P., Kondrat'eva T.D. Influence of biotechnological product Agroactive on the "soil – plant" system in experiment with corn plant. *Agrokhimicheskii vestnik = Agrochemical herald,* 2014, no. 1, pp. 18–19. (In Russian).
7. Orlova O.N. The biological fungicides against root rot of cucumber. *Kartofel' i ovoshchi = Potato and Vegetables,* 2015, no. 1, pp. 20–21. (In Russian).
8. Syrmolot O.V., Baidelyuk E.S., Kocheva N.S. The use of biological products and growth stimulants in the cultivation of soybean in the Primorsky Territory. *Dostizheniyanauki i tekhniki APK = Achievements of Science and Technology of AIC*, 2020, vol. 34, no. 8, pp. 19–24. (In Russian).
9. Saenko G.M., Bushneva N.A. Effectiveness of prior-sowing soybean seeds treatment against diseases and pest effecting seedlings. *Maslichnye kul'tury = Oil Crops,* 2017, no. 1 (169), pp. 75–82. (In Russian).
10. Syrmolot O.V., Kocheva N.S. Impact assessment of bacterias of *Bacillus* and *Pseudomonas* genus on soy productivity. *Mezhdunarodnyi nauchno-issledovatel'ski zhurnal = International Research Journal*, 2019, no. 10 (88), part 2. pp. 35–39. (In Russian). DOI: 10.23670 IRJ.2019.88.10.029.
11. Sitalo G.M., Bel'tyukov L.P. Economic and bioenergetics efficiency of the use of bio drugs when cultivating peas. *Zernovoe khozyaistvo Rosii = Grain economy of Russia,* 2018, no. 2, pp. 54–57. (In Russian).
12. Vasil'ev A.A. Influence of Mival- Agro on a phytosanitary state and productivity of potatoes. *Zashchita i karantin rastenii = Board of Plant Protection and Quarantine,* 2015, no. 8, pp. 17–19. (In Russian).
13. Vakulenko V.V. Epin-Extra and Zircon to protect the pea crop. *Kartofel' i ovoshchi = Potato and Vegetables*, 2016, no. 4, pp. 11–12. (In Russian).

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