https://doi.org/10.26898/0370-8799-2021-1-8
УДК: 632.763.79:632.951:635.21
Тип статьи: оригинальная
Type of article: original

ЗАЩИТА КАРТОФЕЛЯ ОТ КАРТОФЕЛЬНОЙ КОРОВКИ *HENOSEPILACHNA VIGINTIOCTOMACULATA* MOTSCH. (COLEOPTERA, COCCINELLIDAE)

Коваленко Т.К., Пронюшкина А.С.
Дальневосточный научно-исследовательский институт защиты растений
Приморский край, с. Камень-Рыболов, Россия

Представлены результаты применения экологически безопасных методов борьбы с вредителями картофеля. Проведены сравнительные полевые испытания инсектоакарицидов и микробиологических препаратов на посадках картофеля районированного сорта Янтарь в Приморском крае в 2018, 2019 гг. Объект исследований – личинки и жуки картофельной коровки *Henosepilachna vigintioctomaculata*. Посадку клубней проводили в оптимальные для региона сроки – конец апреля – начало мая. В исследованиях использованы препараты Фитоверм на основе аверсектина С (50 г/л), Акарин на основе авертина N (2 г/л), Бацикол на основе штамма *Bacillus thuringiensis* var. *darmstadiensis* (BtH_{10}), Битоксибациллин на основе штамма *Bacillus thuringiensis* var. *thuringiensis* (BtH_1). Препараты изучены в отдельных опытах и в совместных с инсектицидом Корадо. Растения картофеля опрыскивали препаратами однократно. Учеты численности вредителя проводили до обработки и после обработки на 5, 10, 15-е сутки на 10 растениях картофеля в трех повторностях в соответствии с утвержденными методиками. Высокую эффективность 90,5–94,0% показал биоинсектицид Фитоверм в норме применения 0,16 л/га. Однократное применение биоинсектицидов на протяжении 15 сут сдерживало интенсивность развития вредителя ниже порогового уровня. Совместное использование биоинсектицидов и инсектицида против картофельной коровки обеспечивало снижение численности фитофага на 90,8–99,8% по сравнению с контрольным вариантом (без применения средств защиты растений). Включение препаратов биологического происхождения Фитоверм, Акарин, Бацикол, Битоксибациллин в технологии возделывания картофеля позволит ограничить численность картофельной коровки и решить проблему экологизации защиты растений на юге Дальнего Востока.

Ключевые слова: картофель, вредитель, картофельная коровка, инсектоакарицид, биоинсектицид, инсектицид, биологическая эффективность, урожайность

POTATO PROTECTOIN AGAINST THE POTATO LADYBIRD *HENOSEPILACHNA VIGINTIOCTOMACULATA* MOTSCH. (COLEOPTERA, COCCINELLIDAE)

Kovalenko T.K., Pronyushkina A.S.
The Far Eastern Research Institute of Plant Protection
Kamen-Rybolov, Primorsky Territory, Russia

The results of the application of environmentally friendly methods of potato pest control are presented. Comparative field trials of insectoacaricides and microbiological preparations were carried out on potatoes of the recognized variety Yantar in the Primorsky Territory in 2018 and 2019. The object of research was the larvae and beetles of the potato ladybird *Henosepilachna vigintioctomaculata*. The tubers were planted at the optimal time for the region, late April – early May. The study used Fitoverm preparations based on aversectin C (50 g/l), Akarin based

on avertin N (2 g/l), Batsikol based on the strain of *Bacillus thuringiensis* var. *darmstadiensis* (BtH_{10}), Bitoxybacillin based on the strain of *Bacillus thuringiensis* var. *thuringiensis* (BtH_1). The preparations were studied independently and with Corado insecticide. Potato plants were sprayed with the preparations once. Pest counts were carried out before treatment and after treatment on the 5th, 10th, 15th day on 10 potato plants in three replications in accordance with the approved methods. Bioinsecticide Fitoverm showed a high efficiency of 90.5–94.0% at the application rate of 0.16 l/ha. A single application of bioinsecticides for 15 days restrained the intensity of the pest development below the threshold level. The combined use of bioinsecticides and an insecticide against the potato ladybird provided a decrease in the phytophage population by 90.8–99.8% compared to the control variant (without the use of plant protection products). The inclusion of preparations of biological origin Fitoverm, Akarin, Batsikol, Bitoxybacillin in potato cultivation technology will allow to limit the number of potato ladybird and solve the problem of plant protection in an environmentally-friendly way in the south of the Far East.

Keywords: potatoes, pest, potato ladybird, insectoacaricide, bioinsecticide, insecticide, biological efficiency

Для цитирования: *Коваленко Т.К., Пронюшкина А.С.* Защита картофеля от картофельной коровки *Henosepilachna vigintioctomaculata* Motsch. (Coleoptera, Coccinellidae) // Сибирский вестник сельскохозяйственной науки. 2021. Т. 51. № 1. С. 67–73. https://doi.org/10.26898/0370-8799-2021-1-8

For citation: Kovalenko T.K., Pronyushkina A.S. Potato protection against potato ladybird *Henosepilachna vigintioctomaculata* Motsch. (Coleoptera, Coccinellidae). *Sibirskii vestnik sel'skokhozyaistvennoi nauki = Siberian Herald of Agricultural Science,* 2021, vol. 51, no. 1, pp. 67–73. https://doi.org/10.26898/0370-8799-2021-1-8

Конфликт интересов
Авторы заявляют об отсутствии конфликта интересов.
Conflict of interest
The authors declare no conflict of interest.

INTRODUCTION

The 28-spotted potato ladybird Henosepilachna vigintioctomaculata Motsch., 1853 (Coleoptera, Coccinellidae) causes significant damage to potato plantings in the south of the Far East. When protecting crops, insecticides belonging to different chemical classes are used. The systematic use of chemicals leads to the formation of resistant populations of the pest, which is a factor in the deterioration of the ecological situation. One of the methods of reducing the negative impact of pesticides on the environment is the treatment of planting material with combined preparations with insecticidal and fungicidal properties [1, 2]. The studies carried out indicate that the pre-planting treatment of tubers with Prestige, SC is promising for the control of potato pests in the Primorsky Territory [3].

Currently, manufacturers prefer environmentally friendly biological plant protection systems. The use of biological products contributes to the conservation of environmental biodiversity [4, 5]. In the conditions of Primorsky Territory, work was carried out to study and evaluate the effectiveness of microbiological preparations against the potato ladybird but the range of biological preparations has been significantly updated recently. Insectoacaricidal preparations based on avermectins synthesized by the actinomycete Streptomices avermitilis are used to protect crops from harmful organisms [6–9].

Of greatest interest are preparations based on the entomopathogenic bacteria Bacillus thuringiensis Berliner, which have a selective effect and are safe for humans, warm-blooded animals and the environment. Due to the presence of crystals of endotoxin, exotoxin, phospholipase C, and spores, B. thuringiensis exhibits entomotoxic, entomopathogenic, and metatoxic effects [10, 11]. The All-Russian Research Institute of Agricultural Microbiology (ARRIAM, St. Petersburg - Pushkin) has developed entomopathogenic biological products Batsikol and Bitoxibacillin. Batsikol is based on the Bacillus thuringiensis var. darmstadiensis (BtH_{10}), which has a specific effect on coleoptera. The basis of Bitoxibacillin is the bacterium Bacillus thuringiensis var. thuringiensis (BtH_1). The

preparations are designed to combat a wide range of mass phytophagous pests of agricultural crops [12–14]. The study of new bioinsecticides is important for improving the range of biological agents for controlling the potato ladybird in the Primorsky Territory.

The purpose of the research is to evaluate the biological and economic efficiency of preparations of biological origin against the potato ladybird in the soil and climatic conditions of the southern Far East.

MATERIAL AND METHODS

Studies to assess the biological effectiveness of drugs were carried out in 2018, 2019. Field experiments were carried out in the village of Dubovy Klyuch of the Ussuriysk district of the Primorsky Territory on the planting of potatoes of the zoned Yantar variety. The object of research is the larvae and beetles of the potato ladybird. The tubers were planted at the optimal time for the region (late April - early May). The plot area was 16.8 m^2. In each variant of the experiment three replications were carried out. The placement of plots in replicates is randomized. To regulate the number of potato ladybirds Fitoverm, EC preparations (a.i. aversectin C, 50 g / l) were used at application rates of 0.07 and 0.16 l / ha (LLC NBTs "Farmbiomed"), Akarin, EC (a.i. avertin N, 2 g / l) - 1.2 and 1.6 l / ha, Batsikol, F (Bacillus thuringiensis, strain BtH_{10}) - 15 l / ha and Bitoxibacillin, F (Bacillus thuringiensis, strain BtH_1) - 15 l / ha (ARRIAM). The preparations were used separately and together with the insecticide Corado, SC (a.i. imidacloprid, 200 g / l) - 0.1 l / ha. Potato plants were sprayed with the preparations once. Pest counts were carried out before treatment and after treatment on the 5th, 10th, 15th day on 10 potato plants of each replication in accordance with the approved methods[1]. The biological effectiveness of the preparations was determined by the reduction in the number of the pest adjusted for control and was calculated using the Henderson and Tilton formula (see footnote 1). Statistical data processing was carried out according to B.A. Dospekhov[2].

RESULTS AND DISCUSSION

In 2018, the number of potato ladybird larvae before protective measures ranged from 6.9 to 15.0 ind./plant with a population of 69.3% of plants. Larvae of the first - third instars were present on the plants. In 2019, at the time of treatment, young larvae prevailed on the plants with numbers from 5.9 to 8.5 ind./plant with a population of 78.7% of plants.

Avermectin-based preparations showed high biological effectiveness against the potato ladybird. A significant initial effect was shown by the bioinsecticide Fitoverm at the rate of application of 0.16 l / ha, ensuring the death of 93.3% of the larvae of the pest on the 5th day after treatment. The effectiveness of the protective action of the drug remained at the level of 90.5–94.0% for 15 days. In the norm of application of 0.07 l / ha the effectiveness of bioinsecticide in the years of research was significantly lower and amounted to 79.7-84.7% on the 5-15th day (see Table 1).

A rather high efficiency of 74.0–81.6% against the larvae of the potato ladybird was shown by another preparation based on avermectins, Akarin. There was no significant difference in biological effectiveness between the variants with different application rates (1.2 and 1.6 l / ha).

Throughout the entire reference period, the bioinsecticide kept the number of potato ladybird below the economic threshold of harmfulness. In the course of the research, it was found that Fitoverm, in the norm of application of 0.07 l / ha, showed almost the same effectiveness with the drug Akarin in regulating the number of potato ladybirds, but in the norm of application of 0.16 l / ha the efficiency was significantly higher. Fitoverm at this consumption rate showed insecticidal activity at the level of the chemical preparation Corado.

The effectiveness of microbiological preparations based on Bacillus thuringiensis on the

[1]Methodical guidelines for registration tests of insecticides, acaricides, molluscicides and rodenticides in agriculture. SPb.: ARRIBPP, 2009. 321 p.

[2]Dospekhov B.A. Field experiment technique. M: Kolos, 1985.336 p.

Табл. 1. Эффективность биоинсектицидов против картофельной коровки (среднее за 2018, 2019 гг.)
Table 1. Effectiveness of bioinsecticides against potato ladybird (average for 2018, 2019)

Option	Preparation rate of application, l/ha	Average number of larvae, number. (on average per one plant)				Decrease in the number of pests relative to the original, adjusted for control after treatment by day of registration, %		
		before treatment	after treatment by day of registration					
			5	10	15	5	10	15
Control	–	7,2	8,4	8,2	5,9	–	–	–
Fitoverm, EC	0,07	9,2	2,2	1,4	1,4	81,7	84,7	79,7
Fitoverm, EC	0,16	6,7	0,7	0,9	0,4	93,3	90,5	94,0
Akarin, EC	1,2	6,8	2,2	2,0	1,7	74,0	75,3	74,2
Akarin, EC	1,6	8,6	3,0	2,3	1,8	74,4	80,5	81,6
Batsikol, Fl.	15	8,0	3,7	2,2	0,7	63,8	80,5	87,7
Bitoxibacillin, Fl.	15	8,7	3,1	2,0	1,5	69,2	84,7	84,5
Corado, SC	0,1	9,7	0,2	0,05	0,01	97,7	99,6	99,8
Fitoverm, EC + Corado, SC	0,03 + 0,03	7,5	0,3	0,08	0,2	96,8	99,3	97,0
Akarin, EC + Corado, SC	0,6 + 0,03	8,0	0,6	0,1	0,01	92,0	97,7	99,8
Batsikol, Fl + Corado, SC	7,5 + 0,03	6,8	0,4	0,05	0,01	94,2	99,2	99,7
Bitoxibacillin, Fl + Corado, SC	7,5 + 0,03	7,8	0,9	0,08	0,2	90,8	99,2	97,7
LSD_{05}	–	–	–	–	–	8,3	5,5	6,0

5th day after treatment was marked significantly lower. These preparations showed a low efficiency of 56.6–61.0% in 2018. In the same year, at the time of treatment, in addition to the larvae of the first and second instars larvae of the third instar were observed on the plants (in 2019, only young larvae were present on the plants). Weather conditions (frequent heavy rains during the growing season) did not allow the treatment to be carried out in time and subsequently influenced the effectiveness of the preparations. By the 10th day, in the variants with the use of Batsikol and Bitoxibacillin, an increase in the toxic effect was observed, the decrease in the number of the pest was 80.5–84.7%. The effectiveness of the protective action remained at the level of 84.5–87.7% and on the 15th day after treatment. By this time, significant differences were noted in the biological effectiveness of Batsikol with the preparations Fitoverm (0.07 l / ha) and Akarin (1.2 l / ha).

The use of tank mixtures of chemical plant protection products with biological products helps to reduce the pesticide load. When using preparations based on actinomycetes (Fitoverm and Akarin), Bacillus thuringiensis (Batsikol and Bitoxibacillin) and Corado (0.03 l / ha), the number of pests on the 5th day after treatment decreased by 90.8–96.8%. On the 10-15th day, almost complete death was noted (97.0-99.8%). Tank mixtures of preparations showed efficiency at the level of an insecticide at a consumption rate of 0.1 l / ha.

The use of chemical and biological preparations had an effect on the yield of potatoes, the increase in the yield of potato tubers averaged over 2 years from 2.3 to 4.6 t / ha, while the control indicator was 26.0 t / ha (see Table 2). The largest yield increase of 3.8-4.6 t / ha was obtained when Fitoverm was used at a consumption rate of 0.16 l / ha and the combined use of biological preparations with an insecticide.

CONCLUSION

The studies carried out confirm the prospects of using preparations based on actinomycetes (Fitoverm and Akarin) and Bacillus thuringiensis (Batsikol and Bitoxibacillin) in regulating

Табл. 2. Урожайность картофеля при применении препаратов (среднее за 2018, 2019 гг.)
Table 2. Productivity of potatoes with the application of preparations (average for 2018, 2019)

Experiment option	Preparation rate of application, l/ha	Average yield, t/ha	Yield gain	
			t/ha	%
Control	–	26,0	–	–
Fitoverm, EC	0,07	29,0	3,0	11,5
Fitoverm, EC	0,16	29,8	3,8	14,6
Akarin, EC	1,2	28,3	2,3	8,8
Akarin, EC	1,6	28,8	2,8	10,8
Batsikol, Fl.	15	28,6	2,6	10,0
Bitoxibacillin, Fl.	15	28,3	2,3	8,8
Corado, SC	0,1	30,2	4,2	16,2
Fitoverm, EC + Corado, SC	0,03 + 0,03	30,0	4,0	15,4
Akarin, EC + Corado, SC	0,6 + 0,03	29,9	3,9	15,0
Batsikol, Fl + Corado, SC	7,5 + 0,03	30,3	4,3	16,5
Bitoxibacillin, Fl + Corado, SC	7,5 + 0,03	30,6	4,6	17,7
LSD_{05}		3,0		

the number of potato cows in Primorsky Krai. A single application of bioinsecticides ensured a decrease in the number of pests by 63.8–94.0% and had an impact on the formation of the yield.

A high level of effectiveness of biological products Fitoverm, Batsikol, Bitoxibacillin, Akarin was observed when used together with the insecticide Corado. In these variants, a significant protective result (97.0–99.8%) was noted on the 15th day after application. The addition of biological products to the insecticide allows reducing the pesticide consumption rate by 3 times without reducing the overall biological effectiveness of the mixture, increasing the yield by 15.0-17.7% and reducing the chemical load on the agrobiocenosis.

СПИСОК ЛИТЕРАТУРЫ

1. *Шорохов М.Н., Петрова Н.Г., Долженко В.И.* Совершенствование ассортимента инсектофунгицидов // Российская сельскохозяйственная наука. 2020. № 3. С. 28–31. DOI: 10.31857/S2500262720030072.
2. *Долженко О.В., Кривченко О.А.* Полифункциональный препарат для защиты картофеля от вредных организмов // Известия Санкт-Петербургского государственного аграрного университета. 2018. № 2 (51). С. 94–99.
3. *Коваленко Т.К.* Эффективность применения инсектицидов для защиты картофеля от вредителей в Приморском крае // Сибирский вестник сельскохозяйственной науки. 2018. Т. 48. № 4. С. 14–19. DOI: 10.26898/0370-8799-2018-4-2.
4. *Агасьева И.С., Исмаилов В.Я., Нефедова М.В., Федоренко Е.В.* Видовой состав и биорегуляторная активность энтомофагов в системе управления численностью вредителей картофеля (*Solanum tuberosum* L.) // Сельскохозяйственная биология. 2016. Т. 51. С. 401–410. DOI: 10.15389/agrobiology.2016.3.401rus.
5. *Агасьева И.С., Федоренко Е.В., Мкртчян А.О., Исмаилов В.Я.* Влияние химических и биологических препаратов на выживаемость энтомофагов вредителей кукурузы // Успехи современного естествознания. 2018. № 9. С. 7–11. URL: http://www.natural-sciences.ru/ru/article/view?id=36858. DOI: 10.17513/use.36858.
6. *Долженко Т.В., Долженко В.И.* Инсектоакарициды на основе аверсектина С и амамектина бензоата // Агрохимия. 2017. № 4. С. 41–47.
7. *Сергеева О.В., Долженко Т.В.* Биологическая эффективность аверсектина С в отношении сосущих вредителей // Известия Санкт-Петербургского государственного аграрного университета. 2018. № 2 (51). С. 89–94.

8. *Долженко Т.В.* Метаболиты актиномицетов для защиты сада от вредителей // Вестник Орловского государственного аграрного университета. 2012. № 3 (36). С. 91–93.
9. *Шульгина О.А., Андреева И.В., Шаталова Е.И., Штерншис М.В.* Подавление численности фитофагов капусты Фитовермом в условиях юга Западной Сибири // Достижение науки и техники АПК. 2010. № 12. С. 52–54.
10. *Гришечкина С.Д., Ермолова В.П., Романова Т.А., Нижников А.А.* Поиск природных изолятов *Bacillus thuringiensis* для создания экологически безопасных биологических препаратов // Сельскохозяйственная биология. 2018. Т. 53. № 5. С. 1062–1069. DOI: 10.15389/agrobiology.2018.5.1062 rus.
11. *Доброхотов С.А., Анисимов А.И., Гришечкина С.Д., Данилов Л.Г., Леднев Г.Р., Фурсов К.Н.* Эффективность микробиологических препаратов против основных вредителей овощных, ягодных культур и картофеля в Ленинградской области // Сельскохозяйственная биология. 2015. Т. 50. № 5. С. 694–704. DOI: 10.15389/agrobiology. 2015.5.694 rus.
12. *Гришечкина С.Д., Ермолова В.П.* Эффективность бацикола на основе нового штамма *Bacillus thuringiensis* var. *darmstadiensis* № 25 против вредителей фитофагов и фитопатогенов // Сельскохозяйственная биология. 2015. Т. 50. № 3. С. 361–368. DOI: 10.15389/agrobiology. 2015.3.661rus.
13. *Гришечкина С.Д.* Механизмы действия и эффективность микробиологического препарата бацикола // Сельскохозяйственная биология. 2015. Т. 50. № 5. С. 685–693. DOI: 10.15389/agrobiology.2015.5.685 rus.
14. *Гришечкина С.Д., Ермолова В.П., Коваленко Т.К., Антонец К.С., Белоусова М.Е., Яхно В.В., Нижников А.А.* Полифукциональные свойства производственного штамма *Bacillus thuringiensis* var. *thuringiensis* 800/15 // Сельскохозяйственная биология. 2019. Т. 54. № 3. С. 494–504. DOI: 10.15389/agrobiology.2019.3.494 rus.

REFERENCES

1. Shorokhov M.N., Petrova N.G., Dolzhenko V.I. Improving the range of insectofungicides. *Rossiiskaya sel'skokhozyaistvennaya nauka = Russian Agricultural Sciences,* 2020, no. 3, pp. 28–31. (In Russian). DOI: 10.31857/S2500262720030072.
2. Doizhenko O.V., Krivchenko O.A. Multifunctional preparation for potato protection against harmful organisms. *Izvestiya Saint-Petersburgskogo agrarnogo universiteta = Izvestiya Saint-Petersburg State Agrarian University*, 2018, no. 2, (51), pp. 94–99. (In Russian).
3. Kovalenko T.K. Effectiveness of plant protection products against pests on potatoes in Primorsky Territory. *Sibirskii vestnik sel'skokhozyaistvennoi nauki = Siberian Herald of Agricultural Science*, 2018, vol. 48, no. 4, pp. 14–19. (In Russian). DOI: 10.26898/0370-8799-2018-4-2.
4. Agas'eva I.S., Ismailov V.Ya., Nefedova M.V., Fedorenko E.V. The species composition and bioregulatory activity of entomophages in potato pest control system (*Solanum tuberosum* L.). *Sel'skokhozyaistvennaya biologiya = Agricultural Biology*, 2016, vol. 51, no. 3, pp. 401–410. (In Russian). DOI: 10.15389/agrobiology.2016.3.401rus.
5. Agas'eva I.S., Fedorenko E.V., Mkrtchyan A.O., Ismailov V.Ya. Influence of chemical and biological preparations upon survival among entomophages of corn pests. *Uspekhi sovremennogo estestvoznaniya = Advances in Current Natural Sciences,* 2018, no. 9, pp. 7–11. URL:http://www.natural-sciences.ru/ru/article/view?id=36858. (In Russian). DOI: 10.17513/use.36858.
6. Dolzhenko T.V., Dolzhenko V.I. *Insecto-acaricides based on Aversectin C and Emamectin benzoate*. *Agrokhimiya = Agricultural chemistry*, 2017, no. 4, pp. 41–47. (In Russian).
7. Sergeeva O.V., Dolzhenko T.V. Biological effectiveness of Aversectin C against sucking pests. *Izvestiya Saint-Petersburgskogo agrarnogo universiteta = Izvestiya Saint-Petersburg State Agrarian University*, 2018, no. 2 (51), pp. 89–94. (In Russian).
8. Dolzhenko T.V. Actinomycete metabolites to protect the garden from pests. *Vestnik Orlovskogo gosudarstvennogo agrarnogo universiteta = Vestnik Orel State Agrarian University*, 2012, no. 3 (36), pp. 91–93. (In Russian).
9. Shulgina O.A., Andreeva I.V., Shatalova E.I., Shternshic M.V. Suppression of crucifer insect pest by Phitoverm under conditions of south of Western Siberia. *Dostizheniya nauki i tekhniki APK = Achievements of Science and Technology of AIC*, 2010, no. 12, pp. 52–54. (In Russian).

10. Grishechkina S.D., Ermolova V.P., Romanova T.A., Nizhnikov A.A. Search for natural isolates of *Bacillus thuringiensis* for development of ecologically friendly biologicals. *Sel'skokhozyaistvennaya biologiya = Agricultural Biology*, 2018, vol. 53, no. 5, pp. 1062–1069. (In Russian). DOI: 10.15389/agrobiology.2018.5.1062 rus.
11. Dobrokhotov S.A., Anisimov A.I., Grishechkina S.D., Danilov L.G., Lednev G.R., Fursov K.N. The main pests microbiological control in vegetable, baccate crops and potato in Leningrad Province. *Sel'skokhozyaistvennaya biologiya = Agricultural Biology*, 2015, vol. 50, no. 5, pp. 694–704. (In Russian). DOI: 10.15389/agrobiology.2015.5.694 rus.
12. Grishechkina S.D., Ermolova V.P. Efficiency of Batsikol based on a new strain *Bacillus thuringiensis* var. *darmstadiensis* № 25 for biocontrol of phytophagous pests and phytopathogens. *Sel'skokhozyaistvennaya biologiya = Agricultural Biology*, 2015, vol. 50, no. 3, pp. 361–368. (In Russian). DOI: 10.15389/agrobiology.2015.3.661rus.
13. Grishechkina S.D. Mechanism and activity spectrum of microbiological preparation Batsikol with phytoprotective action. *Sel'skokhozyaistvennaya biologiya = Agricultural Biology*, 2015, vol. 50, no. 5, pp. 685–693. (In Russian). DOI: 10.15389/agrobiology.2015.5.685 rus.
14. Grishechkina S.D., Ermolova V.P., Kovalenko T.K., Antonets K.S., Belousova M.E., Yakhno V.V., Nizhnikov A.A. Polyfunctional properties of the *Bacillus thuringiensis* var. *thuringiensis* industrial strain 800/15. *Sel'skokhozyaistvennaya biologiya = Agricultural Biology*, 2019, vol. 54, no. 3, pp. 494–504. (In Russian). DOI: 10.15389/agrobiology.2019.3.494 rus.

Информация об авторах

(✉) **Коваленко Т.К.,** кандидат биологических наук, ведущий научный сотрудник; **адрес для переписки:** Россия, 692684, Приморский край, с. Камень-Рыболов, ул. Мира, 42-а; e-mail: biometod@rambler.ru

Пронюшкина А.С., научный сотрудник

Author information

(✉) **Tat'yana K. Kovalenko,** Candidate of Science in Biology, Lead Researcher; **address:** 42-a, Mira St, Kamen-Rybolov, Primorsky Territory, 692684, Russia; e-mail: biometod@rambler.ru

Anna S. Pronyushkina, Researcher

Дата поступления статьи 14.12.2020
Received by the editors 14.12.2020