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BIOPESTICIDE TEST FOR MEALYBUGS IN GREENHOUSE PLANTS OF TROPICAL AND SUBTROPICAL CLIMATE IN THE CONDITIONS OF THE NUR-SULTAN GREENHOUSE COMPLEX

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Abstract

The article considers the results of a biopesticide test for a pest of plants in the greenhouse of the Botanical Park of Nur-Sultan. The article aims to determine the effectiveness of protective measures for the conservation of collectible plants in the greenhouse of the Botanical Garden of Nur-Sultan. In order to fulfill this task, the object of the study was the main pest of the Nur-Sultan greenhouse, the mealybug and the dynamics of its population development. The study revealed the annual and seasonal dynamics of the number of mealybugs and traced the sequence of alternation of ornamental plants with phytophages throughout the year. To assess the pest's resistance to biological control, two biopesticides were taken. These are: "Bona Forte Spray" on a natural pyrethrin basis and " Phytoverm " on the basis of aversectin - C. In accordance with the research results, conclusions were drawn.

Keywords: вotanical garden, greenhouse, mealybug, biopesticide, biotest.

Introduction

Greenhouse crop production has experienced strong growth in recent decades, reaching about 4 million hectares in 2010. Due to favorable environmental conditions and the constant availability of the main plants, Pests are the main production constraints, which has led to a parallel increase in the use of pesticides. In addition, consumer demand for garden products freed from chemical insecticide residues is also growing, and interest in microbial and other biological pest control solutions has never arisen. Thrips, aphids, mealybugs and mites feed on the suction mouthpiece, and this microbial biocontrol concentrates on nematodes and fungi that are infected by direct penetration into the host body. Currently, there are at least 28 mycoinsecticides and mycoacaricides for greenhouse pest control. However, the introduction of these products was slow, as they often did not meet the expectations of greenhouse pest control managers. The bacterium Bacillus thuringiensis and several baculoviruses have been successfully used against lepidoptera pests in protected cultures. These pathogens are very specific and fully compatible with other biocontrol

agents. However, their effectiveness is limited against other sensitive pests leading a hidden lifestyle, and they are ineffective against the main pests of protected crops. Biopesticides are based on living microorganisms and cannot be used to achieve control comparable to highly effective broad-spectrum chemical insecticides. Instead of autonomous solutions, arthropod pathogens should be considered primarily as components of greenhouse and insecticide resistance management programs [1].

Reducing dependence on chemical pesticides is considered an important task for sustainable crop production. The use of microbial biocontrol agents (MBCAs) is the main component of sustainable pest management. It is known that many antagonistic microorganisms suppress plant diseases, but their practical application and commercialization are still partially limited because they have low efficiency. Although significant disease control has been achieved in the MBCAs laboratory or greenhouse, there are still shortcomings in practice [2].

The Botanical Garden of Astana is a young research institution in Kazakhstan (founded in 2018). Within two years, the range of ornamental trees, herbaceous perennials, fruit, berry, vegetable, fodder, medicinal, spicy-aromatic, rare and endangered plants has been expanding in the garden. Annually replenishing the collection funds at the expense of adult plants, seeds, cuttings coming from abroad and from different regions of Kazakhstan, as well as accidental penetration of insect pests, among which there may be quarantine objects.

Expositions of tropical and subtropical plants (ornamental plants of the closed ground) are the attraction of the Astana Botanical Garden and the whole city, where guests come at all times of the year. The conditions of the closed ground, that is, high humidity and temperature, the absence of beneficial insects, non-compliance with quarantine measures and agrotechnical techniques, create favorable conditions for the development and mass reproduction of pests.

Mealybug (Hemiptera: Pseudococcidae) are small insects sucking phloem, nymphs and adult females that feed by sucking juice from roots, stems, which cause direct and indirect damage to the plant [3].

Mealybug harms many crops. For example, even though papaya is important for Kenya as a strategic garden crop, damage to this crop by pests leads to significant economic losses in the country. The most important and dangerous pest in the country today is the papaya mealybug paracoccus marginatus (Williams & Granara de Willink, 1992). It is a small polyphagic succulent insect that infects several plants from different botanical families (Miller and Miller 2002) [4].

One of the decisive factors limiting the export of Brazilian grapes is the mealybug (Hemiptera: Pseudococcidae). Only the presence of these pests in the collected and shipped fruits is the main reason for quarantine refusal [5]. In addition, a dense population of medicinal herbs reduces the vital activity of plants, causing defoliation and introducing toxic substances into the leaf, causing chlorosis. In addition, the main harm of these pests is the result of the spread of

viruses that affect the quality of the final product and the longevity of vineyards [6].

In addition to all other damages, medicinal herbs reduce the marketability of kitchen grapes by emptying the honey bee, which contributes to the formation of burnt mold on the fruits.

In this regard, in the conditions of the Astana Botanical Garden, the study of insect pests of greenhouse plants of tropical and subtropical climates is relevant.

Materials and methods of research

According to the conducted research, spider mites, mealybug, leeches, earthworms have been identified in the Botanical Park of Astana. Including a raccoon is a mealy worm.

Living organisms constantly penetrate from the external environment into the closed soil, to a certain extent affecting the agrobiocenosis. In turn, organisms that have survived unfavorable conditions here (winter, drought, heavy rains) fall from the closed ground into the external environment. Outside the greenhouse, they multiply and often penetrate into the closed soil.

Closed soil conditions create favorable conditions for the reproduction and development of the pest throughout the year.

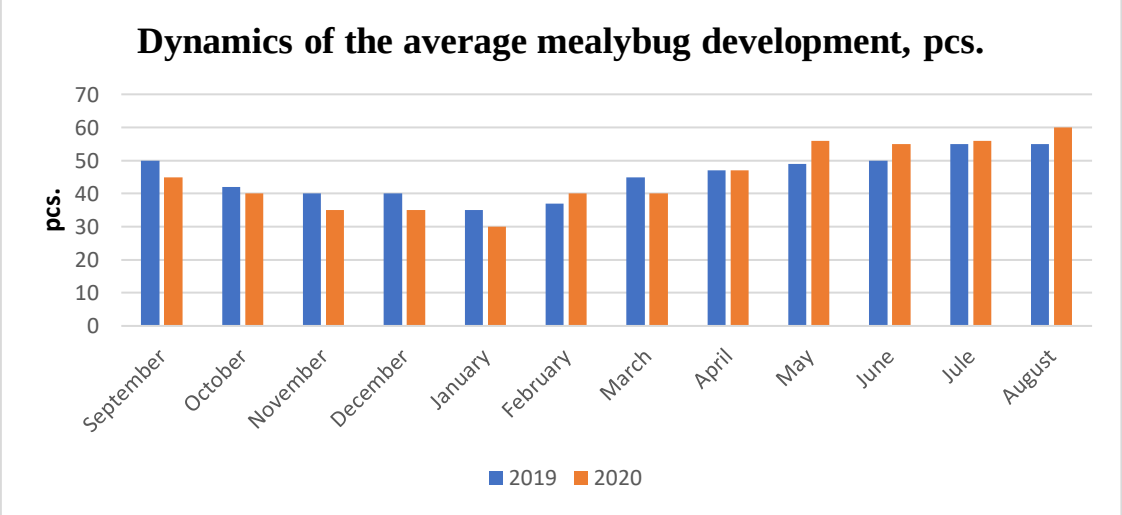

Figure 1 - Dynamics of the average mealybug development, pcs.

In 2019-2020, observations were made on the average dynamics of the mealybug development. As a result, a mealybug population develops in May, i.e., an outbreak of mealybug occurs in the spring and summer months. It is not surprising that in the spring months plants also wake up from a period of rest. Young leaves come out and feed on worms.

As our observations have shown, mealybug often damages young plants. Therefore, we studied the morphology of mealybug, resistance to biological

pesticides. The study of mealybug was carried out according to the **Ivanovo method**.

We took the 2 biopesticides - "Phytoverm CE" and "Spray Bona Forte" to the object of the study.

"Phytoverm CE" is a colorless liquid, the active substance is "Aversectin-C". An insecticide of biological origin, designed to combat a complex of pests on vegetable crops of open and protected soil, fruit and berry crops, potatoes, flower crops, indoor flowers.

The natural insecticide "Spray Bona Forte" is made from inflorescences of Dalmatian chamomile. Effectively combats many types of flying and crawling insects. Designed to protect indoor and ornamental plants of the open ground [7].

Results

The research was carried out in the Botanical Garden of Nur-Sultan. The research work was carried out on young leaves of codium. 10 pieces of wire were laid on 5 Petri dishes. There were 50 pieces in total. The fracture was collected within 3,7,14 days The results of the biological efficacy of the biopesticide "Phytoverm CE" are presented in Table 1.

Table 1 - Biological efficiency of "Phytoverm CE", %

Petri dish number	Experimental samples	Number of units					Reduction of the number of pests in the calculation days, %			
		Before processing	Calculation dates							
			1	3	7	14	1	3	7	14
1	Observation	10	10	10	10	7	-	-	-	-
2	"Phytoverm CE"	5	10	7	5	5	0	30	50	50
3	"Phytoverm CE"	5	10	7	4	3	0	30	60	30
4	"Phytoverm CE"	5	10	7	5	4	0	30	50	40
5	"Phytoverm CE"	3	10	5	5	3	0	50	50	30
6	"Phytoverm CE"	4	10	6	4	4	0	40	60	60

As can be seen from Table 1, in option No. 1 the decrease in the number of pests on the 14th day in the design days was 50%, and in Option No. 2 - 30% and in subsequent options-40%, 30%, 60%. The effectiveness of the insecticide in environmental protection measures has become a priority.

Before treatment, the number of mealybugs was counted, and the adult and larval ones were divided (Table 2).

Table 2 - The number of mealybugs found in the test samples before processing, pcs.

Samples	"Spray Bona Forte" Adult / larva		"Phytoverm CE" Adult / larva	
	1	2	1	2

Codium motley "Mrs. Iceton"	5/5	6/4	7/3	5/5
Codium motley "Mammi"	6/4	7/3	5/5	6/4
Codium motley "Petra"	4/6	5/5	4/6	7/3
Codium motley "Spirale"	5/5	3/7	6/4	5/5
Codium Motley "Excellent"	5/5	6/4	8/2	6/4

10 pieces for each sample were placed from mealybug. He had both adults and larvae in different ways. Then, before carrying out the work on the treatment with the insecticide 00 and "Phytoverm CE", dosages were set (Table 3).

Table 3 - Dosage of insecticide application

№	Active substance	Class threat	Medication dilution	Exposure time
"Spray Bona Forte"	Pyrethrin	3	-	4-5 hours
"Phytoverm CE"	Aversectin-C	3	2 g/l	6-8 hours
Note: the treatment was carried out in accordance with the established standards, ensuring all relevant safety rules when working with chemicals				

10 pieces of mealybug were placed on each sample. He had both adults and larvae in different ways. Then, before carrying out the work on the treatment with the insecticide "Spray Bona Forte" and "Phytoverm CE", dosages were set (Table 3).

After the planned dosage, the treatment with the insecticide "Spray Bona Forte" was carried out (Table 4).

Table 4 - Biological efficiency of "Spray Bona Forte" pesticide from mealybug in Codium, %

№ п / п	Experimental samples	Repetition	Number of units					Reduction of the number of pests in the calculation days, %			
			Before proces-sing	Calculation dates							
				1	3	7	14	1	3	7	14
"Spray Bona Forte"											
1	Observation	10	10	10	10	10	7	-	-	-	-
2	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mrs. Iceton' – Codium motley 'Mrs. Iceton'	1	10	10	7	5	5	0	30	50	50
2	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mrs. Iceton' – Codium motley 'Mrs. Iceton'	2	10	10	8	5	5	0	40	50	50
3	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mammi' – Codium motley 'Mammi'	1		10	7	4	3	0	30	60	30

3	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mammi' – Codium motley 'Mammi'	2	10	10	6	4	3	0	40	60	70
4	Codiaeum variegatum L. Rumph. ex A. Juss. 'Petra' – Codium motley 'Petra'	1	10	10	7	5	4	0	30	50	40
4	Codiaeum variegatum L. Rumph. ex A. Juss. 'Petra' – Codium motley 'Petra'	2	10	10	6	5	3	0	40	50	70
5	Codiaeum variegatum L. Rumph. ex A. Juss. 'Spirale' – Codium motley 'Spirale'	1	10	10	5	5	3	0	50	50	30
5	Codiaeum variegatum L. Rumph. ex A. Juss. 'Spirale' – Codium motley 'Spirale'	2	10	10	5	4	3	0	50	60	70
6	Codiaeum variegatum L. Rumph. ex A. Juss. 'Excellent' – Codium motley 'Excellent'	1	10	10	6	4	4	0	40	60	60
6	Codiaeum variegatum L. Rumph. ex A. Juss. 'Excellent' – Codium motley 'Excellent'	2	10	10	5	4	4	0	50	60	60

The applied "Spray Bona Forte" showed an average of 50% of the biological effectiveness of the studied plants. Of all the plants studied, only the codium "Excellent" has a noticeable result in 2 repetitions. Within 3 days after processing, 5 out of 10 worms remained, and then 4 live. Phytoverm is a biological insecticide of intestinal contact action for the protection of flower crops of open and protected soil (Table 5).

Table 5 - Biological efficiency of the pesticide "Phytoverm CE" of mealybug in Codium, %

№ п/п	Experimental samples	Repetition	Number of units					Reduction of the number of pests in the calculation days, %			
			Before processing	Calculation dates							
				1	3	7	14	1	3	7	14
"Phytoverm CE"											
	Observation	1	10	10	10	10	7	-	-	-	-
1	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mrs. Iceton' – Codium motley 'Mrs. Iceton'	1	10	10	8	8	8	0	20	20	20
1	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mrs. Iceton' – Codium motley 'Mrs. Iceton'	2	10	10	8	8	8	0	20	20	20

2	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mammi' – Codium motley 'Mammi'	1	10	10	7	7	7	0	30	30	30
2	Codiaeum variegatum L. Rumph. ex A. Juss. 'Mammi' – Codium motley 'Mammi'	2	10	10	8	8	8	0	20	20	20
3	Codiaeum variegatum L. Rumph. ex A. Juss. 'Petra' – Codium motley 'Petra'	1	10	10	9	9	9	0	10	10	10
3	Codiaeum variegatum L. Rumph. ex A. Juss. 'Petra' – Codium motley 'Petra'	2	10	10	9	9	9	0	10	10	10
4	Codiaeum variegatum L. Rumph. ex A. Juss. 'Spirale' – Codium motley 'Spirale'	1	10	10	8	8	8	0	20	20	20
4	Codiaeum variegatum L. Rumph. ex A. Juss. 'Spirale' – Codium motley 'Spirale'	2	10	10	8	7	7	0	20	30	30
5	Codiaeum variegatum L. Rumph. ex A. Juss. 'Excellent' – Codium motley 'Excellent'	1	10	10	8	7	6	0	20	30	40
5	Codiaeum variegatum L. Rumph. ex A. Juss. 'Excellent' – Codium motley 'Excellent'	2	10	10	8	8	8	0	20	20	20

The average biological efficiency of "Phytoverm CE" was 25%. Of the 10 plants taken under control, not a single high efficiency was observed.

The biological effectiveness of the insecticid "Phytoverm CE" is on average 20% for 14 days of each species. Codium "Excellent" and "Mrs. Iceton" had the same reaction to the pesticide. Biological efficiency of 20%.

Discussion of the results and conclusion

According to the long-term data of the Nur-Sultan Botanical Garden, every year at the end of April or early May, during the period of mass egg laying, insecticide treatment works lead to the death of eggs. Insecticides "Phytoverm CE" and "Spray Bona Forte" were used in the greenhouse of the Nur-Sultan Botanical Garden. Pesticides "Phytoverm CE" and "Spray Bona Forte" were used in the same conditions. Both showed low biological efficacy in pesticides.

As a result of the insecticide "Phytoverm CE" in version No. 1, the decrease in the pest population on the 14th day on the settlement days was

50%, and in version No. 2-30% and in subsequent versions-40%, 30%, 60%.

The applied "Spray Bona Forte" showed an average of 50% of the biological effectiveness of the studied plants. Of all the plants studied, only the codeum "Excelent" has a noticeable result in 2 repetitions. Within 3 days after processing, 5 out of 10 worms remained, and then 4 live.

The annual and seasonal dynamics of the number of pests were studied, the sequence of alternation of ornamental plants with phytophages during the year was determined. In 2019 – 2020, the average dynamics of the development of mealybug was observed inside. As a result, a mealybug population develops in May, i.e., an outbreak of mealybug occurs in the spring and summer months. It is not surprising that in the spring months plants also wake up from a period of rest. Young leaves come out and feed on worms.

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БИОПЕСТИЦИДНЫЙ ТЕСТ НА МУЧНИСТОГО ЧЕРВЕЦА У РАСТЕНИЙ ОРАНЖЕРЕИ ТРОПИЧЕСКОГО И СУБТРОПИЧЕСКОГО КЛИМАТА В УСЛОВИЯХ ОРАНЖЕРЕЙНОГО КОМПЛЕКСА НУР-СУЛТАН

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Аннотация

В статье рассматриваются результаты биопестицидного теста на вредителя растений в оранжерее Ботанического парка Нур-Султана. Цель статьи - определить эффективность защитных мероприятий по сохранению коллекционных растений в оранжерее Ботанического сада г. Нур-Султана. Для выполнения этой задачи объектом исследования был основной вредитель оранжереи Ботанического сада г. Нур-Султана - мучнистый червец и динамика развития его популяции. В ходе исследования была выявлена годовая и сезонная динамика численности мучнистых червецов и прослежена последовательность чередования декоративных растений с фитофагами в течение всего года. Для оценки устойчивости вредителей к биологическому контролю были взяты два биопестицида. Это: "Спрей Бона Форте" на основе натурального пиретрина и "Фитоверм" на основе Аверсектина-С. В соответствии с результатами исследования были сделаны выводы.

Ключевые слова: ботанический сад, оранжерея, мучнистый червец, биопестицид, биотест.

НҰР -СҰЛТАН ОРАНЖЕРИЯ КЕШЕНІ ЖАҒДАЙЫНДАҒЫ ТРОПИКАЛЫҚ ЖӘНЕ СУБТРОПИКАЛЫҚ КЛИМАТТЫҢ ОРАНЖЕРИЯ ӨСІМДІКТЕРІНДЕГІ АҚ ҮЛПЕКТІ СЫМЫРҒА ҚАРСЫ БИОПЕСТИЦИД СЫНАҒЫ

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Түйін

Мақалада Нұр-сұлтан ботаникалық саябағының оранжереясындағы өсімдік зиянкестеріне биопестицидтік тест нәтижелері қарастырылады. Мақаланың мақсаты - Нұр-сұлтан ботаникалық бағының оранжереясында коллекциялық өсімдіктерді сақтау бойынша қорғау іс-шараларының тиімділігін анықтау. Бұл тапсырманы орындау үшін зерттеу нысаны Нұрсұлтан жылыжайының негізгі зиянкестері - ақ үлпекті сымыр және оның популяциясының даму динамикасы болды. Зерттеу барысында ақ үлпекті сымыр санының жылдық және маусымдық динамикасы анықталды және сәндік өсімдіктердің жыл бойына фитофагтармен кезектесуі байқалды. Зиянкестердің биологиялық бақылауға төзімділігін бағалау үшін екі биопестицид алынды. Олар: табиғи пиретрин негізіндегі "Бона Форте Спрейі" және Аверсектин-С негізіндегі "Фитоверм". Зерттеу нәтижелеріне сәйкес қорытынды жасалды.

Кілт сөздер: ботаникалық саябақ, жылыжайы, ақ үлпекті сымыр, биопестицид, биотест.