UDC 579.887 582.665

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INVESTIGATION OF THE RESISTANCE OF DIFFERENT VARIETIES OF BUCKWHEAT TO INFECTIOUS DISEASES AFTER THE PRE-SOWING TREATMENT OF SEEDS AND VEGETATING PLANTS WITH BIOLOGICAL PREPARATIONS

Досліджено вплив гумату натрію, біопрепаратів «Вермісол», «Вітазим» та «Біоекофунге-1» на ураженість гречки сірою гниллю, пероноспорозом, аскохітозом, бактеріозом, вірусним опіком, а також комплексом перелічених хвороб шляхом передпосівної обробки насіння та вегетуючих рослин гречки сортів Вікторія, Роксолана, Кара-Даг, Рубра, Зеленоквіткова 90, Степова, Єлена, Аеліта, Лада та Fagopyrum tataricum Gaertn. Показана перспективність використання цих препаратів в умовах агроценозу для захисту посівів гречки від комплексу хвороб. Найбільша ефективність виявлена для препарату «Біоекофунге-1», який, окрім захисту рослин від патогенів різних таксономічних груп, також стимулював проростання насіння. Розроблена схема діагностики та профілактики захворювань гречки.

Ключові слова: гречка, біостимулятори, регулятори росту рослин, вірус опіку гречки, аскохітоз, сіра гниль, пероноспороз, бактеріоз.

Introduction. One of the modern trends of increasing of yield and quality of crop is the implementation in agricultural production of high energy-saving technologies with the use of biologically active substances. The plant growth regulators are natural or synthetic low molecular weight substances that in extremely small concentrations in plants significantly modify their metabolic processes. They contain a balanced complex of phytoregulators, biologically active substances and trace elements [1].

Growth regulators increase the resistance of plants to adverse factors of natural or anthropogenic origin: the critical temperature, water deficiency, toxic effects of pesticides, diseases and pest damage. The results of the research and industrial inspection indicate that the application of plant growth regulators in agriculture is one of the most affordable and highly profitable agronomic measures to increase the productivity of major crops and improve their quality [2].

It is known that in addition to pathogenic forms of microorganisms in buckwheat were also found valuable agroecological groups of microorganisms. During laboratory tests it was established the dynamics of microorganisms changes depending on varietal affiliation of buckwheat (the number of actinomycetes and nitrogen-fixing bacteria significantly varied). However, a particular value has a group of microscopic fungi, which number in the rhizosphere of buckwheat was the highest. It is proved that these organisms are able to structure the arable layer and synthesize organic compounds in a more accessible form for plants [1]. Thus, the part of the majority of biological products for plants that exist in the world market are symbiotic bacteria and microscopic fungi and also microorganisms that produce biologically active substances having an antagonistic effect on pathogens and protect plants from disease.

Infectious diseases of buckwheat are the main factor in reducing yield and losses in the crop cultivation. Buckwheat is affected by viral, bacterial and fungal diseases at different stages of plant development, depending on pathogen type.

Viral diseases cause significant damage to buckwheat that reduces crop, disrupting the formation of grain and compromising its quality. The most harmful for buckwheat in CIS are such viral diseases as tobacco mosaic virus, cucumber mosaic virus and virus of buckwheat burn [3].

Currently, the issue of viral diseases in buckwheat in Ukraine remains very important. In recent years this problem has been solved, which is why a series of studies to identify the causative agent of one of the most harmful diseases of buckwheat, i.e. buckwheat burn virus (BBV), studying its structural components and properties. Viral burn annually brings significant losses to buckwheat, reducing the yield to 80 % [4]. Except BBV, buckwheat is affected by several dozen of viruses, so the control of viral diseases in buckwheat is important for agriculture [1].

The causative agent of Botrytis bunch rot, which also extended to the buckwheat, is fungus *Botrytis cinerea Fr* [5]. Sidorova S.F. showed that the most characterized manifestation of the disease are present in the flowering period and during the formation of the first fruits. The storage of infection are crop residues, where the fungus persists as sclerotia. Highly resistant varieties were not found [6]. The source of the initial infection are seeds, plant debris and soil. Harmfulness of botrytis is 35.3 %. This disease is harmful for early lesions in the flowering stage [7].

Ascochyta blight (*Ascochyta bresadolae Sacc*) is common in Ukraine, Russia, Belarus, Yugoslavia, North America [8]. Long-term observations give reason to affirm that the causative agent of Ascochyta blight affect buckwheat in the cotyledon leaf stage and budding phase – flowering, fruit formation. Fungus preserved in plant debris and the shell of seeds. The infection reaches the maximum at the beginning of the growing period of plants and severely affects yields [9].

Downy mildew (*Peronospora fagopyri Elenev*) strongly affects buckwheat, causing the formation of an empty shell. The researchers noted that this disease is widespread in western regions of Ukraine and in different regions of Europe [10]. In the Skirts of Ukraine Downy mildew is evident on buckwheat cotyledon and true leaves, buds, flowers and inflorescences as well as the green fruit. The affected leaves prematurely wither and fall off. Flowers, buds and fruits become brown, underdeveloped, wither and fall off. Overall harmfulness of Downy mildew is 27 %. It should be noted that *Perenospora fagopyri Elenev* is a highly specialized type and it affects only buckwheat [11].

Microbiological analysis of global buckwheat seed collection showed high contamination of complex pathogenic bacteria (88-89 %). The most common among pathogenic microorganisms, affecting buckwheat, are bacteria *Pseudomonas solonacearum, Xanthomonas heteroceae*, *Pseudomonas angulata*, *Pseudomonas syringae van HaII*, *Bacterium proteamaculans*, which cause a range of symptoms, leading to a significant reduction in yield [12].

These data indicate the need to develop effective measures and implement them into agriculture to prevent buckwheat infectious diseases. It is known [13] that the seeds are the main source of bacterial, viral and fungal infections. Except seed contamination, its rapid development is also observed at the stage of vegetative plants. It is known that in severe cases of buckwheat infectious diseases the shortage may reach 45%. The research **aimed** at testing preparates buckwheat seeds for pre-seeding treatment, growth stimulation and plants protetion againts pathogenes of different taxonomic groups.

Materials and methods. The objects of study were 10 varieties of buckwheat that are commonly used as seed material in agrocenoses of Ukraine and Europe, namely: Victoria, Roxolana, Kara-Dag, Rubra, Zelenokvitkova-90, Stepova, Elena, Aelita, Lada and Fagopyrum tataricum Gaertn. The research was carried out in vegetation compartments of the D.K. Zabolotny Institute of Microbiology and Virology of NAS of Ukraine and experimental fields of Podolsk state agrarian-technical University in 2009-2015 years.

Microbiological and phytopathological analysis of the samples was performed by the standard technique. For the study of pathogenic microorganisms used culture liquid, which were obtained by cultivation of bacteria on selective nutrient media for different groups of phytopathogens [14]. Culture of studied fungi were grown on potato-glucose agar in Petri dishes. For sowing on the dishes with agar medium with the addition of the xylans inoculum (3 x 3 mm) from the edge (10 mm) of the colony, which was rapidly growing, was used. Inoculated dishes were sealed with “Parafilm” to maintain humidity of the environment with xylans and incubated at 26 ± 2 ^{o}C for 3 to 21 days [15].

To confirm viral lesions of plant there were prepared preparations for electron microscopy by the standard technique [16, 17] and viewed in electron microscope JEM-100 ("JEOL", Japan) at an instrumental magnification of 20-120 thousand with an accelerating voltage of 80 KV [18]. To detect intracellular inclusions the preparations for luminescence microscopy were prepared using a standard procedure and were stained by fluorochrome dyes (acridinium orange (1:10 000)) [17].

The field studies were conducted in the experimental fields of Podolsk state agrarian-technical University, seeds collection was obtained in its research institute. Sowing was carried out in wide way with aisles of 45 cm, seeding depth – 4 cm. Assessment of the impact of buckwheat plants infectious diseases was performed according to the formula:

$$P = \frac{a \times 100}{N},$$

where P – the prevalence of the diseases in %; *a* – the number of diseased plants; *N* – the total number of plants in the sample.

Assessment of stability was performed on a 4-point scale [19]: 0 – disease is absent; 1 – oily spots on leaves, covers up to 10 % of the surface of the leaf blade; 2 – necrotic spots occupy up to 30 % of the surface of the leaves, from the bottom of which there is a friable gray-violet bloom; 3 – necrotic spots occupy from 30 to 60 % of the leaf surface, which leads to drying and defoliation of leaves.

The intensity of the lesions which is a qualitative indicator of the disease was determined visually by the affected area of the leaf blade surface using a 4-point scale. To convert from points to percent there was used the generally accepted formula to determine the development of the disease (extent of injury):

$$R = \frac{\sum (a \times b) N}{K},$$

where R is the development of the disease (lesions), %; $\sum(a \times b)$ is the sum of the number of plants (*a*) on the corresponding score of the lesion (*b*); N is the total number of plants; K – the highest score of the scale [20].

Evaluation of varieties was conducted in provocative environments. The collection was sown near early spring crops where the spread of the disease has reached more than 50 %.

The study of the effect of sodium humate, biological products "Vermisol", "Vitasym" and "Bioecofunge-1" was conducted under the conditions of agrocenosis. The study of the effect of sodium humate on lesion of buckwheat by complex diseases was carried out by pre-sowing treatment of seeds and vegetating plants of buckwheat variety Lada. Investigated the spread of Botrytis bunch rot, Downy mildew, Ascochyta blight, bacteriosis and burn virus on treated and control plants.

Studies of a biological product "Vermisol" conducted by pre-treatment of seeds, root and by foliar feeding. The treatment by "Vitasym" drug was carried out in the phase of real leaves and beginning of flowering. Conducted a study of germination of seeds of buckwheat varieties Elena for the conditions of treatment by "Bioecofunge-1" (laboratory-vegetation experiment), and the impact of the drug on the reproduction of phytoviruses by analysis of intracellular viral inclusions.

Results and discussion. To modern growth regulators, which found its practical application in crop, should include sodium humate. The active substance of sodium humate is sodium salts of humic acids, as well as a large number of amino acids [21]. It is known that sodium humate has stimulating growth and fungicidal properties. This drug is designed to enhance the growth and adaptation to adverse environmental conditions, reduction of nitrates use and plant organisms increased resistance to disease. The use of sodium humate contributed faster passage of ontogenesis. Laboratory germination of drug-treated seed was increased to 1.8-5.8 %; main root length increases to 28.3-34.6 %; the number of lateral roots – to 14.6 %, and the zone of root hairs – to 3.5-4.1 mm.

The drug inhibits the germination of many fungi and their conidia. For example, the germination viability of *Botrytis cinerea* conidia decreased in 1.7-3.3 times, *Fusarium oxysporam var. Orthoceras* on the 25-30 %. At concentrations of 0.01 %, sodium humate completely stopped germination of conidia of powdery mildew pathogen of tomatoes. Plants processing by sodium gumat not only accelerates the growth of green mass but also strengthens the root system. It increases the permeability of the cell membrane, intensively promotes the accumulation of potassium in the cytoplasm (Table 1). It is known that humic acids that are the part of sodium humate, possess non-specific protective effect, they have radioprotective effect and reduce the content of pesticides and nitrates in air, water and soil [19].

Deeva V.P., Shehech Z.I., Sanko N.V. (1988) indicate that the physiological effect of humic compounds due to their paramagnetic properties and affect the membrane permeability and protein synthesis system of the cells [21]. Analysis of the impact of pre-treatment of buckwheat seed of Lada varieties by different concentrations of sodium humate to the resistance to complex diseases shows that reducing of complex disease infestation is 24.9-25.1 % (Table 1). Treatment of vegetative buckwheat plants of Lada varieties with 0.01 % of sodium humate shows that the spread of Botrytis bunch rot decreased to the 10.7 %, Downy mildew – to 14.9 %, Ascochyta blight – to 4.9 %, bacteriosis – to 9.9 %, viral burn – to 9.7 %. Proved that sodium humate is effective in a delay of buckwheat disease and can be used in industrial crops.

Table 1 – **The effect of buckwheat variety Lada processing by sodium humate on plant resistance to diseases**

№	Options	Prevalence, %				
		Botrytis bunch rot	Downy mildew	Ascochyta blight	Bacteriosis	Viral burn
Treatment of seed						
1	Dry seeds (control)	10.4 ± 2.0	15.3 ± 1.8	6.8 ± 0.4	13.1 ± 1.3	14.2 ± 1.4
2	Seeds, soaked in water	11.2 ± 1.7	4.2 ± 0.3*	5.3 ± 0.5	4.1 ± 0.2*	13.8 ± 2.2
3	Seeds treated with 0.1 % solution of sodium humate	2.6 ± 0.2*	3.1 ± 0.1*	4.6 ± 0.3*	2.3 ± 0.1*	2.9 ± 0.1*
4	Seeds treated with 1 % solution	2.4 ± 0.1*	3.1 ± 0.2*	3.2 ± 0.2*	2.5 ± 0.1*	2.9 ± 0.2*

	of sodium humate					
Treatment of vegetating plants						
5	Control	18.1 ± 1.7	25.1 ± 2.4	12.1 ± 0.8	18.3 ± 2.1	21.2 ± 3.5
6	Seeds treated with 0.01 % solution of sodium humate	7.4 ± 0.7*	10.2 ±1.0*	7.2 ± 0.5*	8.4 ± 1.0*	11.5 ±1.6*

Note: * – $p < 0.05$ in relation to indicators for control

As shown by our study, biostimulator "Vermisol", obtained from organic environmentally friendly fertilizer "Biohumus", increased yield by an average of 20-30 %, improves seed germination, increases the resistance of plants to frost, drought, reduces the content of heavy metals, radionuclides and nitrates in agricultural products, inhibits the growth of pathogenic microorganisms, saving fertilizer costs by 50 % and is compatible with all agrochemicals. "Vermisol" is recommended for use in the preliminary treatment of seeds, root and foliar feeding. The analysis of the impact of the drug "Vermisol" on the prevalence of different species and varieties of buckwheat by complex diseases shows that reducing of the infestation in cases of processing of vegetating plants is 5-7.5 %, seeds treatment – 0.8-6.6 % (Table 2).

Table 2 – **The prevalence of diseases of buckwheat plants depending on the application of biopreparation "Vermisol"**

№	Variety	Options	Prevalence, %		
			Downy mildew	Viral burn	Complex of deseases
1	Victoria	Control	7.3 ± 1.1	5.6 ± 0.2	12.9 ± 1.3
		Treatment of seed with "Vermisol"	3.1 ± 0.3*	4.4 ± 0.1*	7.5 ± 0.7*
		Treatment of vegetating plants with "Vermisol"	5.4 ± 0.6	3.6 ± 0.1*	9.0 ± 0.9*
2	Roxolana	Control	6.5 ± 0.3	4.7 ± 0.3	11.2 ± 1.1
		Treatment of seed with "Vermisol"	5.4 ± 0.2*	3.2 ± 0.2*	8.6 ± 0.6*
		Treatment of vegetating plants with "Vermisol"	4.0 ± 0.2*	2.5 ± 0.1*	6.5 ± 0.2*
3	Kara-Dag	Control	6.0 ± 0.3	7.0 ± 0.4	13.0 ± 1.6
		Treatment of seed with "Vermisol"	5.4 ± 0.4	5.5 ± 0.2*	10.9 ± 1.3*
		Treatment of vegetating plants with "Vermisol"	3.0 ± 0.1*	6.2 ± 0.3	9.8 ± 0.9*
4	Rubra	Control	-	5.0 ± 0.2	5.0 ± 0.3
		Treatment of seed with "Vermisol"	-	4.2 ± 0.1*	4.2 ± 0.1*
		Treatment of vegetating plants with "Vermisol"	-	3.0 ± 0.1*	3.0 ± 0.2*
5	Zelenokvitkova-90	Control	3.9 ± 0.2	4.0 ± 0.3	7.9 ± 0.8
		Treatment of seed with "Vermisol"	-	2.5 ± 0.3*	2.5 ± 0.3*
		Treatment of vegetating plants with "Vermisol"	2.0 ± 0.1*	-	2.0 ± 0.1*
6	Stepova	Control	8.4 ± 0.5	5.0 ± 0.3	8.4 ± 0.7
		Treatment of seed with "Vermisol"	0*	3.0 ± 0.4*	5.0 ± 0.2*
		Treatment of vegetating plants with "Vermisol"	4.2 ± 0.2*	2.6 ± 0.1*	4.2 ± 0.3*
7	Elena	Control	9.0 ±0.7	4.0 ± 0.2	13.0 ± 1.1
		Treatment of seed with "Vermisol"	5.0 ± 0.3*	2.0 ± 0.1*	7.0 ± 0.7*
		Treatment of vegetating plants with "Vermisol"	6.5 ± 0.4*	2.5 ± 0.2*	9.0 ± 0.5*
8	Aelita	Control	9.0 ± 0.5	5.0 ± 0.3	14.0 ± 1.1
		Treatment of seed with "Vermisol"	6.1 ± 0.3*	3.7 ± 0.2*	9.8 ± 0.6*
		Treatment of vegetating plants with "Vermisol"	4.5 ± 0.1*	2.5 ± 0.1*	7.0 ± 0.5*
9	Fagopyrum tataricum Gaertn	Control	-	15.8 ± 1.9	15.8 ±1.5
		Treatment of seed with "Vermisol"	-	9.5 ± 2.1*	9.5 ± 2.4*
		Treatment of vegetating plants with "Vermisol"	-	8.5 ± 1.4*	8.5 ± 2.1*

Note: * – $p < 0.05$ in relation to indicators for control

It should be noted that "Vitazym" is microbiologically synthesized liquid natural biostimulant containing substances that promote plant growth and development, particularly algae extracts, minerals in chelated form, calcium lipnosulfat, organic acids, vitamins and enzymes. Drug is recommended for foliar feeding of plants, seed treatment through irrigation systems. The treatment of buckwheat plants by "Vitazym" drug was performed in the phase of true leaves and early flowering (Table 3). The action of the "Vitazym" to defeat buckwheat diseases was ambiguous and depended on the type of pathogens. Infestation of Downy mildew in cases of buckwheat plants processing by "Vitazym" decreased to 2-3.9 %, Botrytis bunch rot – to 6.7-11.2 %, bacteriosis – to 7.1-9.7 %, viral burn – to 1.9-2.2 %. The drug is promising for application to production [22].

Table 3 – **The influence of "Vitasym" on the affecting of buckwheat plants varieties Elena by complex deseases**

№	Options	Affecting of plants by complex deseases, %
1	Control	47.2 ± 2.3
2	Treatment with "Vitasym", 3%	25.9 ± 1.7*

Note: * – $p < 0.05$ in relation to indicators for control

Studies have shown, that biochemical drug "Bioecofunge-1", based on components of *Basidiomycetes* fungi and their carriers from higher plants, that were used to develop the drug, is promising for prevention of diseases and stimulation of plant growth and development of buckwheat plants. It is mportant to note the comprehensive action of "Bioecofunge-1", which stimulates the growth and development of buckwheat and reduces aggressive pathogens of different nature. "Bioecofunge-1" was developed by Podolsk state agrarian-technical University scientists, department of physiology, biochemistry of plants and bioenergetics.

We first discovered that "Bioecofunge-1" also influenced the reproduction of phytoviruses that affects buckwheat in different ecological agrocenosis (Table 4-5, Fig. 1). For example, the formation of intracellular inclusions under conditions of tobacco mosaic virus infection of plant significantly blocked and their number decreased, that is observed in the study of cells in light and fluorescent microscopy. Crystal formation often becomes loose structure with preserved features of the cell nucleus, which is essential for plant growth and development and the control of seeds infection under conditions of laboratory and vegetation experiments.

Table 4 – **The germination of the seeds of buckwheat varieties Elena after treatment with "Bioecofunge-1"** (laboratory-vegetation experiment)

№	Options	The number of seeds (PCs)	Rose on day 15 (PCs / %)	Number of healthy plants (%)	General condition of plants
1	Without treatment (control)	150	21 (14 %)	23.8 %	Most of the plants had chlorose-mosaic symptoms
2	A 0.1% aqueous solution, 60 min	150	66 (44 %)	83.5 %	Had normal habit
3	0.5% aqueous solution, 60 min	150	60 (40 %)	67.3 %	Had normal growth and development, individual necrosis
4	0.1% aqueous solution, 90 min	150	51 (34 %)	57.2 %	Chlorosis of the lamina
5	0.5% aqueous solution, 90 min	150	63 (42 %)	70.4 %	Elongation of the stem in some plants, the leaves are normal

Table 5 – **Formation of internally cellular viral inclusions in buckwheat varieties Elena under the treatment of seeds with "Bioekofunge-1"** (plants on day 15 after the treatment of seeds)

№	Options	The number of studied cells	The number of inclusions	%	The condition of the inclusions
1	Without treatment	20	8.0	40.0	Typical inclusion of the TMV,

	(control)				a clear morphological signs
2	0.1% aqueous solution, 60 min	20	3.0	15.0	Other inclusions with distruction
3	0.5% aqueous solution, 60 min	20	2.0	10.0	

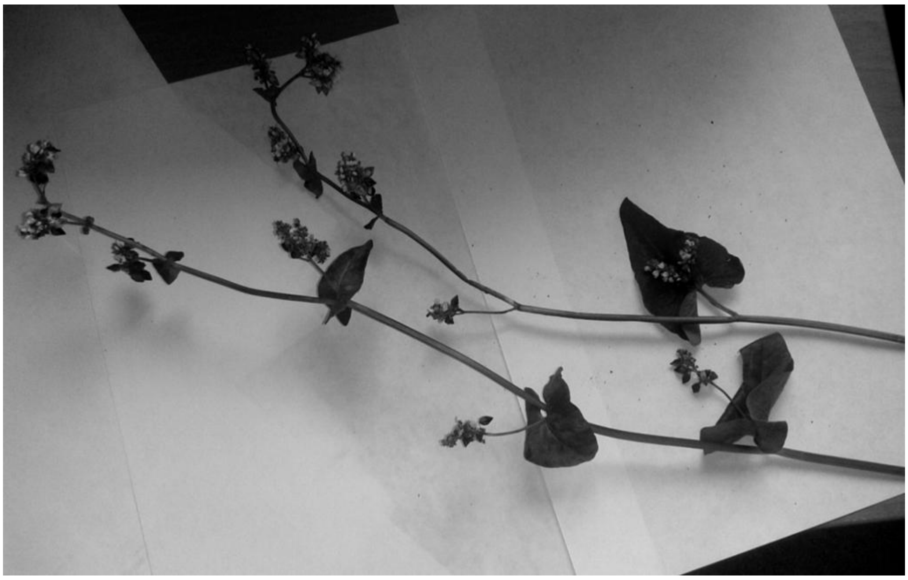
Moreover, these methodological approaches provide an opportunity to discover the circulation of tobacco mosaic virus accompanying vegetation (weeds) that surround buckwheat in agrocenosis of Steppes and Polesie. As a result of the studies we propose the following scheme of diagnosis and prevention of buckwheat infections (Fig. 2).

According to most researchers, crop protection is currently seen as a problem of social, biological and economic importance. Crop protection against pests is an integral part of the overall system of agricultural activities in the cultivation of any given crop.

An important task of plant protection is the reduction of losses of agricultural products, ensuring prolonged maintenance of productive agro-ecosystems and risk reduction related to the use of pesticides. It should be noted that priority in the field of agriculture and plant has optimum conditions for growing productive crops, including buckwheat. The system of protection against harmful organisms is aimed at eliminating the sources of infection and suppressing pathogen development in the most vulnerable phase of pathogenesis, to obtain maximum yield of high quality, while avoiding environmental pollution.

The integrated protection system of buckwheat should consider biocenological factors that contribute to limit the development of harmful pathogens, and provide a system of methods and means of satisfying the economic and toxicological requirements. That is why agrophytocenosis is in need of advanced technologies, evaluation of microbiological and virological status of soil and vegetation; quality of agriculture, the use in the production of well-designed crop rotations and the introduction of pathogen-resistant crop varieties.

(A)



(B)

Figure 1. **The appearance of the buckwheat plants exposed to the drug "Bioekofunge-1" (A) and control (B).**

Conclusions. Thus, in our studies it was shown that taking into account the wide spread of buckwheat diseases and presence of mixed infections in agrocenosis of Ukraine, it is necessary to develop new methods and products for protection of plants from pathogens of different nature. It has been shown the promising use of biostimulants for growth and development of plants: sodium humate, "Vermisol", "Vitasym" and "Bioecofunge-1" to prevent Botrytis bunch rot, Downy mildew, Ascochyta blight, bacteriosis and burn virus after pre-sowing treatment of seeds and vegetating plants. On the basis of all conducted investigations, the technology of assessing the buckwheat varieties to pathogens under different environmental conditions was developed for the purpose of diagnosis and prevention of different etiology diseases of buckwheat.

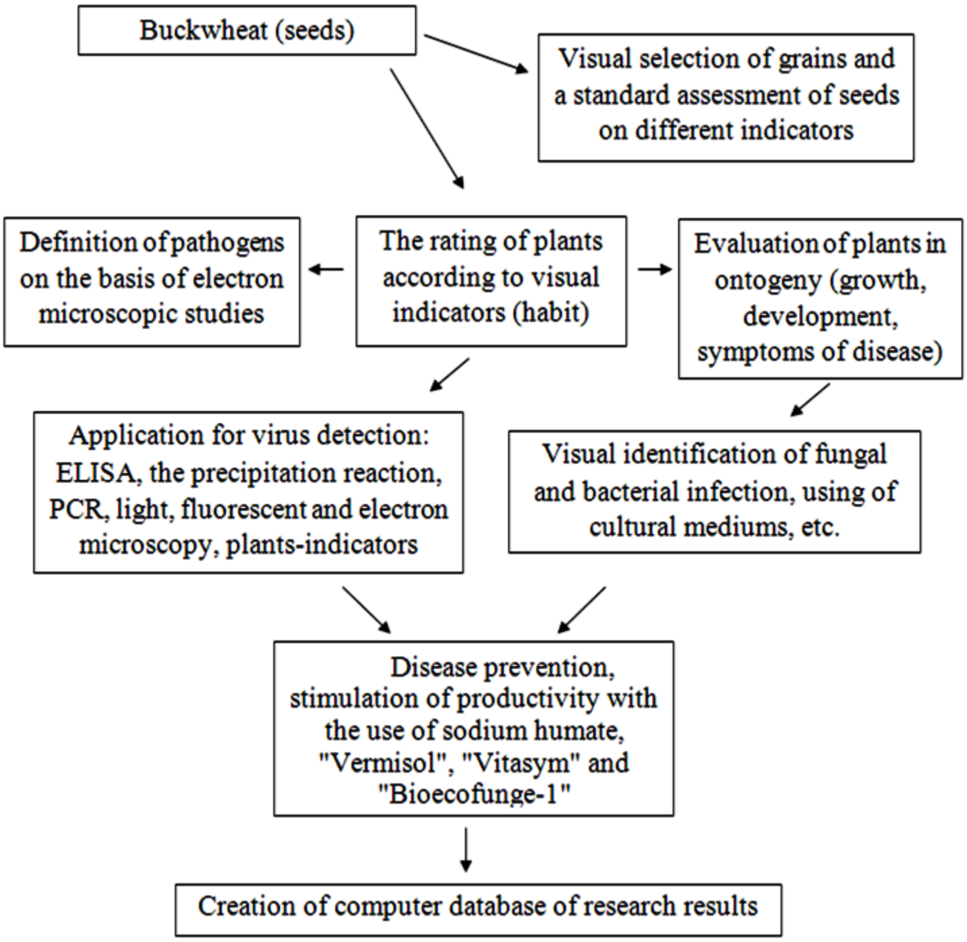


Figure 2. **Technology of sustainability evaluation of buckwheat varieties to pathogens under different environmental conditions, diagnosis and prevention of diseases.**

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Investigation of the resistance of different varieties of buckwheat to infectious diseases after the pre-sowing treatment of seeds and vegetating plants with biological preparations

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In the work it was investigated the influence of sodium humate, biological products "Vermisol", "Vitasym" and "Bioecofunge-1" on buckwheat lesion of Botrytis bunch rot, Downy mildew, Ascochyta blight, bacteriosis, burn virus and a complex of diseases after pre-sowing treatment of seeds and vegetating plants of Victoria, Roxolana, Kara-Dag, Rubra, Zelenokvitkova-90, Stepova, Elena, Aelita, Lada and Fagopyrum tataricum Gaertn buckwheat varieties. The prospects of these biological products use under agrocenosis conditions to protect the crops of buckwheat from the complex of diseases were shown. The highest efficiency identified for the drug "Bioecofunge-1" which, in addition to protecting plants from pathogens of different taxonomic groups, also stimulated the germination of seeds. The scheme of diagnostic and prevention of buckwheat diseases was deve-loped.

Key words: buckwheat, biostimulants, plant growth regulators, buckwheat burn virus, Ascochyta blight, Botrytis bunch rot, downy mildew, bacteriosis.

Исследование устойчивости различных сортов гречихи к инфекционным болезням при предпосевной обработке семян и вегетирующих растений биопрепаратами

А.А. Демченко, В.К. Шевчук, Л.В. Юзвенко, О.А. Бойко, Л.П. Бабенко, В.В. Мокрозуб, Л.Н. Лазаренко, А.В. Калиниченко, А.Л. Бойко

Исследовано влияние гумата натрия, биопрепаратов «Вермисол», «Витазим» и «Биоэкофунге-1» на поражаемость гречихи серой гнилью, пероноспорозом, аскохитозом, бактериозом, вирусным ожогом, а также комплексом перечисленных болезней путем предпосевной обработки семян и вегетирующих растений гречихи сортов Виктория, Роксолана, Кара-Даг, Рубра, Зеленоквиткова 90, Степная, Елена, Аэлита, Лада и Fagopyrum tataricum Gaertn. Показана перспективность использования данных препаратов в условиях агроценоза для защиты посевов гречихи от комплекса болезней. Наибольшая эффективность выявлена для препарата «Биоэкофунге-1», который, помимо защиты растений от патогенов разных таксономических групп, также стимулировал прорастание семян. Разработанная схема диагностики и профилактики заболеваний гречихи.

Ключевые слова: гречиха, биостимуляторы, регуляторы роста растений, вирус ожога гречихи, аскохитоз, серая гниль, пероноспороз, бактериоз.

Надійшла 12.04.2016 р.