ZESZYTY NAUKOWE MANS w Łomży nr 94 s. 78-87
data przesłania 19.03.2024 ./ akceptacji artykułu 30.11.2024

Liudmyla Perepelytsia
https://orcid.org/0000-0003-1610-1239
Zhytomyr Ivan Franko State University

Efficiency of the use of innovative technologies in crop production

Summary

As a result of hostilities in the territory of Ukraine and the crisis in the agricultural sphere of the economy of our country, the search for innovative technologies of cultivation of crops is extremely urgent. Biological preparations used in organic agriculture have several advantages: accessibility, economic efficiency, environmental friendliness and high efficiency of active substances. This is ensured by a comprehensive impact on the integral plant on the physiological and biochemical levels of the organization. The result of their action is more effective growth and growth of plant productivity.

Key words: organic agriculture, innovative technologies, biological preparations, growth, plant development.

Introduction

The life of higher plants in natural conditions proceeds in close interconnection with the microorganisms that inhabit the rhizosphere, forming an association "microorganisms - root system". It is proved that associative bacteria have a positive effect on plant growth and development: increase seed germination [1, 2], increase the resistance of plants to stress factors [3], reduce the incidence of plants with viral, fungal and bacterial infections, stimulate the absorption atmospheric nitrogen, activate the development of the root system [4]. These useful properties of microorganisms are manifested by the production of a complex of biological and active substances: phytohormones (auxins, gibberellins, cytokinins), vitamins of group B [2, 4].

Microbial preparations allow you to regulate the number and composition of the microbial complex on the roots, depending on the needs of plants. The literature has studies of the effects

of biological products based on Azotobacter chroococcum on tomato agrocultures [4], feed beet and cabbage [2].

Literature sources do not contain information on the use of Azotophyt P to increase germination energy and laboratory germination of *Apium graveolens* L. seeds with different storage time. Representatives of the genus *Apium* are of considerable interest in terms of use in the economy due to the valuable features of biochemical composition, therapeutic and nutritional properties [1]. Investigation of methods of activation of processes of germination of seeds *A.graveolens* L. The effects of Azotophyt P will establish the feasibility of using drugs allowed for organic agriculture.

Purpose: to study the effect of Azotophyte P on the processes of germination of seeds *A.graveolens* L. and to determine the term of accounting of energy of germination and similarity of this crop, depending on the shelf life of seeds.

Material and research methods. Celery seeds of the root *Apium graveolens* L. Diamond (Bejo Zaden) 2023 and storage periods of 2, 3, 4 and 5 years were used for the study. Seed germination was determined in the laboratory in accordance with DSTU 4138–2002 [7]. The seeds were germinated on moist filter paper in Petri cups 100 pieces each. Seed germination in experiments 1-5 (D.1-5) was carried out in distilled water, and experiments 6-10 (D.6-10)-using seeds soaked for 2 hours in the preparation of Azotophyte P (10 ml/500 ml water). The scheme of the experiment included 10 variants: № 1 - 1 year of storage, № 2 (2 years), № 3 (3 years), № 4 (4 years), № 5 (5 years); Azotophyte P: Experiment № 6 (1 year of storage), № 7 (2 years), № 8 (3 years), № 9 (4 years), № 10 (5 years). Normally sprouted was considered seeds, in which the length of the root was not less than the length of the seed. Germination energy was determined by the percentage of sprouted seeds for 4 and 7 days, and germination for 9-20 days (respectively for one-year and seeds with a shelf life of 2-5 years). The experiment was performed in a threefold repetition. The optimum temperature of celery seed germination was maintained-20-22 ^{o} C.

To determine the quality of seeds (germination energy and germination), the introduction of PPPs and mineral and organic fertilizers used the International BPS scale. Since 1989, the BSF scale has been offered by BASF, Bayer AG, Ciba Geigy AG and Hoechst AG as part of a BBCH Code for Cereals. This scale, which shows at what stage of ontogeny the plant is located, has begun to be actively used in Ukraine since 2013 for all agricultural plants.

Observation and introduction of drugs took place at such stages of growth of Selery Air Force (00 - 17):

✓ 0: germination: BBCH (00)-dry seeds, BBCH (05-07)-seeds of seeds, BBCH (09)-seed germination;

✓ 1: Leaf development: BBCH (10-11)-the phase of the first real leaf, BBCH (13-14)-phase 3-4 true leaves, BBCH (15-17)-phase of 5-7 true leaves.

Used the following variants of the PPR and fertilizer application system:

✓ B1 - without the use of protection and fertilizers, watering with water;

✓ B2 - chemical technology of plants protecting tools (PPT) and application of mineral fertilizers;

✓ B3 - introduction of biological PPT and organic fertilizers.

Table. 1. Scheme of experimental variants

Factor A Gender	**Factor B Fertilizer application and plant protection products**	**Factor C Celery Growth Phases**					**Factor D**
		BBCH (00)	**BBCH (09)**	**BBCH (10-11)**	**BBCH (13-14)**	**BBCH (15-17)**	**Soil**
Diamond	B1	Water	Water	Water	Water	Water	Water
	B2	Hydrogen peroxide (3%)	Prevucur Cornevin	Actelik Yara Terra (13:40:13)	RootStar Unyform	Yara Terra (18:18:18) Actophyte	Prevucur Vertimek
	B3	Mycofrand Phytocide Liposam	Azotophyte P Aktoverm liposam	Helprost Phytocide Actoverm Liposam Zhyve dobryvo	Mycofrand Phytochelp Bitoxibacil-lin Liposam	Chelprost Phytocid Actoverm Liposam Zhyve dobryvo	Azotophyte T Mycochelp Bitoxibacil-lin
Tango	B1	Water	Water	Water	Water	Water	Water
	B2	Hydrogen peroxide (3%)	Prevucur Cornevin	Actelik Yara Terra (13:40:13)	RootStar Unyform	Yara Terra (18:18:18) Actophyte	Prevucur Vertimek
	B3	Mycofrand Phytocide Liposam	Azotophyte P Aktoverm Liposam	Helprost Phytocide Actoverm Liposam Zhyve dobryvo	Mycofrand Phytochelp Bitoxibacil-lin Liposam	Chelprost Phytocid Actoverm Liposam Zhyve dobryvo	Azotophyte T Mycochelp Bitoxibacil -lin

Source: Own results based on research conducted. Zhytomyr Ivan Franko State University

Research results

Development of schemes of application of plant protection products Apium graveolens L. For development in the initial stages of growth, plants require the introduction of certain pesticides and fertilizers. Therefore, the following requirements were taken into account when drawing up the scheme: first, on celery, the curtain and root, as on leafy vegetable crops, prohibited use of pesticides at all stages of plant development, since the aboveground part of the plant is used in human nutrition [10]. However, celery diseases and pests [9], which develop rapidly without the influence of PPT, require the introduction of biological products to control them, usually without harming the plant and humans. Secondly, in terms of organic agriculture, biological products that are allowed to use on vegetables should have a number of undeniable advantages over chemical plant protection products: safe for plants and humans, have short periods of expectations, environmentally safe, do not pollute, but vice versa. Replenish the beneficial microflora of the soil, do not addictive pests and pathogens to the active substance, do not accumulate in the tissues of plants, do not pour on the taste of plants without loss of crops [8]. Therefore, the use of biological products is profitable economically, environmentally and promising on green vegetable crops.

We have developed a scheme for introducing biological products of fungicidal, insecticidal and growing action, taking into account the phases of the development of seedlings of *Apium graveolens* L. (tabl.1). The scheme of introduction and rates of biological products expenditure were agreed and adjusted by plant protection professionals Institute of Applied Biotechnology (BTU-Center Research Department). For comparison and obtaining experimental evidence of the efficiency of complex use of biological products on the culture of Apium graveolens L. a scheme of use of chemical PPT and mineral fertilizers was proposed.

Given the needs of *A. graveolens* L. in certain phases of development, prophylactically biofungicides and bioinscticides and soil improvement were introduced (soil tillage). In the phase of Celery development of BBCH (00-03)-biological products for stimulation of seed germination, fungicidal action and adhesive, which significantly enhances the effect of drugs and allows to use biological products economically.

BBCH (09) phase (phase of determination of seed germination) - young seedlings for active growth require increased nutrient absorption for the formation of leaf mass and root system. Therefore, the use of Azotophyt P is quite justified. Insecticide introduction in this phase of development is necessary to control the number of pests.

The BBCH phase (10) is the formation of the first true lust. Plants move to the active autotrophic type of power. In this phase, the plant was introduced by biological products for growth stimulation (Helprost), for additional nutrition of macro and trace elements with nitrogen

and phosphomodulators (Zhyve dobryvo), for prevention - fungicide and insecticide and for enhancement of the efficiency of lipoparates in the tank.

The next phase is important for plants that are grown in seedling. In the BBCH phase (11-13) - the formation of celery plants 1-3 true leaves is performed. Therefore, in this phase, the introduction of the rooting agent and the stimulator of the Mycofrand T to the cassette substrate is appropriate. It is offered to soak the roots of seedlings in biofungicidal phytohalp from root rot, which significantly increases the attraction of seedlings. Prevention of bioinsecticide with adhesive.

The next phase is also important for plant - grown plants. In the BBCH phase (15-17) (formation of 5-7 true leaves), seedlings are planted in open ground. Before planting, the plant is treated to relieve stress during transplantation (Helprost), fertilization (Zhyve dobryvo), preventive fungicidal and insecticidal treatment.

For comparison and experimental confirmation of the efficiency of biological products when growing celery seedlings, a scheme was developed with the standards of introduction of chemical products of plant protection and mineral fertilizers. The drugs were selected by the identity of the influence on the development of celery seedlings for preventive and therapeutic purposes.

Thus, a scheme for the introduction of biological products for productive development of plants on all important phases of development is promising for its use when growing celery seedlings. Experimental confirmation of the effectiveness of biological products compared to chemical protection growths indicates the efficiency of using bios.

The effectiveness of using azotophyte-r biological preparation to stimulate the initial stages of development of Apium graveolens L.

Microbial preparations allow you to regulate the number and composition of the microbial complex on the roots, depending on the needs of plants. The literature has studies of the effects of biological products based on Azotobacter chroococcum on tomato agrocultures [6], feed beet and cabbage [5]. Literature sources do not contain information on the use of nitrogen to increase germination energy and laboratory germination of *A. graveolens* L. seeds with different storage time. Representatives of the genus Apium are of considerable interest in terms of use in the economy due to the valuable features of biochemical composition, therapeutic and nutritional properties [1]. Investigation of methods of activation of processes of germination of seeds *A. graveolens* L. The effects of Azotophyt P will establish the feasibility of using drugs allowed for organic agriculture.

Fresh seeds of celery *Apium graveolens* L. Diamond (Bejo Zaden) is used for the study in 2023 and with storage periods of 2, 3, 4 and 5 years.

Azotophyte P biological products for soaking seeds for 2 h (10 ml/500 ml of water) - the preparation of BTU- Center, contains bacteria cells Azotobacter chroococcum in the amount (1-9) × 109 CFU/cm3, as well as micro and macroelements, biologically active bacterial vital products: enzymes, amino acids, vitamins, phytohormones, fungicidal substances [6]. Certified for organic agriculture: has an international certificate of the Organic Standard and is included in the list of drugs allowed for use in organic farming in Germany: Fibl, Demetr, Naturland.

A. graveolens seeds have a long germination period (20-30 days). Due to the presence of essential oils in the seed shell, which on the one hand protect the seed and on the other - intensively interfere with seed germination. Only annual celery seeds sprout qualitatively, so it is not recommended to use the seeds of this crop with a shelf life of more than 4-5 years.

One of the quality indicators of seed is germination energy and seed germination. Seeds that have high germination energy quickly and friendly sprouts, less suppressed by weeds, more resistant to adverse conditions [2]. Therefore, the search for effective biological drugs that positively affect the growth of those plant development is a promising area of research.

As a result of laboratory tests, it was found that the highest sprouting energy in distilled water was characterized by seeds of 1 year of storage-for 7 days it was 48 %, by 2 years-decreased by 25 % compared to 1 annual. Seeds of the 3rd and 4th years of storage have a sufficiently low germination energy-12 and 3%, respectively. The same tendency to reduce germination energy with an increase in storage period was observed at 9 days of research (fig. 1).

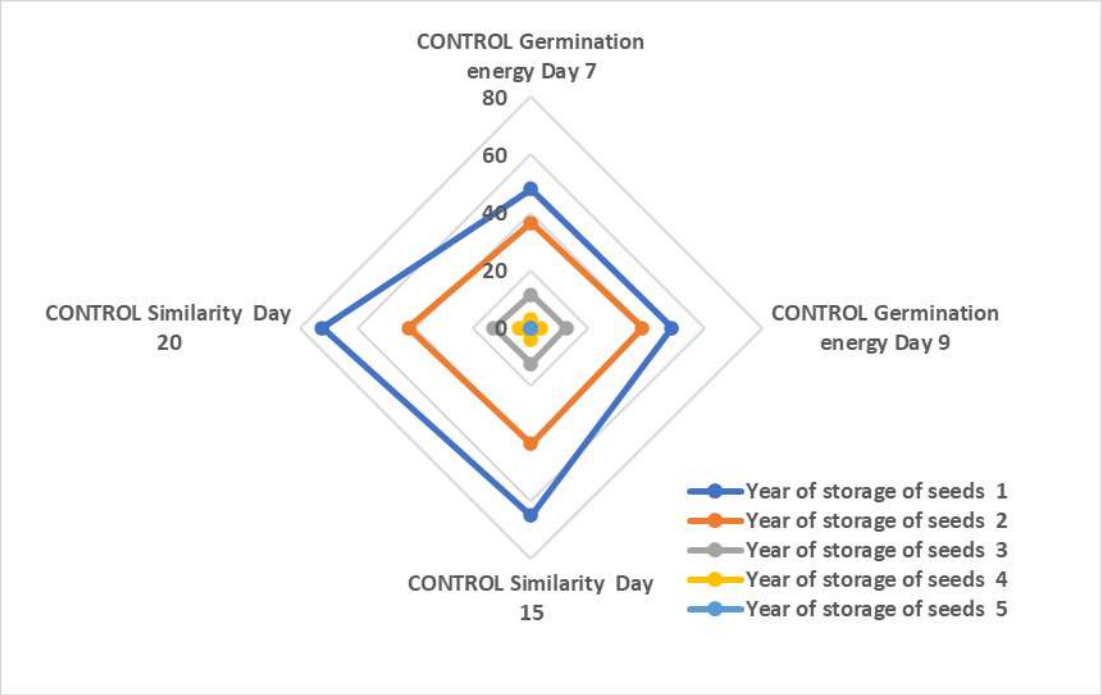

Fig. 1. Germination energy and germination of celery seeds diamond with different storage periods for germination in distilled water (%)

Source: Own results based on research conducted. Zhytomyr Ivan Franko State University

Determined laboratory germination of celery seeds at 15 and 20 days of germination. According to the results of our research (Fig. 1), the germination of seeds of the 1st year of storage was 73%. The germination of celery seeds with an increase in storage period also has a inverse dependence. They observed a decrease in similarity by 41 % (2 year), 82 % (3 year) and 94 % (4 year) relative to fresh seeds. The seeds of the second (D.2) and the third (D.3) of the year of storage lose about 40% of germination, compared to the previous year, which is 65% - 40% - 13%. In the fourth year of storage of celery seeds, germination is insignificant and is 4%. The seeds of the 5th year of storage in distilled water did not sprout.

Pre-sowing cultivation of vegetable seeds with a biological preparation of Azotophyt P in order to stimulate seed germination improves the permeability of the seed membranes, which accelerates the access of oxygen and water to the embryo and, accordingly, increases the intensity of its germination [6]. We have established that biologically active substances of Azotophyt P reliably increased the energy of germination and germination of seeds, regardless of the shelf life of seeds (fig. 1, 2). There was a reduction in the term of accounting of similarity and germination energy by three days, compared to experiments № 1-5 for germination of seeds in distilled water. Thus, the energy of germination of celery seeds of 1 year of storage (D. 6) for the actions of Azotophyt P was calculated for 4 days (49.25%), and for the same seeds sprouted

in distilled water (D.1) - for 7 days (D.1) 48.15%), given the old seeds - for 9 days (48.67%). On the 9th day for seeds treated with Azotophyt P (D.6) already determined the germination of seeds - 87.92%, which was 4% different from the final indicators of the germination of fresh seeds (88.32%). This indicates the activation of seed germination processes by the effects of Azotophyt P and the reduction of the germination rate.

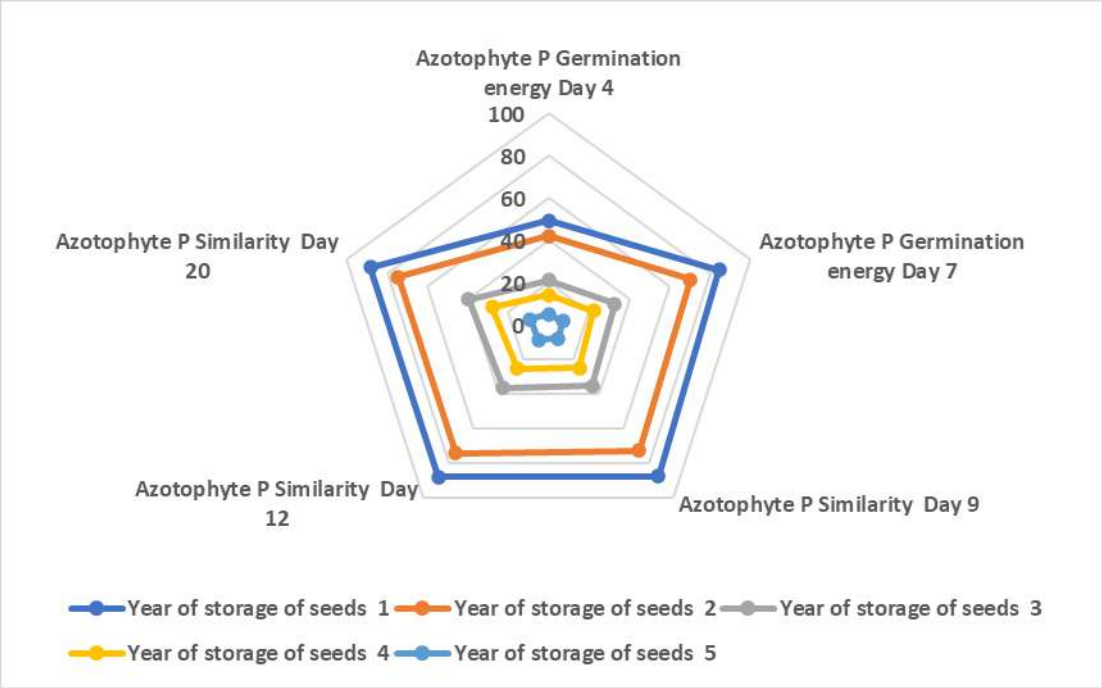

Fig. 2. Influence of Azotophyte P biological preparation on germination energy and laboratory germination of celery seeds Diamond (%)

Source: Own results based on research conducted. Zhytomyr Ivan Franko State University

According to a comprehensive study of the impact of nitrogen biotophyte biological preparation and years of seed storage on germination energy and germination of seeds, it was found that these indicators are affected by both the years of storage of culture and the regulatory properties of the drug Azotophyte P (fig. 2). Seed treatment of 2023 ears collection (D.6) Azotophyte P provided maximum rates of seed germination (49.25 %) and germination (88.32 %). It was noted that celery seeds of 2 years of storage (D.7) for biological treatment had laboratory germination (74 %) at the level of seeds of 1 year of collection without growth regulators (72 %) (D.1). A similar tendency is observed with the germination of seeds of the 3rd year of storage (D.8)-it was at the level of germination of seeds of the 2nd year of storage (D.2) and was 40%.

The positive effect of Azotophyte P on the germination of seeds is observed compared to the germination of seeds of different years of conservation. Thus, the seeds of the second year of

storage (D.7) lost its germination by only 16 %, compared to freshly harvested seeds, which is 24 % higher than in D.2. Seeds of 4 years of storage (D.9) have a similarity of 28 %, which is 24 % more than the same seeds sprouted on water (D.4). The germination of seeds of 5 years of storage for the action of Azotophyt P (D.10) was 9.18%, and no seed germination was observed in the experiment with the same seeds (D.5).

Pre-sowing treatment of *A. graveolens* Azotophyte P seeds can improve seed sowing, such as germination energy and germination, especially effectively used for seeds with long storage. At the same time, Azotophyt P activates the processes of germination of *A. graveolens* seed germination and shortens the germination rate.

Conclusions

1. Pre-sowing treatment of celery seeds of root *A. graveolens* by the drug Azotophyte P allows to improve the seed qualities, such as: germination energy by 36 % and germination by 16 %.

2. It is investigated that with each subsequent year of storage the germination energy is reduced by 25-93% and the germination of celery seeds by 41-94% (2-4 a year of storage).

3. The efficiency of the use of Azotophyte P to increase the sowing qualities of seeds with long shelf life. Thus, the percentage of deviation from the control of seed germination was in the range of 75-611% (2-4 years of storage), for the germination of seeds% of the deviation was 22-567% (2-4 years of storage). That is Azotophyte P significantly increases the friendship of the stairs.

4. At the same time, Azotophyt P reduces the sprouting period: determination of germination energy by 2 days, and germination by 8 days.

5. It is proved that for 5 years of storage of seeds in the control version showed absolute dissimilarity. However, in the treatment of seeds with Azotophyt P, the germination was 9.2 %. This indicates that the physiologically active substances Azotobacter Chroococcum, which are excreted outside, actively affect the hormonal balance and enzymatic activity of seeds, which provides an increase in the germination of celery seeds.

Bibliography

1. Barabash O. Yu., Shram O.D. Table root crops. Kyiv: Higher School, 2003. 85 p.

2. Volkon V.V., Nadkernichna O.V. Microbial preparations in agriculture: theory and practice. Kiev: Agrarian Science, 2012. 312 p.

3. Grytsayenko Z.M., Karpenko V.P. Methods of biological and agrochemical studies of plants and soils. Kyiv: CJSC "Nichlav", 2003. 320 p.

4. Kuzmenko OB Organic agriculture as a factor of European integration of Ukraine. Bulletin of the Poltava State Agrarian Academy. 2013. № 3. P. 151-154.

5. Kuts O.V., Dukhin E.O., Rudim Yu. A. The action of biofungicide of micohelp on sowing qualities of seeds of vegetable plants. *Vegetables and melons*. 2022. Iss. 71. P. 67-75.

6. Lologov O.N. Bioppreparations for tomatoes in the soil. *Rastenyevodeship*. 2002. № 13. P. 7-18.

7. DSTU 4138: 2002. A crop seeds. Quality determination methods. State standard. Kyiv: State Consumer Standard of Ukraine, 2003. 173 p.

8. Sitnikov D.M. Biotechnology Microorganizms of Azotfixators and Prospects for Passing Drugs on their Basics. *Biotechnology.* 2012. Volume 5, № 4. P. 34-45.

9. Sich Z.D., Sich I.M. Harmony of vegetable beauty and benefit. Kyiv: Aristen, 2005. 190 p.

10. Tactaev B., Podberezko I.M.The efficiency of use of tank mixes of fungicides with growth regulators and microfertilizers in the control of phytopathogens in potato agrocenoses. *Phytosanitary safety.* 2022. Iss. 68. P. 185-193.