



**STATE SCIENTIFIC CENTER OF RUSSIAN FEDERATION –
INSTITUTE OF BIO-MEDICAL PROBLEMS OF RUSSIAN SCIENTIFIC ACADEMY**

Estimate of microbiological state of a conveyor type plant growth facility during its using in hermetically sealed compartments

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Zyablova N.V., Krivobok N.M., Deshevaya E.A.***

The aim of the present work is:

- studying of the microorganism dynamic on the surfaces during growing of plants in inhabited and non- inhabited hermetic compartments;**
- studying of the affecting of the disinfecting preparation “Veltogran” the Phycomycetes and plant growth in dependence of the “Veltogran” concentration.**

PLANT GROWING IN THE CLOSE HERMETIC CHAMBERS

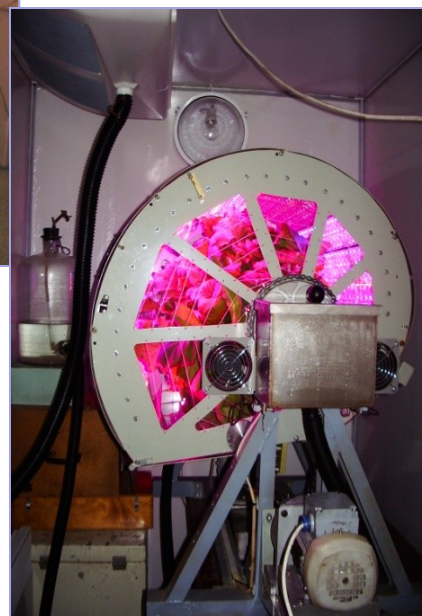
HERMETIC CHAMBER

0,07 m³

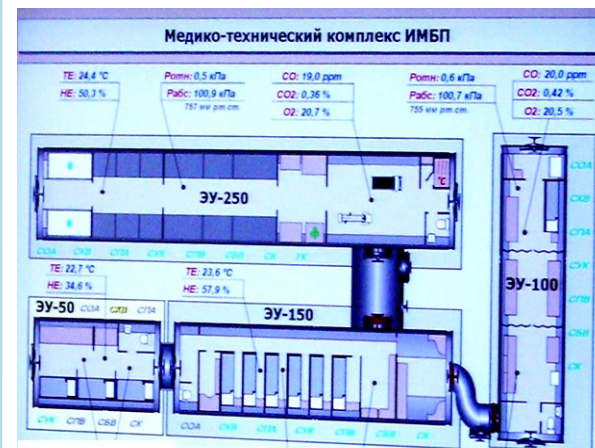


CLIMATIC CHAMBER "POLAIR"

3 m³

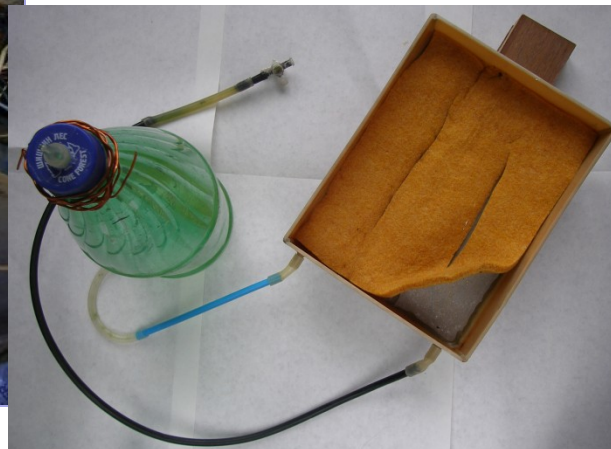


MEDICINE TECHNICAL COMPLEX OF IBMP, ЭУ-250, 250 m³



**Plant growing in
hermetic chamber,
0,07 m³**

- ❖ **Duration of the experiment:** 30 days
- ❖ **Experimental object:** Chinese cabbage *Brassica chinensis* L., cv. Vesnyanka, created in All-Russian Research Institute of Vegetable Breeding and Seed Production of Russian Academy of Agricultural Sciences
- ❖ **Method of growing:** hydroponics
- ❖ **Mineral nutrition:** 0,5 strength Chesnokov standard solution with microelements
- ❖ **Water potential in the root zone:** $(-1,0) \pm 0,05$ kPa
- ❖ **Air temperature:** 26 ± 3 °C
- ❖ **Air relative humidity:** 36 ± 5 %
- ❖ **Photosynthetic photon flux density, $\mu\text{M}/(\text{m}^2 \cdot \text{s})$:** 320 ± 30
- ❖ **Photoperiod:** 24 hrs



Root module equipment:
vessel of size 20×15×5 cm with porous metal-ceramic membrane and fibrous ion-exchange artificial soil connected the bottle (Marriott vessel)

Plant growing in climatic chamber “POLAIR”,
3 m³



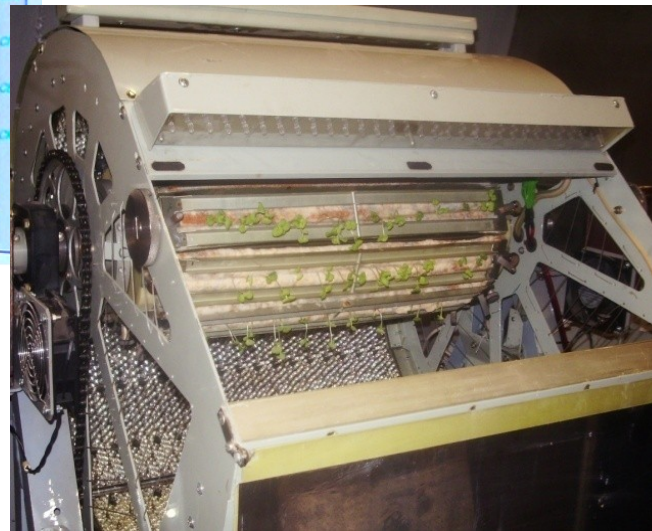
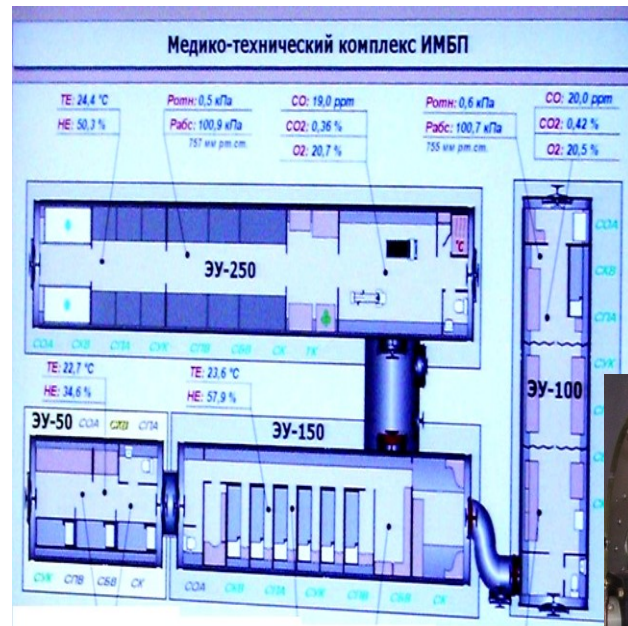
- ❖ **Duration of the experiment:** 45 days
- ❖ **Experimental object:** Chinese cabbage *Brassica chinensis* L., cv. Vesnyanka, created in All-Russian Research Institute of Vegetable Breeding and Seed Production of Russian Academy of Agricultural Sciences
- ❖ **Method of growing:** hydroponics
- ❖ **Mineral nutrition:** 0,5 strength Chesnokov standard solution with microelements
- ❖ **Water potential in the root zone:** $(-1,0) \pm 0,7$ kPa
- ❖ **Air temperature:** 25 ± 2 °C
- ❖ **Air relative humidity:** 55 ± 5 %
- ❖ **Photosynthetic photon flux density, $\mu\text{M}/(\text{m}^2 \text{s})$:** 200 ± 30
- ❖ **Photoperiod:** 24 hrs



Ground modal of the space conveyer plant growth facility “Phytocycle-LED”, arranged in the climatic chamber “POLAIR”

**Plant growing in
inhabited hermetic
chamber,
250 m³**

- ❖ **Duration of the experiment: 14 days**
- ❖ **Experimental object: Chinese cabbage *Brassica chinensis* L., cv. Vesnyanka, created in All-Russian Research Institute of Vegetable Breeding and Seed Production of Russian Academy of Agricultural Sciences**
- ❖ **Method of growing: hydroponics**
- ❖ **Mineral nutrition: 0,5 strength Chesnokov standard solution with microelements**
- ❖ **Water potential in the root zone: $(-1,0) \pm 0,7$ kPa**
- ❖ **Air temperature: 30 ± 3 °C**
- ❖ **Air relative humidity: 70 ± 15 %**
- ❖ **Photosynthetic photon flux density, $\mu M/(m^2 s)$: 50 ± 5**
- ❖ **Photoperiod: 24 hrs**



Ground modal of the space conveyer plant growth facility "Phytocycle-LED", arranged in the greenhouse compartment of the medicine technical complex of IBMP

TESTING OF THE MICROBIOLOGICAL STATUS

HERMETIC CHAMBER (0,07 m³)

- Microbiological analyses were carried out after plant harvesting. Root mat segments were washed by the distilled water with followed incubation of the samples in Petri dishes with 22 °C

CLIMATIC CHAMBER “POLAIR” (3 m³)

- Microbiological analyses of air samples were carried out during plant growing by the aspirate-sedimentable method with followed incubation of the samples in Petri dishes with nutrient medium;
- Microbiological analyses of surfaces of the chamber and plant growth facility were carried out during plant growing by the contact imprint method*

* The methodic has been created in the laboratory O-122, IBMP, under the leadership of the professor N.D. Novicova

MEDICINE TECHNICAL COMPLEX OF IBMP ЭУ-250 (250 m³)

- Microbiological analyses of the artificial soil surfaces were carried out at the end of the experiment with the help of a cotton wool tampon (the standard method used in the ISS)

EXPERIMENTAL ESTIMATE OF THE POSSIBILITY OF THE DISINFECTING PREPARATION “VELTOGRAN” USING FOR DEPRESSING PHYTOMYCETES GROWTH

PRELIMINARY EXPERIMENTS: GROWING THE PHYTOMYCETES SPECIES IN PETRI DISHES WITH PREPARATION-CONTAINING NUTRIENT MEDIUM



**Experimental object: Phytomyces cultures
*Penicillium sp., Mucor sp., Aspergillus sp.***

**Nutrient medium: artificial potato- glucose
nutrient medium**

**Concentration of the preparation in the
medium , % of water: 0,000 (control); 0,025;
0,050; 0,075; 0,100**

Temperature of incubation: 22,0 ± 0,5 °C

Duration f incubation: 5 days

The experiments were carried out at the plant phytopathology department, Moscow Timiryazev Agricultural Academy

EXPERIMENTAL ESTIMATE OF THE DISINFECTING PREPARATION

“VELTOGRAN” INFLUENCE ON THE GROWING PLANTS



The experiments were carried out at the plant phytopathology department, Moscow Timiryazev Agricultural Academy

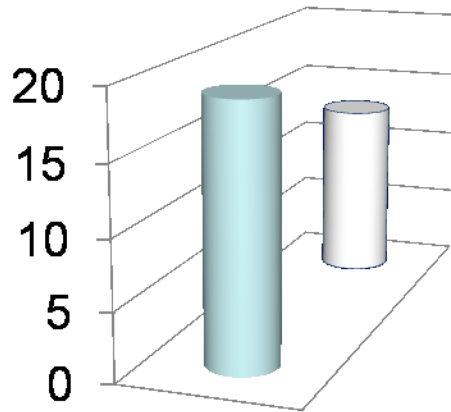
- **Experimental object:**
- - Chinese cabbage *Brassica chinensis L.*, cv. Vesnyanka, created in All-Russian Research Institute of Vegetable Breeding and Seed Production of Russian Academy of Agricultural Sciences;
- - Cucumber *Cucumis sativa L.*, F1 hybrid Estafeta, created in Moscow Timiryazev Agricultural Academy
- **Method of growing:** soil culture
- **Mineral nutrition:** peat-and-soil mixture (nitrogen – 140 mg/l, phosphorous – 140 mg/l, potassium – 230 mg/l, pH – 5,5 7,0)
- **Soil humidity:** 70% capillary moisture capacity
- **Air temperature:** 24 ± 1 °C
- **Air relative humidity:** : 65 ± 5 %
- **Concentration of the preparation in the soil, % of water:** 0,000 (control); 0,025; 0,050; 0,075; 0,100
- **Duration of the experiment:** 40 – 49 days

RESULTS OF PLANT GROWING IN HERMETIC CHAMBER, 0,07 m³

•Departures in plant growth and development have not been found

• Microbiological analysis of the root zone have not showed the presence of pathogenic microorganisms

Shoot fresh weight, g



•Only saprophyte species have been found in the root zone:

- *Mucor sp.*,
- *Penicillium sp.*,
- *Trichotecium sp.*,
- *Bacillus sp.*

Microbiological analysis of the root zone have not showed the differences between control and test crops in size of population and species composition

plants grown in the laboratory

plants grown in the hermetic chamber

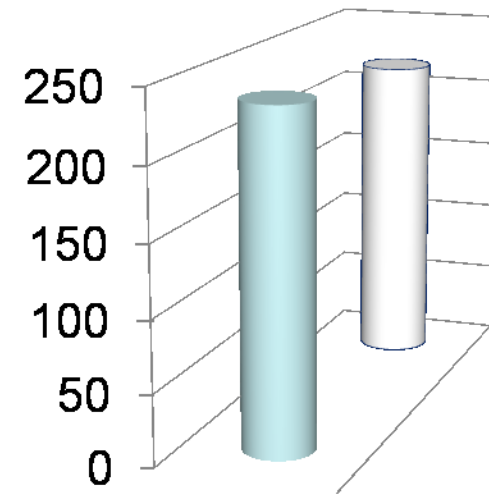
RESULTS OF PLANT GROWING IN CLIMATIC CHAMBER, 3 m³

Phycomycetes concentration in the air in the chamber (KOE/m³)

Date	Injection of air moisture condensate		Daily studying at 14 p.m.
	Before injection	After injection	
12.05	Not found .	1,0x10 ¹ Trichoderma sp	
15.05	Not found	Not found	
18.05			Not found
19.05			Not found
20.05			Not found
21.05			1,0x 10 ¹ Aspergillus sp.
22.05			1,0 x 10 ¹ Aspergillus sp.

•Departures in plant growth and development have not been found

Crop fresh weight, g/root module



plants grown in the laboratory

plants grown in the hermetic chamber

Concentration of colony forming units of fungi in the air does not exceed the norm value (SSP MORD) for hermetic compartment

RESULTS OF PLANT GROWING IN CLIMATIC CHAMBER, 3 m³

Phycomycetes concentration in the plant growth facility “Phytocycle-LED” and in the chamber (KOE/m³)

№	Tested surface	15 day	21 day	42 day
1	External surface of the crimped tube	Not found	Not found	5,0x10 ¹
2	Inner surface of the tank for the nutrient solution	Not found	Not found	Not found
3	Lateral surface of the plant growth facility	1,0x10 ²	Not found	5,0x10 ¹ Chaetomium sp.
4	The surface of the central water-conducting axis	Not found	Not found	Not found
5	The surface of the plastic cover of the root module	Not found	Not found	Not found
6	The surface of the artificial soil	Not found	Not found	Not found
7	The chamber wall	Not found	Not found	Not found
8	The leaf surface	Not found	Not found	Not found

During 42 days the concentration of colony forming units of fungi at the tested surfaces does not exceed the norm value (SSP MORD) for hermetic compartments at the ISS

RESULTS OF PLANT GROWING IN THE GREENHOUSE COMPARTMENT OF THE MEDICINE TECHNICAL COMPLEX OF IBMP, 250 m³

•Departures in plant growth and development have not been found

•Microbiological analysis of the root zone have not showed the presence of pathogenic microorganisms

THE SPECIES HAVE BEEN FOUND:

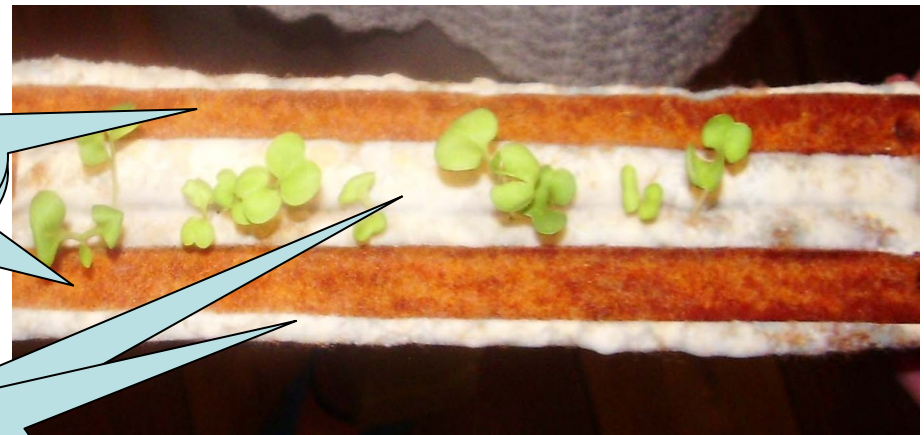
- ✓ *Trichothecium rozeum*,
- ✓ *Trichoderma sp.*,
- ✓ *Fuzarium sp.*,
- ✓ *Mucor sp.*,
- ✓ *Penicillium sp.*

Morphometric characteristics of the seedlings

Age of the seedlings, days after sowing	Height, cm	Fresh weight, g/plant
8	3,5±0,5	0,06±0,01
11	3,2±0,5	0,06±0,01
14	3,5±0,5	0,07±0,01

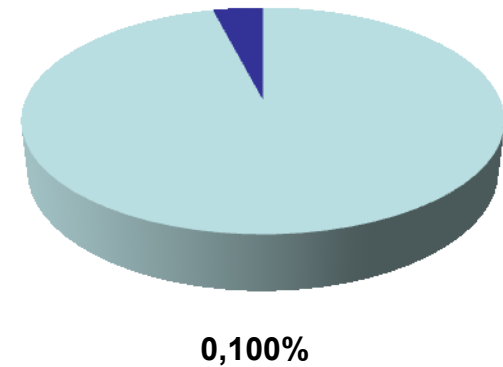
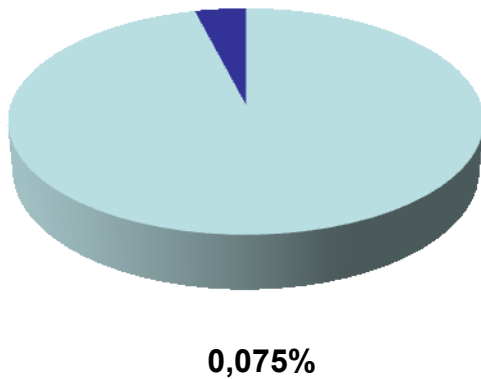
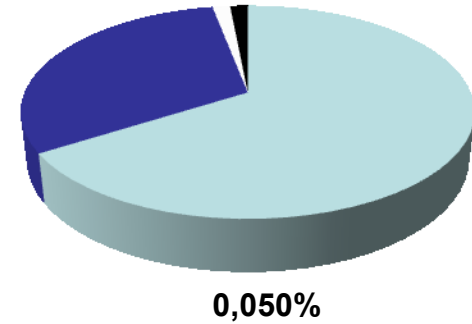
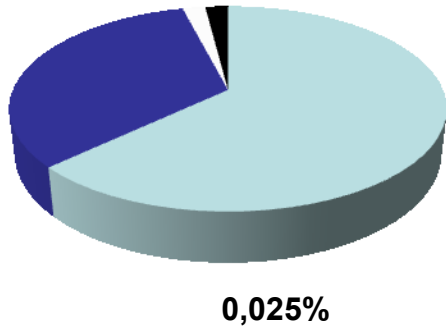
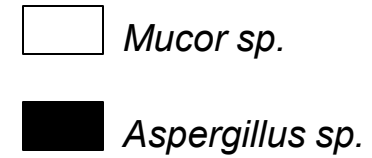
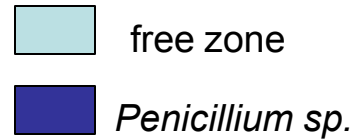
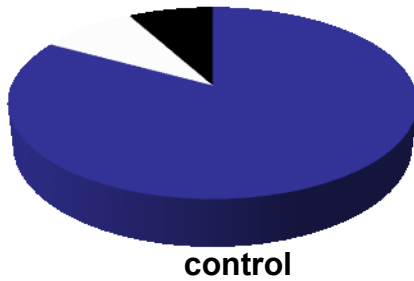
Clean surface under cover

Microorganisms at the open surface



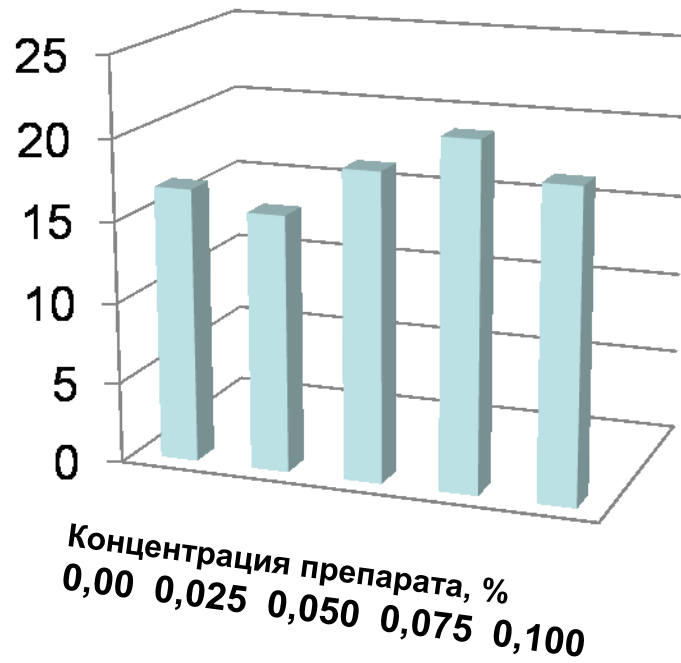
The artificial soil surface (without cover) after plant growing during 14 days

Specific area of nutrient medium in Petri dish under fungi colonies at the 5th day of the incubation in dependence on the concentration of the preparation "Veltogran"

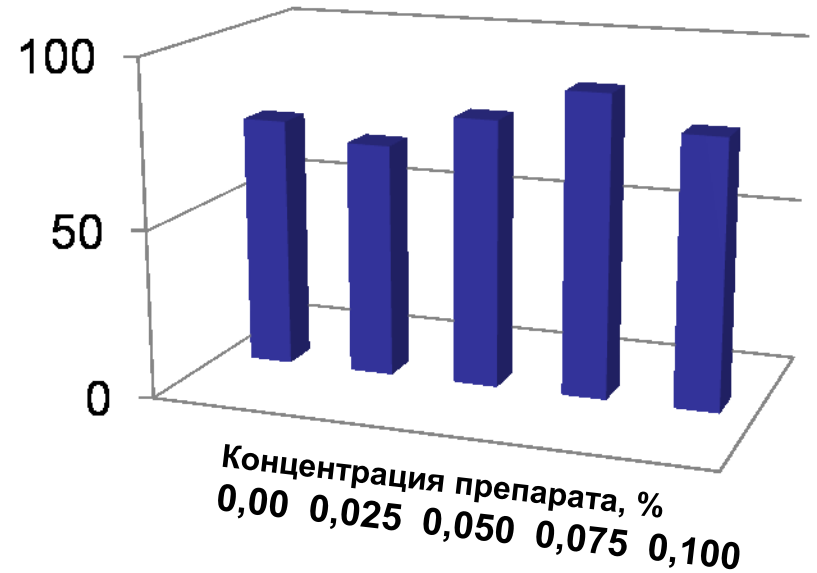


Characteristics of the seed germination and growth of the 41 day old Chinese cabbage plants in dependence on the concentration of the preparation "Veltogran"

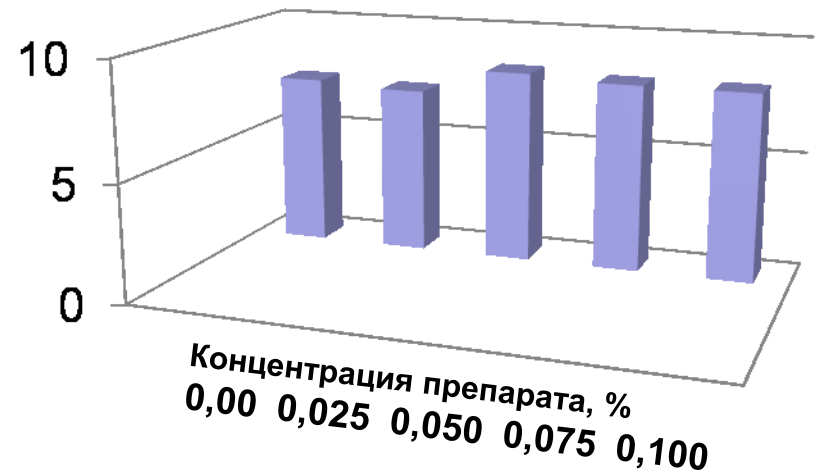
Plant fresh weight, g



Seed germination, %

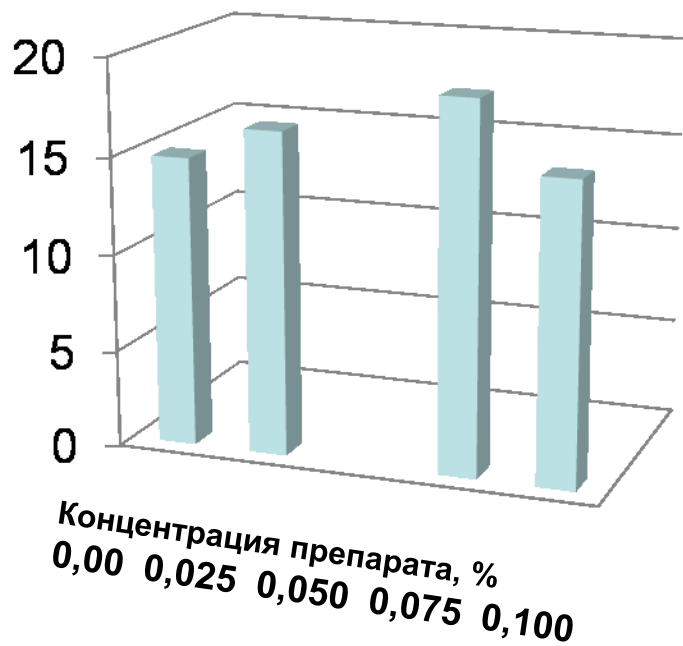


Ratio of the shoot and root fresh weight, g/g

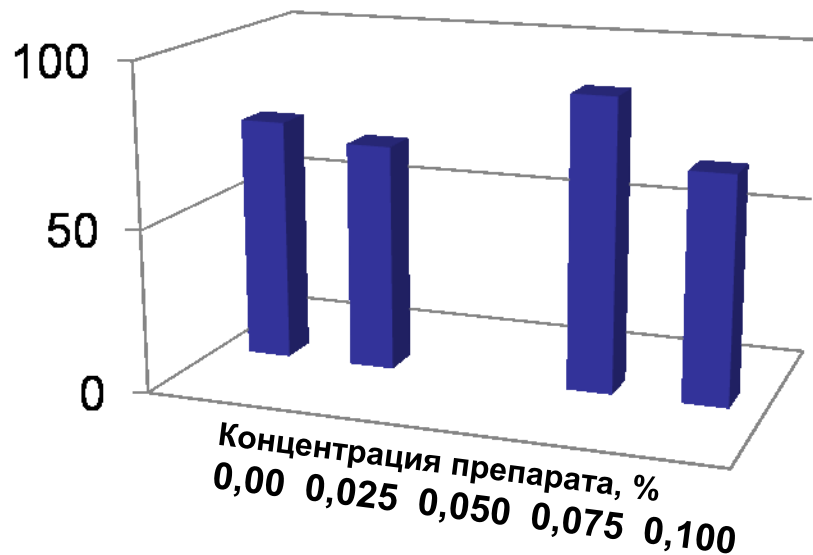


Characteristics of the seed germination and growth of the 49 day old cucumber plants in dependence on the concentration of the preparation "Veltogran"

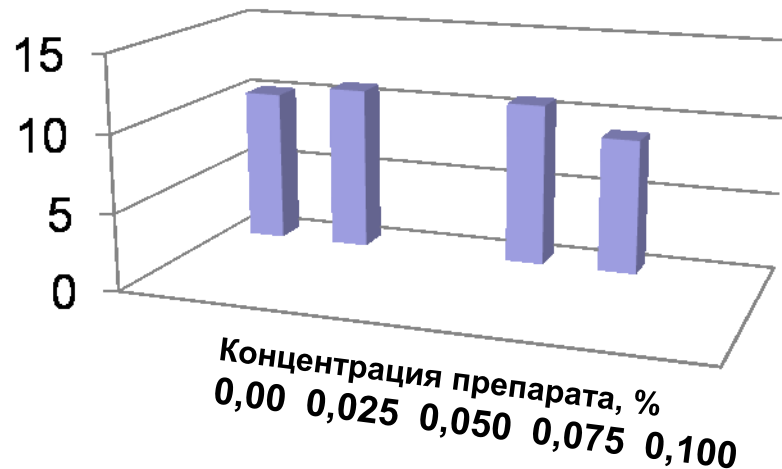
Plant fresh weight, g



Seed germination, %



Ratio of the shoot and root fresh weight, g/g



CONCLUSION

1. The thorough disinfection of a plant growth facility before its installation and elimination the direct contact of wetting artificial soil with air are necessary for ensuring satisfactory microbiological status of a hermetic compartment with prolonged plant growing in the hermetic chamber.
2. The tested preparation “Veltogran” can be used during plant growing in concentration not more 0,100% for depressing phytomyces growth without decreasing of plant productivity.