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INSTITUTE OF BIO-MEDICAL PROBLEM OF RUSSIAN SCIENTIFIC ACADEMY

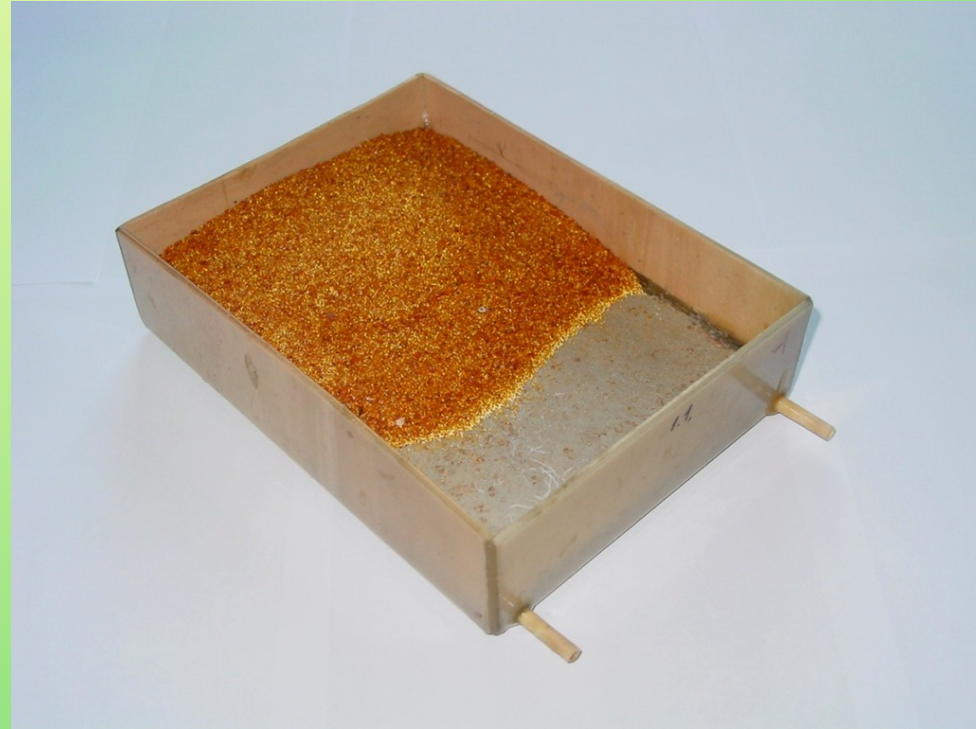
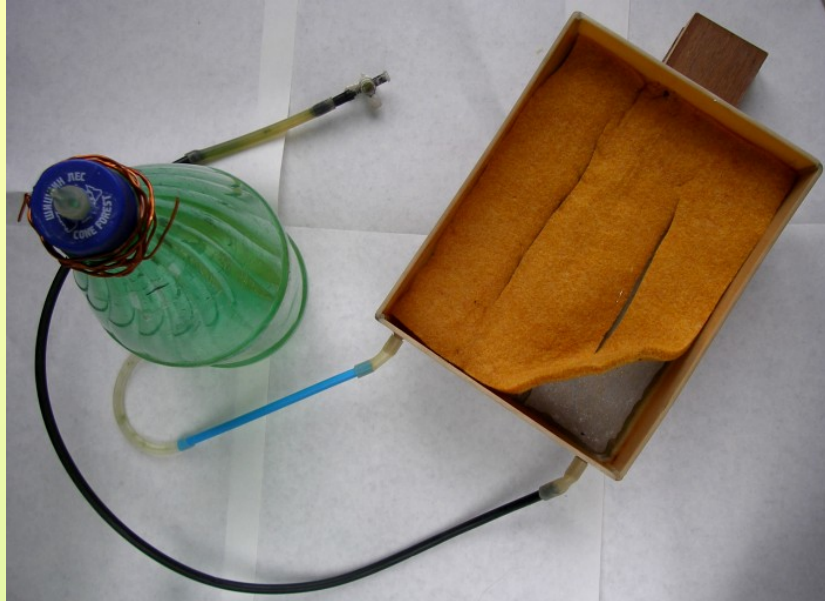


\* INSTITUTE OF PHYSIC AND ORGANIC CHEMISTRY OF BELORUSSIAN NATIONAL  
SCIENTIFIC ACADEMY

**POSSIBILITY OF USING OF ENRICHMENT COLUMN WITH  
CORRECTING ION-EXCHANGE SUBSTRATE FOR  
OPTIMIZATION OF PLANT MINERAL NUTRITION IN SPACE  
PLANT GROWTH FACILITY**

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***Root module with fibrous ion-exchange  
salt-saturated artificial soil BIONA-V3***



***Root module with crumbly ion-exchange salt-  
saturated artificial soil BIONA-312***

**The aim of the present work is**

***to create the technology of increasing of fibrous artificial soil specific productivity in reference to conditions of plant growing in space plant growth facility***

**Experimental object:**

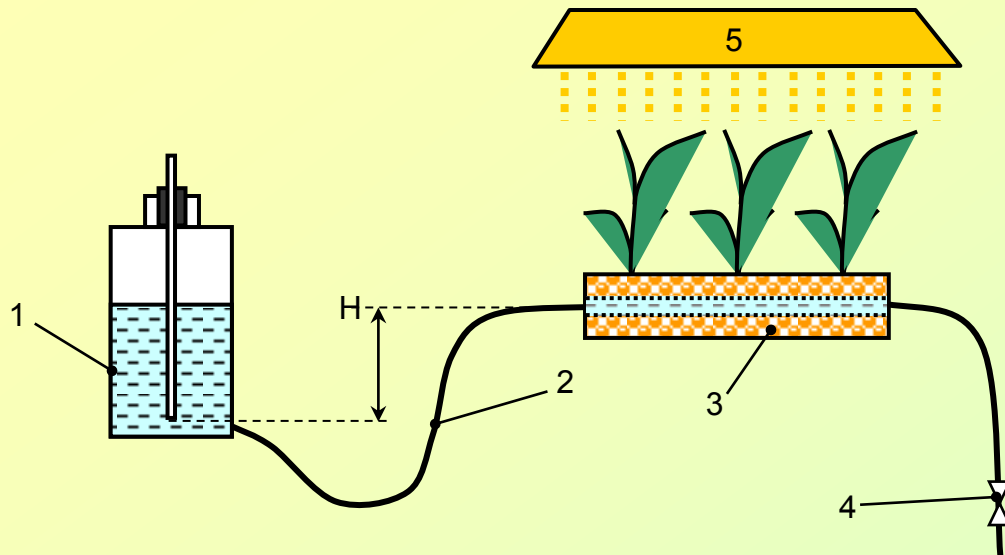
***Chinese cabbage Brassica chinensis L., cv. Vesnyanka, created in All-Russian Research Institute of Vegetable Breeding and Seed Production of Russian Academy of Agricultural Sciences***

**The tested systems of plant mineral nutrition:**

- growing of plants at the fibrous artificial soil BIONA-V3 coupled with slow acting fertilize "Osmocot" moisten distilled water;***
- growing of plants at the fibrous artificial soil BIONA-V3 moisten the salt solutions components of the standard Chesnokov solution;***
- growing of plants at the fibrous artificial soil BIONA-V3 moisten drinking water or the solution run out the enrichment column with correcting ion-exchange substrate (crumbly ion-exchange salt-saturated artificial soil )***

**In all of the experiments the control plants were grown at the fibrous artificial soil BIONA-V3 moisten the 0,5 strength standard Chesnokov solution with microelements**

## SCHEME OF THE TEST-BAD FOR STUDYING OF PLANT MINERAL NUTRITION IN ROOT MODULES EQUIPPED WITH POROUS MEMBRANES AT A STABILIZED WATER POTENTIAL



- 1 – Marriott vessel;
- 2 – a connected tube;
- 3 – a root module;
- 4 – a tap at the connected tube;
- 5 – a light unit;
- H – the water column height, determining of the water potential

## TYPES OF ROOT MODULES



Porous metal-ceramic tube with fibrous ion-exchange artificial soil



Vessel for plant growing equipped with porous metal-ceramic membrane

# GROWING OF PLANTS AT THE FIBROUS ARTIFICIAL SOIL BIONA-V3 COUPLED WITH SLOW ACTING FERTILIZER “OSMOCOT” ( $N_{14}P_{14}K_{14}$ )

## 1<sup>st</sup> experiment

### Variants of the experiment:

1. Fibrous artificial soil, 40 g/RM, and “Osmocot”, 5 g/RM
2. Fibrous artificial soil, 40 g/RM, and “Osmocot”, 10 g/RM
3. Fibrous artificial soil, 40 g/RM, and “Osmocot”, 15 g/RM
4. Fibrous artificial soil, 40 g/RM, and “Osmocot”, 20 g/RM

Light unit: luminescence white lamps

PPF level:  $250 \pm 15 \mu M/(m^2 \cdot s)$

Photoperiod: 12 hrs

Air temperature:  $26 \pm 3 ^\circ C$

Air relative humidity:  $30 \pm 5\%$

Number of plants in the root module: 5

Duration of the experiment: 30 days

## 2<sup>d</sup> experiment

### Variants of the experiment:

1. Fibrous artificial soil, 90 g/RM, and “Osmocot”, 20 g/RM
2. Fibrous artificial soil, 90 g/RM, and “Osmocot”, 30 g/RM

Light unit: high pressure sodium lamp

PPF level:  $350 \pm 40 \mu M/(m^2 \cdot s)$

Photoperiod: 12 hrs

Air temperature:  $26 \pm 3 ^\circ C$

Air relative humidity:  $30 \pm 5\%$

Number of plants in the root module: 5

Duration of the experiment: 30 days



# **GROWING OF PLANTS AT THE FIBROUS ARTIFICIAL SOIL BIONA-V3 COUPLED WITH MONO-SALT SOLUTIONS**

## **Variants of the experiment:**

- 1. Fibrous artificial soil, 40 g/RM, and KNO<sub>3</sub> solution**
- 2. Fibrous artificial soil, 40 g/RM, and Ca(NO<sub>3</sub>)<sub>2</sub> solution**
- 3. Fibrous artificial soil, 40 g/RM, and KH<sub>2</sub>PO<sub>4</sub> solution**
- 4. Fibrous artificial soil, 40 g/RM, and MgSO<sub>4</sub> solution**

**Salt concentration in the mono-salt solutions was equal their concentrations in the 0,5 strength standard Chesnokov solution**

**Light unit: luminescence white lamps**

**PPF level:  $250 \pm 15 \mu\text{M}/(\text{m}^2 \cdot \text{s})$**

**Photoperiod: 12 hrs**

**Air temperature:  $28 \pm 3 \text{ }^\circ\text{C}$**

**Air relative humidity:  $32 \pm 7\%$**

**Number of plants in the root module: 5**

**Duration of the experiment: 30 days**

## **GROWING OF PLANTS AT THE FIBROUS ARTIFICIAL SOIL BIONA-V3 MOISTEN DRINKING WATER OR THE SOLUTION RUN OUT THE ENRICHMENT COLUMN WITH CRUMBLY ION-EXCHANGE SALT-SATURATED ARTIFICIAL SOIL**

### **Variants of the experiment:**

1. Fibrous artificial soil, 30 g/plant, moisten drinking water
2. Fibrous artificial soil, 50 g/plant, moisten drinking water
3. Fibrous artificial soil, 6 g/plant, and the enrichment column with crumbly ion-exchange salt-saturated artificial soil, 200 g

Light unit: high pressure sodium lamp

PPF level:  $380 \pm 20 \mu\text{M}/(\text{m}^2 \cdot \text{s})$

Photoperiod: 24 hrs;

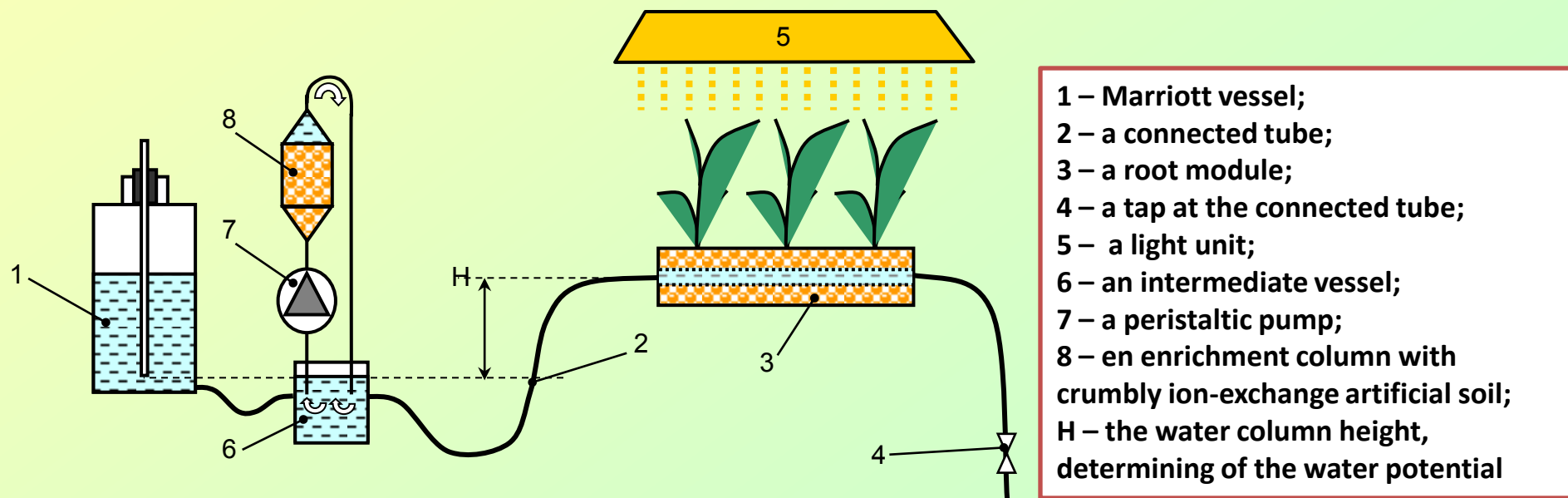
Air temperature:  $30 \pm 4^\circ\text{C}$

Air relative humidity:  $30 \pm 5\%$

Number of plants in the root module: 5

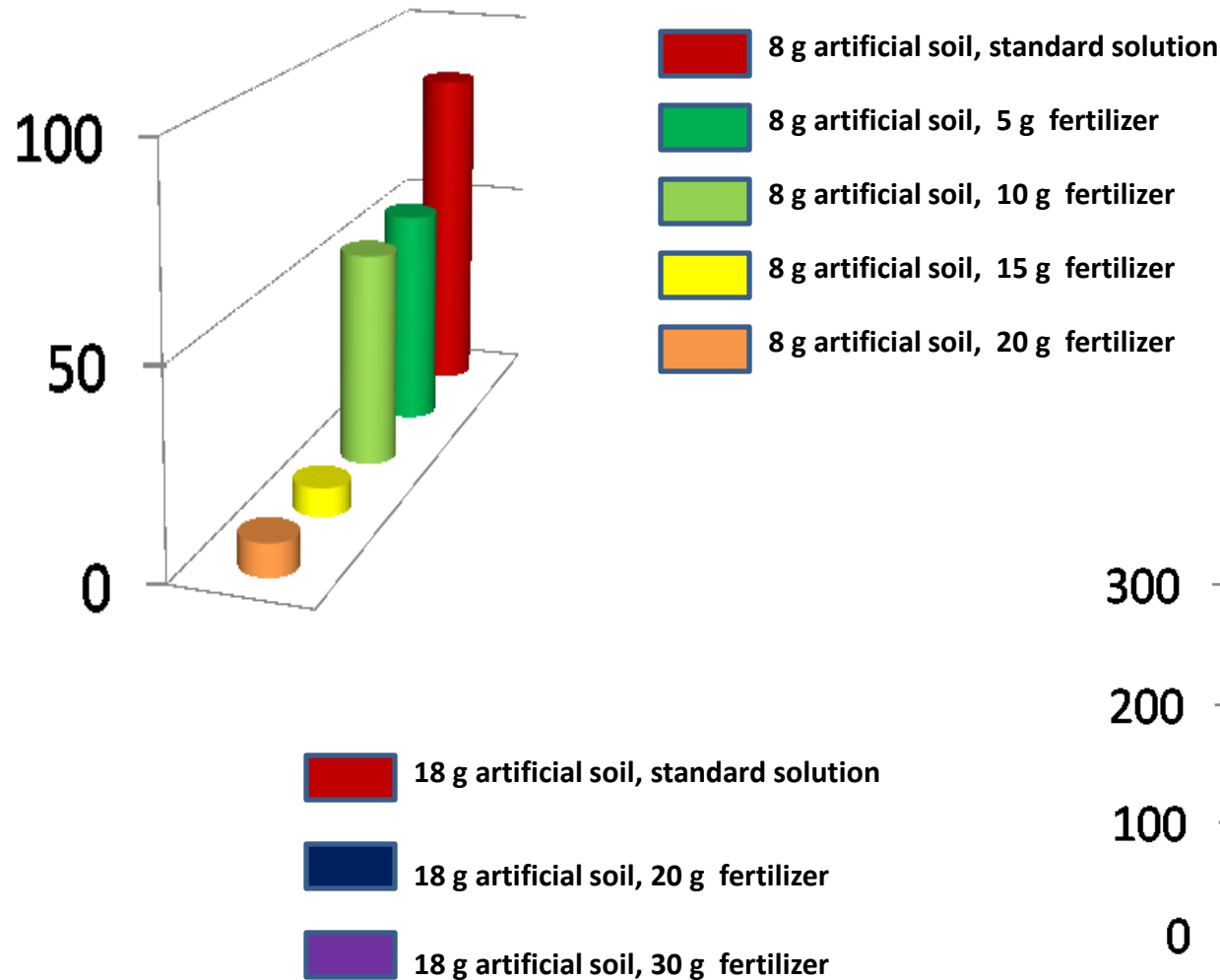
Duration of the experiment: 24

### **SCHEME OF THE TEST-BAD EQUIPPED WITH A ROOT MODULE WITH FIBROUS ARTIFICIAL SOIL AND AN ENRICHMENT COLUMN WITH CRUMBLY ION-EXCHANGE SALT-SATURATED ARTIFICIAL SOIL**

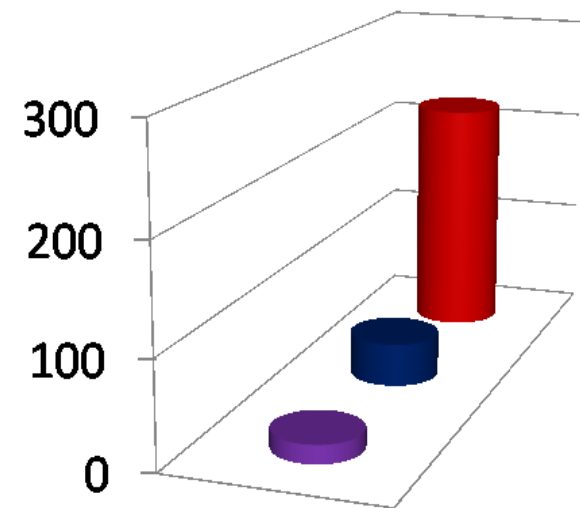


**SHOOT FRESH WEIGHT OF CHINESE CABBAGE PLANTS GROWN AT THE FIBROUS ARTIFICIAL SOIL BIONA-V3 COUPLED  
WITH SLOW ACTING FERTILIZER "OSMOCOT" ( $N_{14}P_{14}K_{14}$ ),  
G/ROOT MODULE**

PPF level:  $250 \mu M/(m^2 \cdot s)$

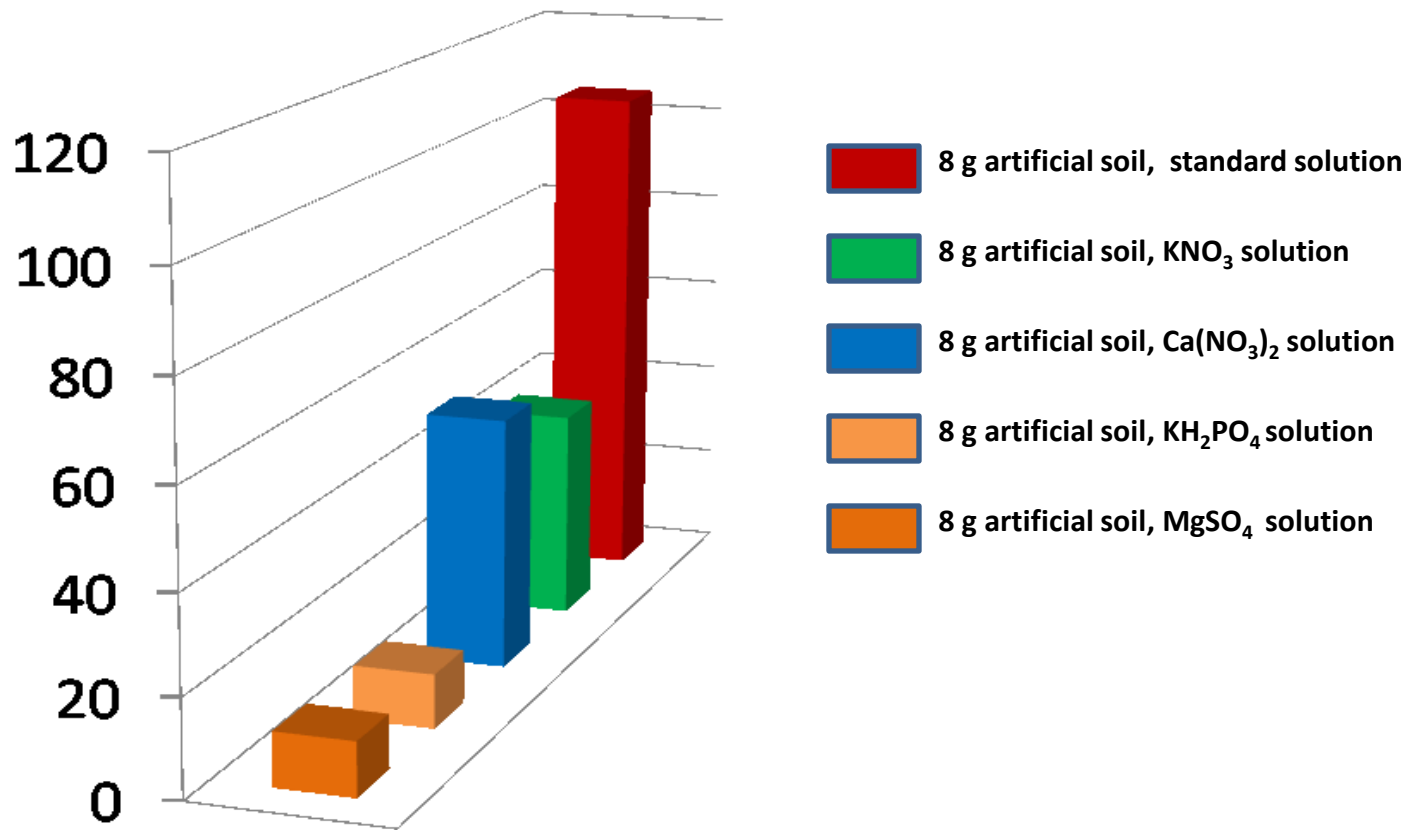


PPF level:  $350 \mu M/(m^2 \cdot s)$

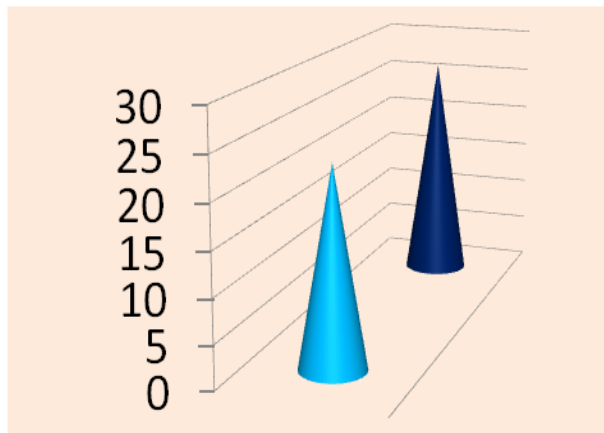




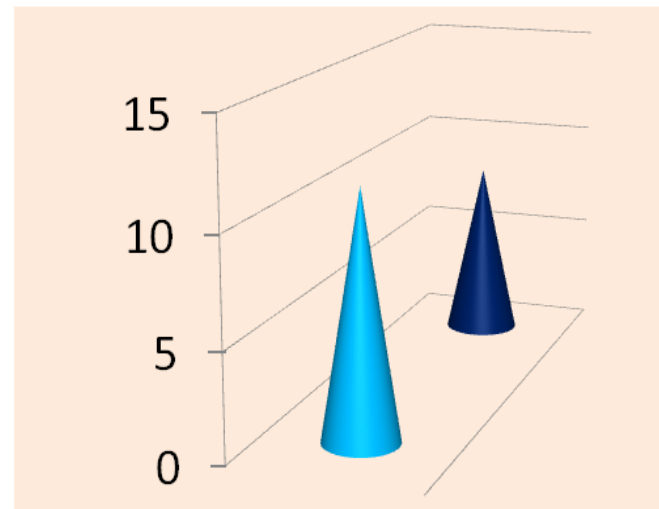
**SHOOT FRESH WEIGHT OF CHINESE CABBAGE PLANTS GROWN AT THE FIBROUS ARTIFICIAL SOIL BIONA-V3  
MOISTEN THE MONO-SALT SOLUTIONS,  
G/ROOT MODULE**



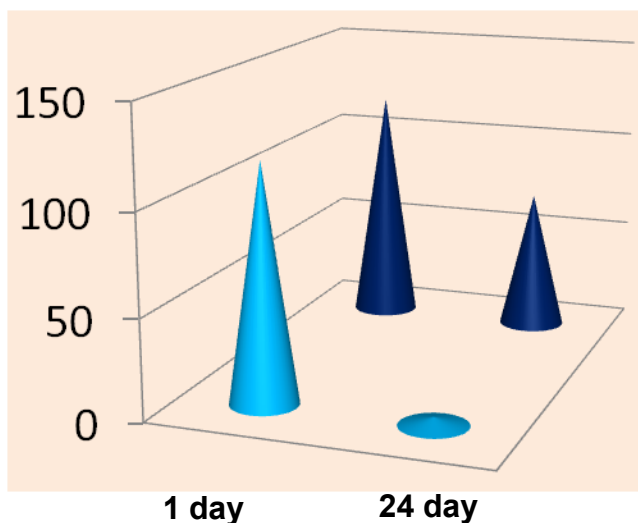
**SHOOT FRESH WEIGHT OF 24 DAY OLD CHINESE CABBAGE  
PLANTS GROWN AT THE FIBROUS ARTIFICIAL SOIL BIONA-V3  
MOISTEN DRINKING WATER,  
G/PLANT**



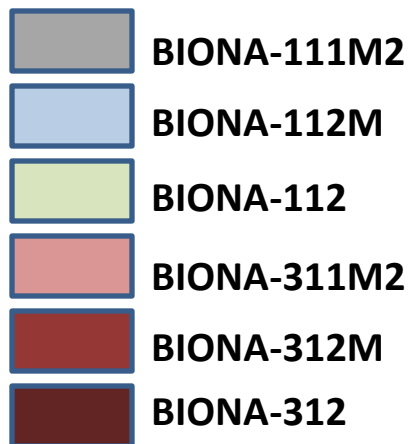
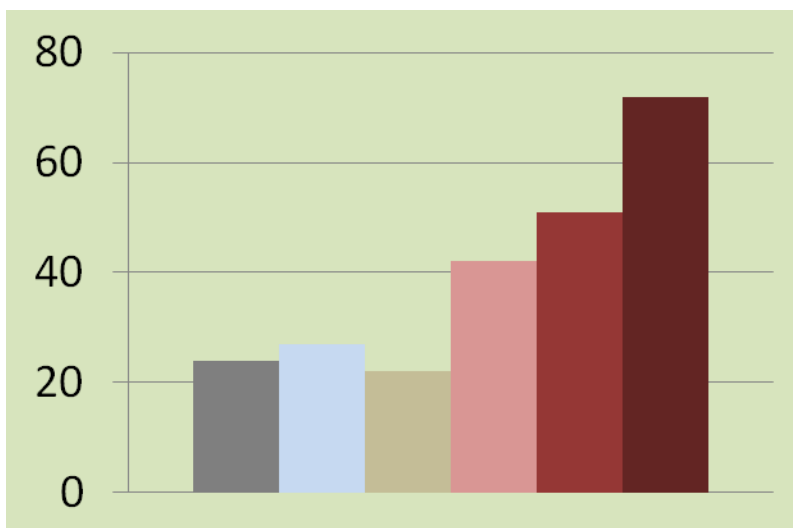
**DRY MATTER CONTENT IN SHOOTS OF 24 DAY OLD  
CHINESE CABBAGE  
PLANTS GROWN AT THE FIBROUS ARTIFICIAL SOIL  
BIONA-V3 MOISTEN DRINKING WATER,, %**



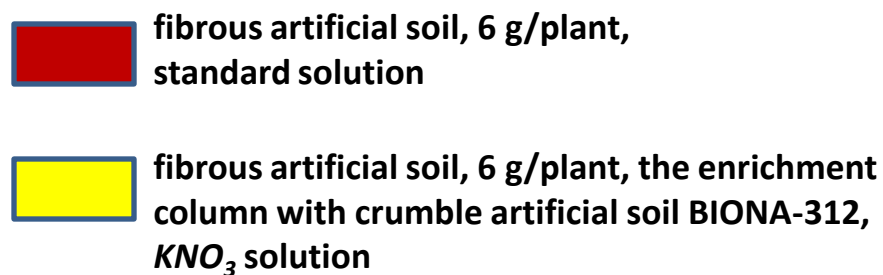
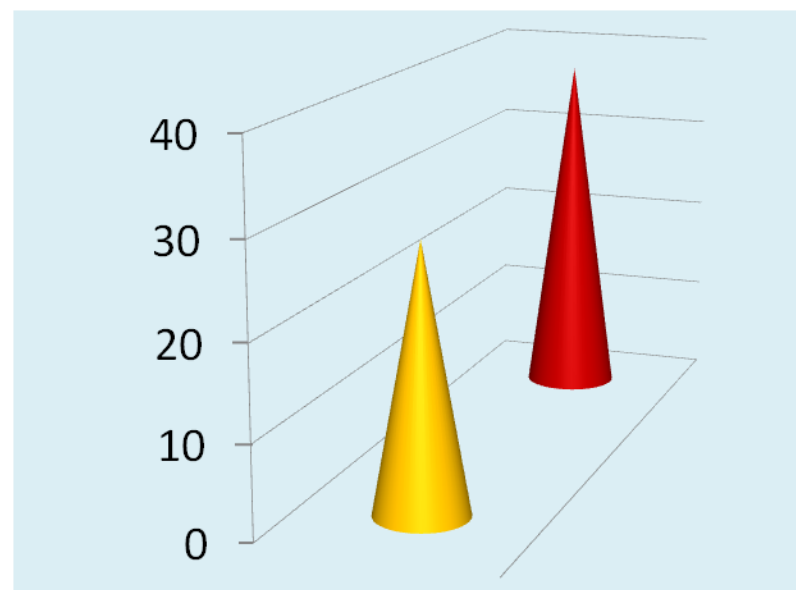
**DYNAMIC OF NITRATE CONTENT IN ROOT ZONE DURING  
GROWING OF PLANTS , MG/L**



**SPECIFIC PRODUCTIVITY OF DIFFERENT TYPES OF  
CRUMBLE ION-EXCHANGE SALT-SATURATED  
ARTIFICIAL SOIL MOISTEN DISTILL WATER,  
G SHOOT FRESH WEIGHT/ 100 G DRY ARTIFICIAL SOIL  
(30 DAY OLD CHINESE CABBAGE PLANTS)**



**RESULTS OF TESTING OF THE PLANT MINERAL NUTRITION SYSTEM EQUIPPED  
WITH THE ENRICHMENT COLUMN WITH CRUMBLE ION-EXCHANGE SALT-  
SATURATED ARTIFICIAL SOIL BIONA-312 MOISTEN  $KNO_3$  SOLUTION  
SHOOT FRESH WEIGHT OF 24 DAY OLD CHINESE CABBAGE PLANTS, G/PLANT**



## **CONCLUSION**

- 1. For Chinese cabbage plants growing at the fibrous artificial soil alone the specific dry weight of the artificial soil must be not less 50 g per a plant.**
- 2. For decreasing of the specific weight of the artificial soil it is necessary to use the additional nutrient sources**
- 3. Using of slow acting fertilizers as the additional nutrient sources is not desirable in high PPF level conditions and limited specific weight of the artificial soil**
- 4. Combination of fibrous and crumble ion-exchange artificial soils moisten solutions of nitric acid salts is an expedient method of plant nutrient supplying**