

clock. Thus, the noise level from the operation of some devices of Daikin and Mitsubishi companies does not exceed 22 dBA, which meets the most stringent environmental requirements.

So, today manufacturers offer many environmentally friendly types of construction products and equipment made from safe materials that are not dangerous during operation and allow you to maintain a favorable atmosphere. The designer's task is to find a reasonable compromise and choose products in this limitless sea of products that, as much as possible meeting the design plan, will be economically and environmentally justified.

## REGENERATION IN CULTURE OF REMONTANT RASPBERRY LEAVES EXPLANTS

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The effect of synthetic preparations with a cytokinin type of action of 6-benzylaminopurine (BAP) at a concentration of 0,3 mg / L and thidiazuron (TDZ) at a concentration of 0,1 mg / L on the induction of regeneration processes in the culture of leaf explants of remountant raspberries was assessed. It was shown that low concentrations of TDZ are more effective than BAP.

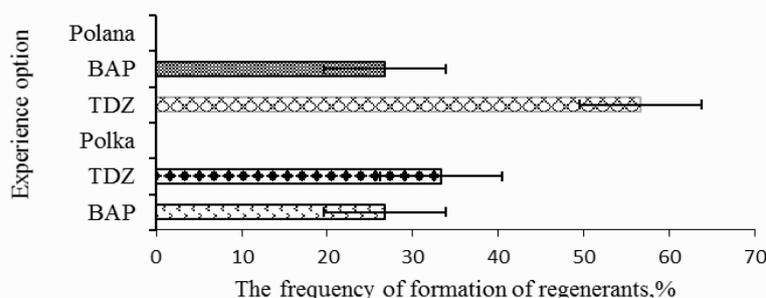
*Keywords:* remountant raspberry, BAP, TDZ, leaf explants.

In the Republic of Belarus, about 10 % of fruit and berry plantations are occupied under raspberries, and every year the area is growing. A special place among the varieties of *Rubus idaeus* L. is occupied by remountant forms unique berry plants that can fruit on annual shoots. With the increase in the planting area, raspberry remountant now acquires the status of an independent industrial culture. In this regard, there is a need to improve the existing technology for the reproduction of raspberries, taking into account the biological characteristics of varieties of the remountant type [1]. A promising direction is the development of approaches to initiate morphogenesis processes in in vitro culture of leaf explants of remountant forms of raspberries (*Rubus idaeus* L.), the physiological features of the development of which cause an extremely low ability to vegetative propagation, which in turn creates a lack of high-quality planting material. In vitro technology is today the main component of modern biotechnology in the production of virus-free healthy planting stock.

The purpose of the study was to evaluate the effect of two synthetic drugs with a cytokinin type of action on the induction of regeneration processes in the culture of leaf explants of remountant raspberries.

As explants, the leaves of a complex leaf of two varieties from the in vitro collection of test plants of the Department of Zoology and Genetics of BrSU named after A.S. Pushkin. To accelerate callus-forming processes on the lower surface, several incisions with a scalpel are required. Expansions prepared in this way were obtained on the basis of a nutrient agar medium prepared as prescribed by Mussige and Skoog, as well as with additional phytohormones: 6-benzylaminopurine (BAP) at a concentration of 0,3 mg / l, thidiazuron (TDZ) at a concentration of 0,1 mg / l The cultivation of leaf explants continued for 4 weeks in a chamber for plant growth at a temperature of 19 °C and periodic illumination (16 hours a day and 8 hours a night) with an intensity of 3000 lux.

The results obtained using leaf explants of raspberry varieties of the Polish selection Polyana and Polka confirmed the idea of the high efficiency of low concentrations of TDZ compared with BAP (Fig. 1).



*Fig. 1.* – The frequency of regeneration in the culture of leaf explants of two varieties of remountant raspberries

Thus, the frequency of formation of regenerated plants (in%), calculated in relation to the number of explant passage, under the influence of TDZ at a concentration of 0,1 mg / l in the Polyana variety was 56,67±9,05, in the Polka variety – 33,33±12,17, which is higher compared to BAP at a concentration of

0,3 mg / L by 30 and 6,67 %, respectively. The observed differences in stimulating regenerative ability turned out to be reliable only in the Polyana cultivar; perhaps this is due to the genotype.

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### INFLUENCE OF COPPER-CONTAINING FERTILIZERS ON CROP GROWTH AND DEVELOPMENT IN THE EARLY STAGES OF GROWTH

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The article is devoted to the problem of efficient use of various forms of mineral fertilizers at the cultivation of crops. The results of the study of the influence of various forms of mineral fertilizers on the growth and development of lupine, peas and wheat are given. These studies allow using copper-containing fertilizers most effectively.

*Keywords:* fertilizers in the form of salt, chelate fertilizers, fertilizers on the basis of nanoparticles, growth and development of plants, application rate, efficiency.

We investigated the influence of various forms of copper fertilizers (salt, chelate and nanoparticles-based fertilizers) on the growth and development of lupine, peas and wheat in laboratory conditions.

In addition to the quantitative index, which depends on the type of soil, the form of copper-containing compounds determining the degree of accessibility of this element to plants is also very important. Microelements in the form of inorganic salts (pyrite cinders, copper sulfate (blue vitriol)), microfertilizer in chelate form and fertilizers based on nanoparticles of microelements are widely used in the agricultural practice of Belarus.

In the experiment, the efficiency of three types of microfertilizers in two consumption rates (0,25 mg and 1 mg copper per 1,0 L of Knop solution) was studied, when they were added to the nutrient solution:

1.  $\text{Cu SO}_4 * 5\text{H}_2\text{O}$  – copper cuprose (salt);
2. Copper chelate (chelate fertilizer);
3. Nanoplant Cu (fertilizer based on copper nanoparticles).

Analysis of the experiment data showed:

Lupine, peas and wheat react differently to copper fertilizer application. But all the plants reacted negatively to the use of  $\text{CuSO}_4 * 5\text{H}_2\text{O}$  at a dose of 1 mg/L. Thus, when  $\text{CuSO}_4 * 5\text{H}_2\text{O}$  (0,25 mg/L) was added to the nutrient solution, the length of lupine roots increased by 32,1 %, their raw weight increased by 13,1 %, but the germination decreased by 2,8 % on length and by 7,2 % on weight.

The better development of the aboveground part of the plant is facilitated by the introduction of Copper chelate (0,25 mg/L), and at the same time the plant is formed with a denser green mass (raw mass of seedlings – 8,2 %). The root system of the plant when using this fertilizer in the specified dose is also developed better, in comparison with the control (long root system – 2,2 %, raw mass of roots – 9,86 %). Therefore, as the lupine is grown up on green mass, it is the most appropriated to use a copper chelate fertilizer at a dose of 0,25 mg/L.

According to the results of our research,  $\text{CuSO}_4 * 5\text{H}_2\text{O}$  fertilizer cannot be used to grow peas. Two doses of consumption proved to be detrimental to the development of peas. Copper chelate showed slightly better results, but only a lower rate (0,25 mg/L) of application can be isolated to increase the crude and dry weight of the seedlings by 6,4 and 15,0 %.

The best result was the use of Nanoplant Cu at a dose of 0,25 mg/L (the weight of roots and seedlings increased by more than 20 %).

Wheat is one of the most important cereals. We have found that when growing this culture, use of  $\text{CuSO}_4 * 5\text{H}_2\text{O}$  and Copper chelate fertilizers in the doses we study leads to a slowdown in the development of the terrestrial and underground part of the plant. Addition of Cu Nanoplant to nutrient solution in two consumption rates promotes plant growth by 9,9–22,0 % and accumulation of both raw and dry wheat mass by 36,5–45,5 %.

The data obtained by us have practical importance, as copper-containing fertilizers are widely used in agriculture and their use must be effective and rational.