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Cultivation of sweet cherry (*Cerasus avium* (L.) Moench) seedlings with using of phosphate-mobilizing microorganisms

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Abstract. In a field experiment the influence of phosphate-mobilizing bacteria (PMB) on growth, development and output of one-year-old grafted sweet cherry seedlings have been studied. Two various phosphate-mobilizing bacteria PMB 6, PMB 7 and their mix were applied for increase of nursery efficiency. We established that the application of PMB increased seedlings thriving, stimulated growth processes, improved frost and winter resistance and vitality of sweet cherry buds, budded on a *Cerasus mahaleb.* PMB 7 and mix PMB 6 + PMB 7 increased an output of seedlings, reduced the cost price of a planting material and increased the level of profitability. The greatest economic benefit was received by using of the mix PMB 6 + PMB 7.

Key words: *Cerasus mahaleb, Cerasus avium,* fruit nursery, seedlings, phosphate-mobilizing bacteria

INTRODUCTION

Fruit plant nursery management is one of the most labour-consuming and not enough mechanized fields of agricultural area. Therefore, the development and introduction of new progressive technologies of cultivation of fruit seedlings providing increase of quality and output of production from unit of area. The application of microbial preparations for improvement of plant nutrition is rather urgent in conditions of high cost of mineral fertilizers and environment pollution by the residues of pesticides. Phosphate-mobilizing bacteria (PMB) are capable to transform hard-soluble phosphates of soil in form accessible to cultural plants, stimulate auxins synthesis, improve growth of roots, increase operating ratio of mineral fertilizers etc (Djatlova, 2001; Melnichuk et al., 2007). However, they are still infrequently used in gardening and nurseries.

Therefore, the purpose of our research was to study an opportunities of PMB application to cultivation of one-year-old sweet cherry seedlings to increase nursery efficiency.

MATERIALS AND METHODS

Objects of the research were plants of mahaleb cherry (*Cerasus mahaleb* (L.) Mill), which were rootstocks for the sweet cherry (*Cerasus avium* (L.) Moench.)

variety ‘Krupnoplodnaya’; the phosphate-mobilizing microorganisms PMB 6 and PMB 7, and also their mix PMB 6 + PMB 7, allocated on soddy-podzolic soil in Belarus. The fruit seedlings were planted on southern chernozem soil.

Bacterial suspensions of PMB were prepared on liquid meat-must-agar (Segi, 1983). Root system of a mahaleb cherry was treated by the bacterial suspension PMB 6 (9.8×10^{10} CFU ml^{-1}) and PMB 7 (50.0×10^{10} CFU ml^{-1}), and also by their mix in the ratio 1:1 before planting. All suspensions were previously mixed with water in the ratio 1:100. Also we added suspensions of PMB at the rate of 200 ml under each plant to the depth of 10 cm after inoculation of a mahaleb cherry seedlings and hibernation of inoculated buds of sweet cherry.

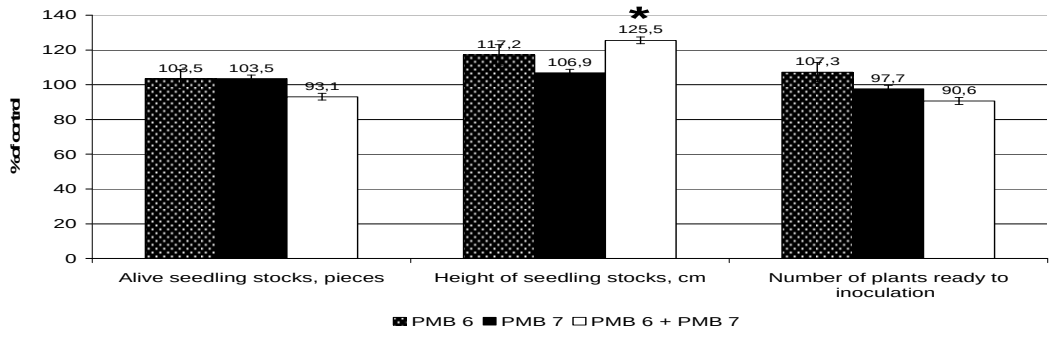
Efficiency of application of PMB was studied in a field experiment in fruit nursery of Steppe department of the Nikitsky Botanical Garden (Simferopol region of Crimea) during 2007–2008 years. Variants of the experiment were:

1. Control (without application of microorganisms)
2. PMB 6
3. PMB 7
4. Mix PMB 6 + PMB 7

The planting distance in nursery was 0.7 x 0.15 m. Farming practices were standard for fruit nurseries on southern chernozem (Tatarinov & Zuev, 1984). No fertilizers were applied in soil at planting. Side dressing of seedlings was carried out in the second field of nursery by ammonium nitrate by N_{70}. The experiment was carried out in four replications. Experiments were conducted by methods wormed out by Andrienko & Gulko (1990). The economic parameters were calculated by Smolinskiy et al. (1980).

RESULTS AND DISCUSSION

Some stages of seedlings development and growth were important during their cultivation. At each stage the influence of the chosen microorganisms was various. Percentage of alive seedling rootstock was high in control variant, it increased in mix of PMB 6 and PMB 7 by 3.5%, however, the mix of PMB 6 and PMB 7 reduced (Fig. 1).

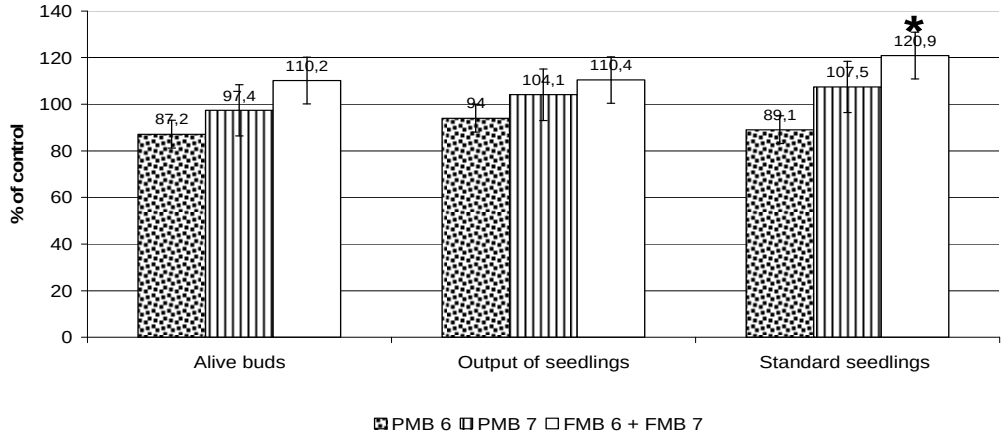


*ANOVA indicated significant difference between the control and this treatment ($p < 0,05$)

Figure 1. Survival, height and number of plants ready for inoculation (% of the control) in 2007.

An important parameter of seedlings growth is its height. PMB 6 and mix of PMB 6 and PMB 7 stimulated growth of seedlings the most (Fig. 1). An indirect parameter of plants status is the number of plants ready for inoculation. PMB 6 has shown the best influence on this parameter increasing the number of plants ready for inoculation up to 7.3%. However, influence of the mix of PMB 6 and PMB 7 showed the best results in the second year of cultivation.

The estimation of inoculated buds of sweet cherry, which were alive after hibernation, showed that the mix of PMB 6 and PMB 7 increased their quantity in comparison with the control by 10.2%. Inoculation of a root system by microorganisms increased plant durability to adverse conditions of winter (Fig. 2).



*see legend of Fig. 1

Figure 2. Influence of microorganisms on quantity of alive inoculated buds and output of sweet cherry seedlings var. 'Krupnoplodnaya' (% of the control) in 2008.

The main parameter of fruit nursery efficiency is total amount of seedlings and share of standard seedlings. Total output of seedlings was 60.3% from number of planted seedling rootstocks. PMB 7 and mix PMB 6 + PMB 7 increased their number by 4.1 and 7.5%, respectively. The share of standard seedlings was also increased by use of these two microorganisms. The mix of PMB 6 and PMB 7 increased the number by 20.9% that was statistically significant in comparison with the control (Fig. 2).

As seedlings output was raised only by use of PMB 7 and mix PMB 6 + PMB 7, the economic parameters of cultivation of seedlings were calculated only for these variants. The output of standard seedlings exceeded control by 2,9–8,1 thousand pieces per one hectare (Table 1). The cost price of production at application of PMB 7 is close to the control one. Use of the mix PMB 6 and PMB 7 considerably lowered as seedlings output increased. Thus the cost price of one seedling decreases up to 0.62 USD.

The profit from one hectare in the control was 17.6 thousand USD that is profitable. The application of PMB 7 increased it by 3.3 thousand USD per one hectare. Especially significant additional profit 10.7 thousand USD per one hectare was received at application of the mix of PMB 6 and PMB 7. The profit was much higher as was received from inoculation of winter wheat and rape by phosphate-mobilizing bacteria preparation 'Phosphoenterin' (Chaykovskaya, 2004; Melnichuk et al., 2007).

Thus, level of profitability increased up to 38.3% in comparison with the control. Hence the maximal economic benefit was received from introduction of new technology of mahaleb cherry root system inoculation by the mix of PMB 6 and PMB 7.

Table 1. Economic efficiency of cultivation of sweet cherry seedlings of the variety 'Krupnoplodnaya' at inoculation of mahaleb cherry by phosphate-mobilizing bacteria, nursery NBG, 2008 (in the prices on February, 2010).

Variant	Output of standard seedlings thousand pieces per ha	Cost price of production, thousand USD per ha	Cost price of one seedling, USD	Profit from one ha, thousand USD	Level of profitabi -lity, %	Economic benefit, thousand USD per ha
Control	38.7	29.9	0.77	17.6	58.9	
PMB 7	41.6	30.1	0.72	20.9	69.4	3.3
PMB 6 + PMB 7	46.8	29.1	0.62	28.3	97.2	10.7

CONCLUSIONS

1. Treatment of mahaleb cherry root system by phosphate-mobilizing bacteria increased thriving of seedlings, stimulated growth processes, improved frost and winter resistance and number of living buds of sweet cherry. 2. The pre-planting treatment of seedlings by microorganisms PMB 7 and mix of PMB 6 and PMB 7 increased an output of sweet cherry seedlings, reduced the cost price of one seedling and increased the level of cultivation profitability of sweet cherry budded seedlings.
3. The greatest economic benefit was received at cultivation of sweet cherry seedlings with application of the mix of PMB 6 and PMB 7 and has made the economic benefit of 10,7 thousand USD per one hectare.

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