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TESTAREA CAPACITĂȚII DE ÎNMULȚIRE PRIN BUTAȘI SEMILEMNIFICAȚI A UNOR SELECȚII PORTALTOI DE PĂR

TESTING THE PROPAGATION CAPACITY THROUGH SOFTWOOD CUTTINGS OF SOME PEAR ROOTSTOCK SELECTIONS

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Abstract

For pear rootstocks, a key objective in breeding programs is achieving a high capacity for vegetative propagation. In this study, the vegetative propagation potential of three pear rootstock selections 'P10', 'P11', 'P63' was evaluated using softwood cuttings, and compared to the control rootstock 'Farold 40'. The experiment was conducted over a period of three years, 2022-2024, both with and without the application of a rooting biostimulator (Radistim V2) in powder form, using three types of substrates: sand, perlite, and a peat-perlite mix. Among all, the selection 'P63' showed the highest rooting percentage (52.52%) in the sand substrate when the rooting biostimulator was applied, which was significantly higher than that of the control rootstock (20.46%).

Cuvinte cheie: portaltoi păr, multiplicare, butășire, biostimulator de înrădăcinare.
Key words: pear rootstock, propagation, cutting, rooting biostimulator.

1. Introduction

Both genotypes from the genus *Pyrus* and from the species *Cydonia oblonga* are used as rootstocks for pear. Although quince induces lower vigor in grafted varieties and is easier to propagate, its compatibility with only a few pear varieties, as well as its low resistance to frost, calcareous soils, and diseases makes rootstocks from the genus *Pyrus* dominant. On a large scale, generative rootstocks are still commonly used. Compared to generative propagation, vegetative propagation offers the advantage that the resulting rootstocks are genetically identical to the mother plant, ensuring the same graft compatibility similar adaptability to environmental conditions, and uniformity of the resulting trees, production, and fruit quality. Care must be taken, however, to maintain high soil moisture and fertility when using vegetative rootstocks. The main factors influencing root formation include the type of cutting, genotype, leaf area (Shandya el al., 2022), and the dynamic regulation of phytohormones (Druege et al. 2016, Bustillo-Avendano et al., 2018). Rootstock breeding pursues multiple objectives, including resistance to specific pathogens and a good capacity for vegetative propagation. Since *in vitro* propagation is relatively costly, more emphasis is placed on propagation through cuttings or layering. In perennial plants, cuttings are taken both during the growing season, when the shoots are semi-lignified, and during dormancy, when the shoots used for cuttings are lignified.

Pear is a species that does not respond as easily to vegetative propagation as quince. The vegetative propagation of rootstocks can be carried out both through micropropagation (*in vitro*) and through macropropagation (layering, softwood cuttings, and hardwood cuttings).

According to Proebsting et al. (2019), pear rootstocks respond best to propagation through micropropagation. Propagation by layering of rootstocks in the genus *Pyrus* does not respond as well as rootstocks in the genus *Malus*, and poor results are also obtained through hardwood cuttings (Loreti and Morini, 1977). For softwood cuttings, careful attention to cutting conditions is required. Necas and Kosina (2008), in a study on propagation using hardwood cuttings treated with 1% Racine (2.5% α-naphthaleneacetic acid) and 0.5% Rhizopon AA (2.5% indole-3-butyric acid), obtained good results in callusing 'Pyrodwarf®' (94%) and 'Pyroplus®' (69%). In 2016, Necas et al., in a study on dry cuttings with three biostimulators at two different times in winter, with and without basal heating, achieved the best results in March in a perlite substrate when using the biostimulator Rhizopon AA with basal heating at 21°C. Softwood cuttings of 20 cm, leafless, grown in a controlled-atmosphere room (26°C, 100% humidity, and a 14-hour photoperiod) in a vermiculite-sand subtrate, and treated with 6000 mg/l IBA, had a rooting rate of 92.9% to the Taiwan Nashi-C rootstock (*Pyrus calleryana*) (Barbosa et al., 2008). Good results on this

rootstock were also obtained by Felberg et al. (2010), who tested cuttings with 25 cm softwood cuttings in a substrate of medium-grain expanded vermiculite, under artificial mist (one-minute watering every 30 minutes) with 4000 mg/l indole-3-butyric acid, achieving a rooting rate of 63.04%. Loreti and Morini (1977) reported 85-95% rooting with softwood cutings of *Pyrus betulaefolia* clones using IBA at 3000-4500 ppm.

In this study, the vegetative propagation capacity of three pear rootstock selections P10, P11, and P63, was tested, using softwood cuttings under artificial fog conditions, with and without rooting biostimulator, on several types of substrate, and compared to the control rootstock, Farold 40.

2. Material and methods

The research was conducted at ICDP Pitești, Romania over a three-year period (2022–2024), toward the end of the shoot growth season, when the cuttings are semi-woody. The cuttings were rooted in greenhouses equipped with water-spraying systems to maintain high air humidity and to prevent water from dripping on the leaf. The experiment was organized as a three-factor design (3 × 4 × 2) using the split-plot method, with three replications. Three substrate types were used: a 2:1 peat–perlite mixture, perlite, and river-washed sand. The 15 cm-thick substrate was placed on raised beds to facilitate drainage of excess water.

Three pear rootstock selections - 'P10', 'P11', and 'P63' - were used as biological material and compared with the 'Farold 40' rootstock. 'Farold 40' is a vegetative pear rootstock from the OHxF series, with very low susceptibility to *Erwinia amylovora* and moderate rooting ability from softwood cuttings (Wertheim, 1998). 'P10' is a medium-height rootstock producing long, vigorous, thornless shoots in the cutting plantation and is tolerant to *Erwinia amylovora* and *Psylla pyri*. 'P11' is a medium-vigorous selection producing vigorous, thornless shoots with short internodes, tolerant to *Erwinia amylovora*, but slightly sensitive to *Psylla pyri* in some years. 'P63' is tolerant to both *Erwinia amylovora* and *Psylla pyri*, with medium vigor; the mother plant produces long, vigorous shoots with 1–2 spines per shoot and larger internodes.

The trees from which the shoots were harvested were cut back to stumps in the spring. Between mid-June and early July, shoots were harvested and shaped to 20–25 cm in length, leaving 3–4 leaves at the tip of each cutting. The third experimental factor was the biostimulant, with two levels: a control without biostimulant and a treatment with Radistim V2. For the treated variant, the base of each cutting (1–1.5 cm from the bottom) was dipped in Radistim V2 powder, which contains naphthylacetic acid, prior to planting. Cuttings were planted in the substrate on the same day they were harvested and shaped, with 100 cuttings per variant. Throughout the rooting period, water was applied as artificial mist, maintaining leaf wetness for the first three weeks. After root emergence, water application was gradually reduced. Rooted cuttings were harvested in mid-November, once roots had matured.

For statistical analysis, IBM SPSS Statistics version 14 (SPSS Inc., Chicago, IL, USA) was used. Data were analyzed using one-way analysis of variance (ANOVA) to assess differences between groups. Post hoc comparisons between rootstocks and substrates were performed using Duncan's multiple range test, with significance set at $p < 0.05$. Graphical representations were generated using Microsoft Excel 2016.

3. Results and discussions

Generally, peat, perlite, sand, vermiculite, or mixtures thereof are used as rooting substrates. In this study, a 2:1 peat–perlite mixture, pure perlite, and river-washed sand were tested. During root formation, cuttings progress through initial expansion, callus formation, and rooting phases. Root formation is a response to environmental stimuli and biostimulants, with phytohormone regulation being one of the most important factors influencing rooting. The present research evaluated the rooting capacity of semi-hardwood cuttings collected toward the end of the shoot growth period, with and without a biostimulant.

For 'Farold 40' rootstock (Fig. 1a, 1b), rooting percentages ranged from 0.34% to 20.66%, depending on substrate and biostimulant application. In the variant without a biostimulant, no significant differences were observed among substrates. When Radistim V2 was applied, rooting percentages were significantly higher in sand and perlite (20.46% and 20.66%, respectively) compared to the peat–perlite mixture (6.43%) (Fig. 2a).

Overall, the biostimulant significantly increased rooting compared to the control, regardless of substrate (Fig. 2b).

The 'P10' selection (Fig. 3a, 3b) showed rooting percentages ranging from 2.78% to 39.45%. The highest rooting occurred in the mixed substrate for both control (35.08%) and biostimulant-treated cuttings (39.08%), significantly higher than other substrates, where values were below 12.69% (Fig. 4a). No

significant differences were observed between control and biostimulant-treated cuttings in mixed substrate and perlite. The rooting percentage is slightly lower in the variant with biostimulant compared to control variant in perlite substrate. In sand, rooting was significantly higher with the biostimulant (8.57%) than without (2.78%) (Fig. 4b). Here, rooting in the variant without a biostimulant is significantly lower at 2.78% compared to the variant with a biostimulant, which had 8.57% rooting (Fig. 4.b).

For 'P11' (Fig. 5a, 5b), rooting ranged from 0% to 16.58%. No significant differences among substrates were observed in either the control or biostimulant-treated cuttings. Rooting percentages in the control variant ranged from 0% to 1.85%, whereas in the biostimulant variant, they ranged from 11.17% to 16.58% (Fig. 6a). Rooting was significantly higher in the biostimulant-treated cuttings compared to control, regardless of substrate (Fig. 6b).

On 'P63' (Fig. 7a, 7b), rooting ranged from 5.99% to 52.52%. Without biostimulant, the highest rooting was in the mixed substrate (29.86%), significantly higher than in sand (5.99%). With biostimulant, rooting ranged from 42.37% in the mixed substrate to 52.52% in sand, with no significant differences among substrates (Fig. 8a). Comparing biostimulant and control within each substrate, significant differences were observed in sand (52,52%) and perlite (48.48%) (Fig. 8b).

To all selections without biostimulant, 'P10' and 'P63' showed the highest rooting in the mixed substrate (35.08% and 29.86%, respectively), significantly higher than 'P11' and 'Farold 40', while 'P11' had the lowest rooting (0% in sand) (Fig. 9). The biostimulant improved rooting across all selections, with 'P63' showing the best performance, achieving 48.48% and 52.52% rooting in perlite and sand, respectively, significantly higher than other rootstocks (Fig. 10).

4. Conclusions

The results of this study are important for rootstock breeding programs, as vegetative propagation capacity is a key selection criterion. Substrate suitability for rooting depends on the genotype. In most cases, the application of Radistim V2 positively influenced rooting percentages. Selection 'P11' showed the lowest rooting capacity and is therefore not recommended for further orchard trials. Selection 'P10' can be propagated with relatively good results in a 2:1 peat–perlite mixture.

Among the three selections, 'P63' stood out, achieving approximately 50% rooting with biostimulant treatment, regardless of substrate. This selection is recommended for orchard trials to evaluate its vigor, productivity, and impact on grafted variety fruit quality.

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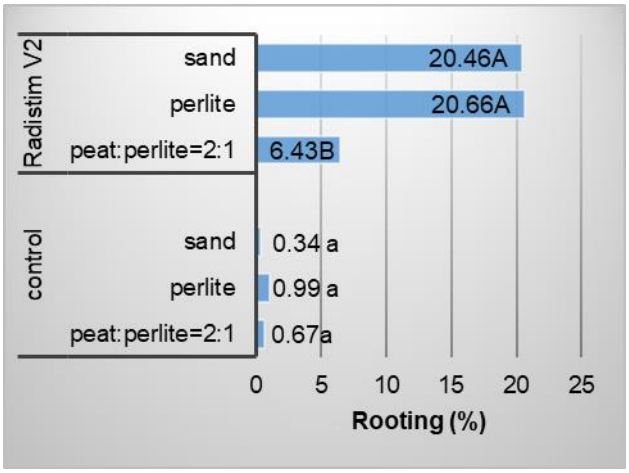
Figures

a

b

Fig. 1. 'Farold 40': a) at the time of planting in perlite; b) at the time of harvesting from the substrate



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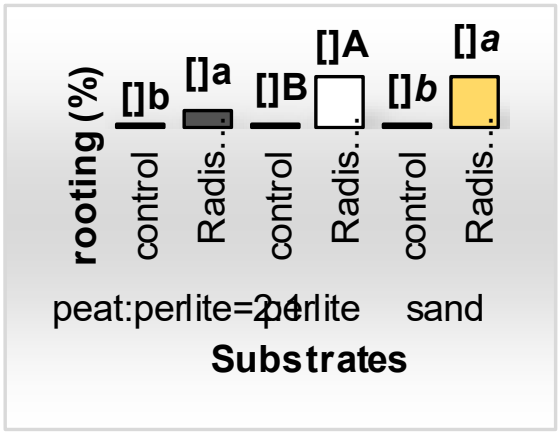

a

Fig. 2. 'Farold 40': a) The influence of the substrate on the rooting of cuttings in the control variant and with Radistim V2*; b) The influence of the biostimulant on the rooting of cuttings on different types of substrate (*different letters represent significant at P≤0,05, by Duncan test)

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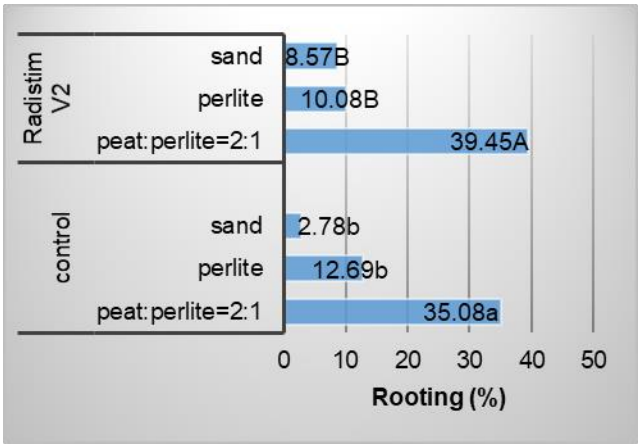
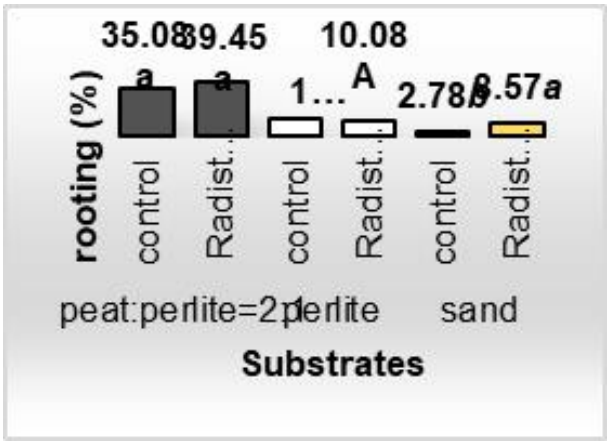
a b

Fig. 3. 'P10': a) at the time of harvesting the shoots from the mother plant; b) at the time of planting in sand



a



b

Fig. 4. 'P10': a) The influence of the substrate on the rooting of cuttings in the control variant and with Radistim V2*; b) The influence of the biostimulant on the rooting of cuttings on different types of substrate (*different letters represent significant at P≤0,05, by Duncan test)

a

b

Fig. 5. 'P11': a) at the time of harvesting the shoots from the mother plant; b) at the time of planting in mixt of peat and perlite

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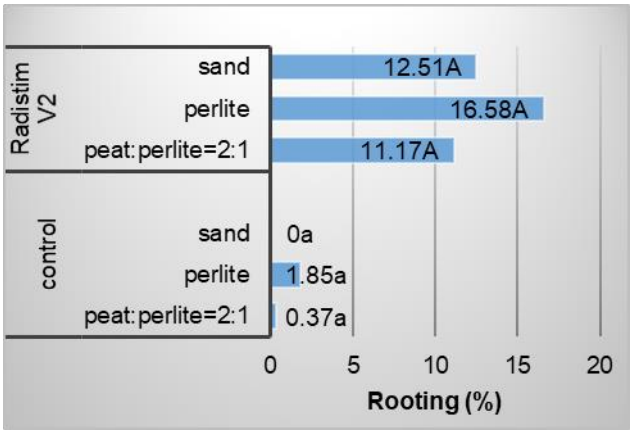
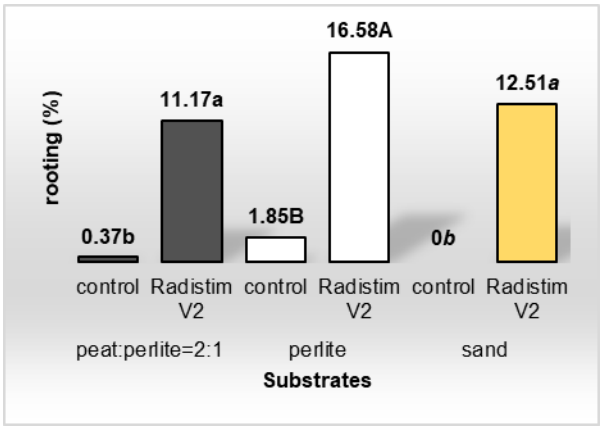


a



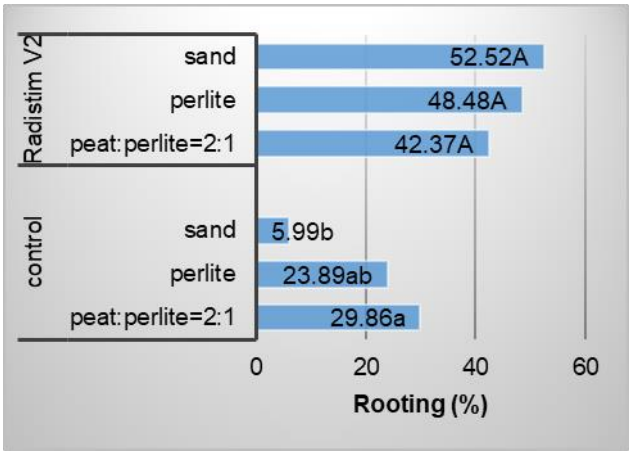
b

Fig. 6. 'P11': a) The influence of the substrate on the rooting of cuttings in the control variant and with Radistim V2*; b) The influence of the biostimulant on the rooting of cuttings on different types of substrate (*different letters represent significant at P≤0,05, by Duncan test)

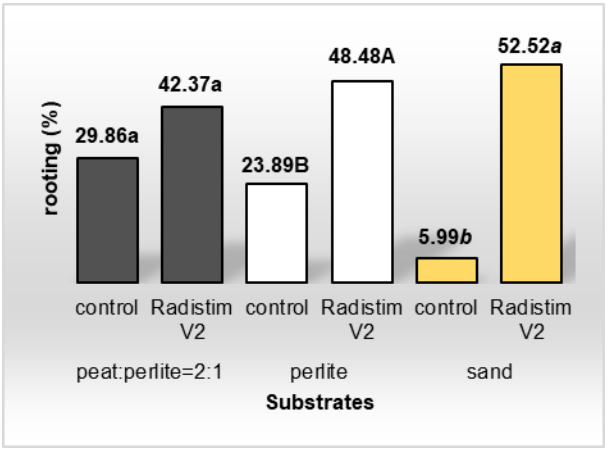
a

b

Fig. 7. 'P63': a) at the time of planting in perlite; b) at the time of harvesting from the substrate



a



b

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Fig. 8. 'P63': a) The influence of the substrate on the rooting of cuttings in the control variant and with Radistim V2*; b) The influence of the biostimulant on the rooting of cuttings on different types of substrate (*different letters represent significant at P≤0,05, by Duncan test)

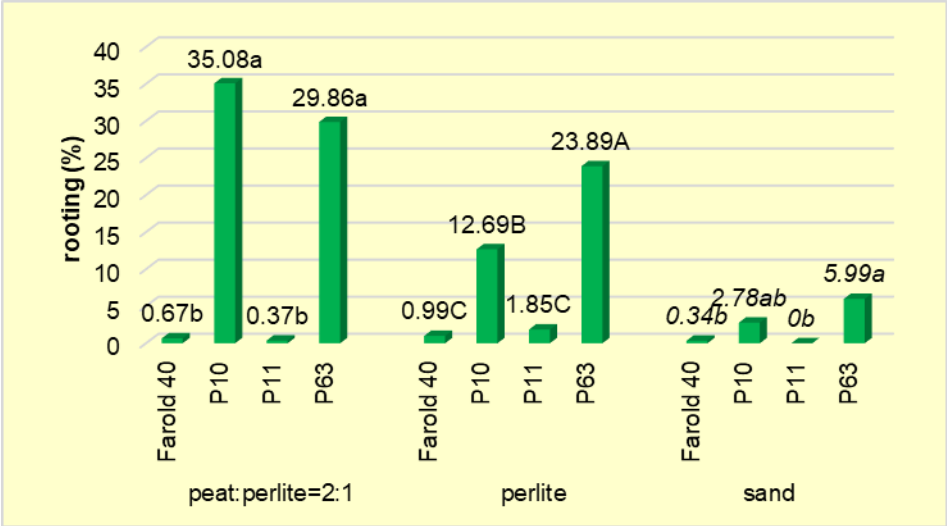

Fig. 9. The variation in the rooting percentage of rootstock cuttings in the control variant on different types of substrate (different letters represent significant at P≤0,05, by Duncan test)

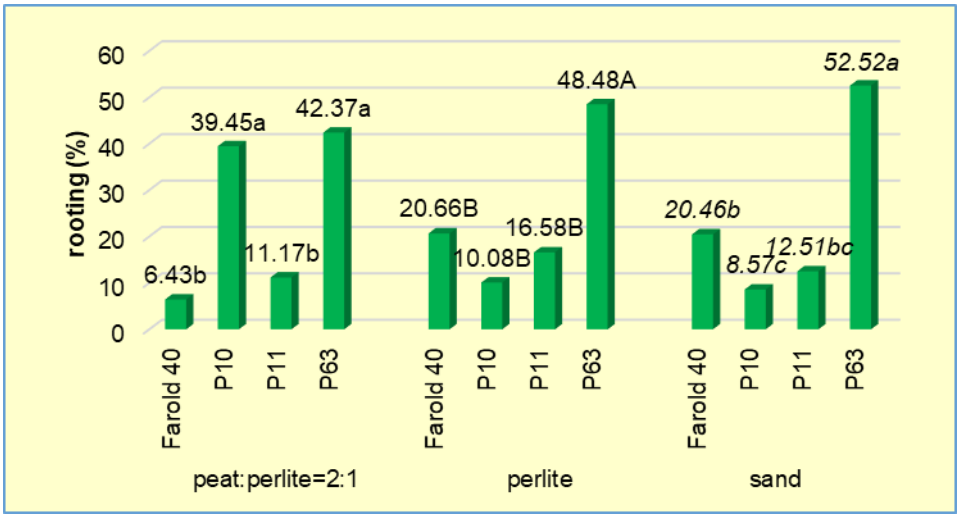

Fig. 10. The variation in the rooting percentage of rootstock cuttings in the variant with rooting biostimulator on different types of substrate (different letters represent significant at P≤0,05, by Duncan test)