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ROOTING OF HAZELNUT (CORYLUS AVELLANA L.) VARIETIES HARDWOOD CUTTINGS

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Abstract
Intensity of rooting on hardwood hazelnut cuttings is evaluated during two consecutive years. The evaluation is conducted on 6 hazelnut varieties (Istarski, Tonda Romana, Extra Yagli, Ludolf, Hall's Giant, Devianna) in greenhouse conditions at experimental greenhouse of Institute of Agriculture, Skopje. The cuttings are collected during dormancy of the plants, before start of vegetation. Two types of auxins IBA (indole-3-butyric acid) 2%, and NAA (α-naphthalene acetic acid) 0.2% are used. From evaluated varieties, Tonda Romana has the highest percentage of rooting (85.5%) and it is characterized with the highest value of rooted cuttings of first class. At all evaluated varieties, treatment with higher concentration of IBA gives higher percentage of rooted cuttings and higher value of rooted cuttings of first class.

Key words: Hazelnut, variety, hardwood cuttings, rooting, biohormone

Introduction

The European hazelnut (*Corylus avellana L.*) is the fruit kind which increasingly spread in the world due to high income and profitability in the orchards. This culture attract increasing attention especially when and where the difficult and expensive manual harvest of the kernels is replaced with harvest mechanization. The biggest production of hazelnut kernels in the world has the Turkye with about 75% of the total world production from which 80% go for export (Faostat, 2012). In the hazelnut cultivation has the inention for decreasing of plant distances in orchards, with aim to achieve the higher yields per ha, which is in maximum utilized in USA, where the yields is reached up to 3 t/ha kernels and with 200% increasing of the Hazelnut plantations area (Faostat, 2012). In this country is going with the interspecies crossing (*Corylus avellana* x *Corylus americana*) with aim to create hybrids for expansion of the cultivation zone to the drier and colder areas (Demchik et al., 2011). Hazelnut is a feedstock that is widely used in food industry especially in chocolate. Eighty percent of the world hazelnut production is used in chocolate sector, 15% in cake, biscuit and sweet sector and 5% in marketing as appetizers (Fiskobirlik, 2003). The increased appetites of the world market for the hazelnut kernels can be satisfied with the increased and more efficient production of the plant material from this culture. The most common techniques of hazelnut propagation are by stool layering and root suckers. Micropropagation is the safest and most productive form of propagation, but in hazelnut it still shows low yield due to contamination during culture establishment and the limited adaptability of the explants to in vitro conditions (Bacchetta et al., 2008). The propagation by cuttings can be considered as rapid and relatively economic method but, in spite of the numerous studies conducted for the hazelnut, the technique has not yet been transferred to an industrial scale due to poor rooting ability and cutting survival of most cultivars (Contessa et al, 2012). Without usage of the chemical agents for root initiation (auxins), the plant material production in this way becomes impossible. Except that, the bud abscission is a limiting factor to propagation of hazelnut stem cuttings, even though the

rooting percentage may be acceptable (Bassil et al., 1991). Actually, the auxins are using for the annulation of the ethylene inhibitory effect on rooting, which is releasing from the cutted plant parts used for rooting. The ethylene disable the rooting process (Serek et al., 2006). Therefore, as the ethylene inhibitors in rooting process can be used some other compounds except the auxins, like silver nitrate ($AgNO_3$) or silver tiosulphate (AgS_2O_3) (Contessa et al, 2012). The hazelnut can be propagated with softwood cuttings or with hardwood cuttings. The softwood cuttings have good rooting with bottom heating and influence of biohormons, except that in the period of 6th to 10th week of rooting, the development of the bud stops (Lagerstedt 1983). At the hardwood cuttings, cold survival and acclimatization problems have been observed. The best rooting has been obtained from semi-hardwood cuttings taken from mid-June to mid-July (Contessa et al, 2011). The using of IBA gives excellent results in rooting of the cuttings from some fruit kinds (Ercisli, Read, 2001). But, other studies show that some modified combinations can provide the better results. According to Agele (2013), coconut water and NAA were found better than IBA and IAA in terms of bud retention and rooting, leaf development and survival of plantlets. In most of the tested species (pepper fruit, guava, bush mango and cashew), wilting of leaves commenced 6 weeks after planting (WAP) and attained 100% mortality thereafter except for pepper fruit cuttings dipped in coconut water. With aim to determine the rooting ability of the different hazelnut varieties (*Corylus avellana L.*) we have used the concentration of different auxins.

Materials and methods

In the period 2004-2005 are collected the hardwood cuttings from six hazelnut varieties (Istarski, Tonda Romana, Extra Yagli, Ludolf, Hall's Giant, Devianna) in the beginning of tree dormancy (November), then stored in sand. At the end of February and in the beginning of March, the cuttings are prepared for the rooting with the mitter cut from the bottom, 5-6 mm below the bud, and flat cut from the top, 8-10 mm above the last top bud, by limiting the cutting length of 30-35 cm. The environmental, and the treatments influence over variety Tonda Romana is also studied. For that purpose, the cutting basal part is treated with biohormons: 2% IBA ($C_{12}H_{13}NO_2$ (Indole-3-butyric acid)) in talc carrier, 0.2% NAA ($C_{10}H_7CH_2CO_2H$ (1-Naphthaleneacetic acid)) and the control variant, without treating. The cuttings are set in inert substrate (sand), 4-5 cm in depth. Thirty cuttings in three replications are used. During the vegetation is performed mist with automized system, and shading, depending on the conditions. The rooting is performed in green house conditions. Through the rooting process, two times are performed the protection with Previcur and foliar feeding. All rooted cuttings which have certain superior vegetative characteristics (over 30 roots, over 10 cm root length, and over 5 cm high of the growth) we classify them in the first class, and other that do not met provided characteristics are separated in the second class.

At the end of the vegetation, in November, after the leaves fall, the hardwood cuttings are extracted from the sand and then are study the following parameters:

- Number of set cuttings;
- Number of rooted cuttings;
- Number of I class cuttings;
- Number of II class cuttings;
- Number of roots;
- Length of roots;
- Height of vegetative growth.

The data are statistically analysed by ANOVA and Fisher's multiple comparision test at level of 0.05 using the Minitab software.

Results and discussion

There are many methods for vegetative propagation of the hazelnut: with grafting, basal shoots, root suckers, layerings, and with cuttings. For most of this methods a large number of mother trees, and the large propagating area is needed, which is mean prolonged period for the mass plant material production and meeting the increased needs for that. The only possible way to starts in the short period the large production of plant material, is to obtain them from rooting of cuttings.

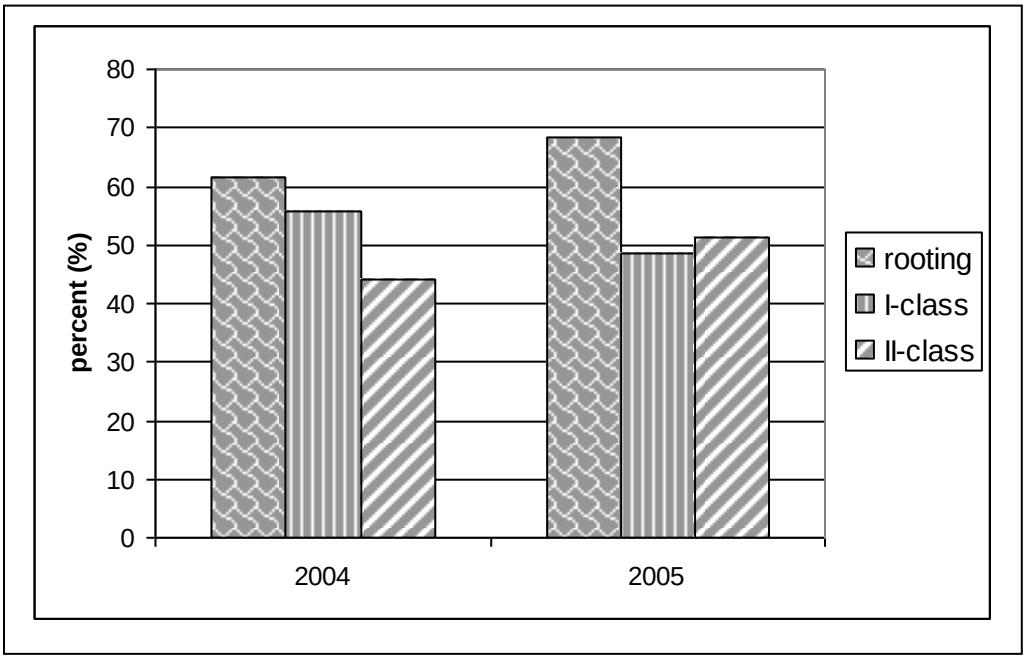

Figure 1. Percent of hazelnut variety Tonda Romana rooting cuttings in different years and its participation in different class

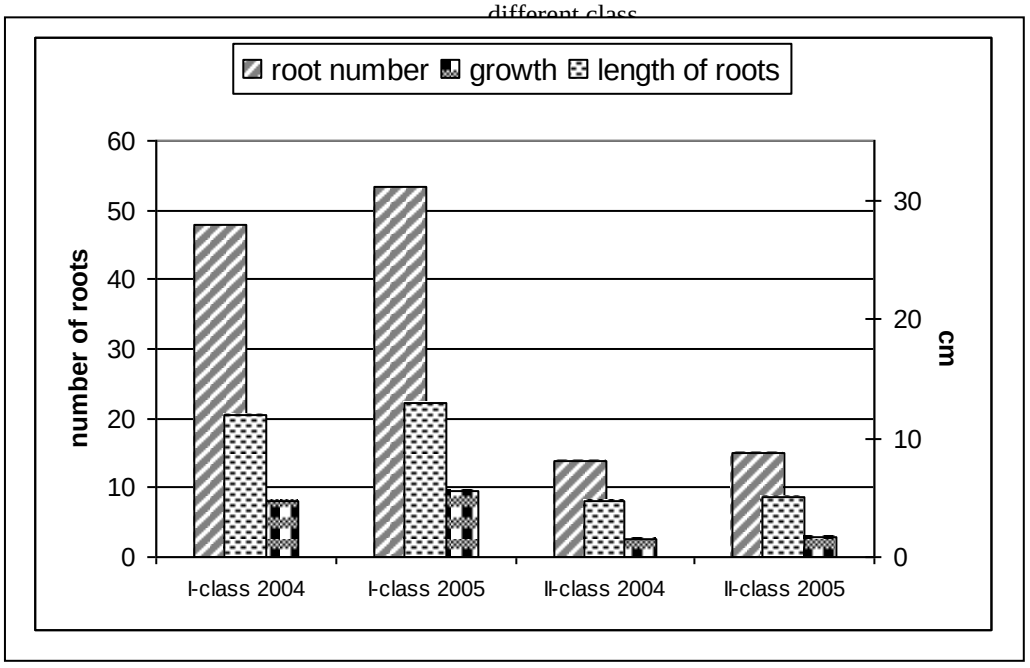

Figure 2. Quality characteristics of the rooted cuttings in different years.

The mother plants from which are taken the branches, needed as material for cuttings, were in excellent condition, without presence of pests and diseases. Our investigations show that the hazelnut (*Corilus avellana L.*), as a species, has affinity to rhizogenesis from the vegetative plant parts, in our case, from one year branches. The rooting intensity vary due to the influence of the different factors. Successively investigations in different years show statistically insignificant influence of the environmental conditions, over total rooting. So, the percent of the rooting at hazelnut variety Tonda Romana in the first year was smaller (61.4%), unlike the next year when the percent reach 68.5% (Fig.1.). The cuttings classification by quality shows that the environmental factors which affect the rooting of the cuttings, not affect the quality of the cuttings. At the same hazelnut variety in the first year, although there was weaker rooting, it was obtained the higher percent of first class

material (55.8%) in equal greenhouse conditions (Fig.1.). The quality characteristics of the rooted cuttings indicate that in the second investigation year is obtained slightly better quality of the rooted cuttings (53.5 roots, 13 cm length of the roots and 10 cm over ground growth) in the first class and in second class (15 roots, 5 cm length of the roots and 3 cm over ground growth). It can be noticed the high difference in the quality between the classes in the first and also in the second year (Fig.2.)

The influence of the treatments with different biohormons (IBA 2% and NAA 0.2%) over the cuttings from the variety Tonda Romana is significantly higher. The highest positive influence over the rooting of cuttings is determined at the treatment with 2% IBA, when is obtained almost ninety percent (89, 5%) rooted cuttings, which is 55% more than in the control (Fig.3.).

Is also determined statistically significant difference in the treatment with 0.2% NAA (71.1%), compared with control. The treatments with different concentrations (500 mgL^{-1} and 1000 mgL^{-1}) of IBA show almost equal influence of the rooting percent of the cuttings (70% and 72.5%) at the variety Tonda Gentile delle Langhe, even, at the lower concentration of the IBA is obtained more rooted cuttings with live buds (56%) (Contessa et al., 2012).

In our case, the differences are more noticeable when are analysed the participation of the different classes in the total amount of the rooted cuttings. So, is noted statistically significant difference in terms of the first class rooted cuttings percent (92.6%) in the treatment with 2% IBA compared with treatment with 0.2% NAA (48.1%) and also with control (15.4%) (Fig.3.). The influence of the different auxins over the rooting can be different. At some fruit kinds (Guava) NAA gives the better results than the IBA (Agele et al., 2013).

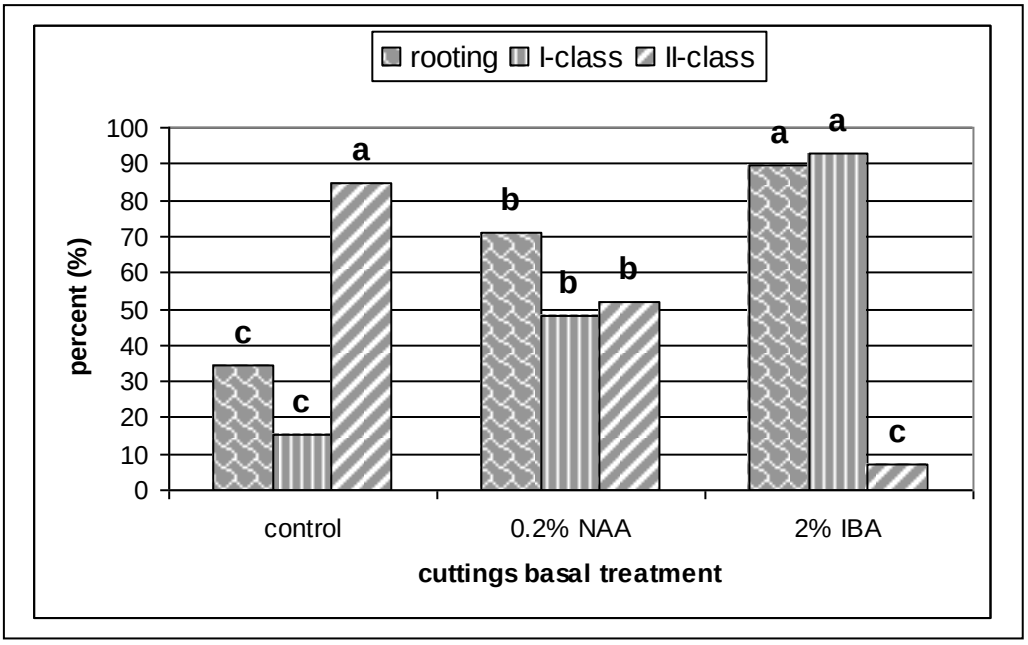

Figure 3. Influence of different auxins on percent of rooting cuttings of the hazelnut variety Tonda di Romana
* Footnote: The means followed by the same letter in similar column are not significantly different at $P \leq 0.05$ by Fisher's multiple comparisons test.

The investigation of the different hazelnut varieties shows partial influence of the genotype (Tonda Romana) over the ability for rooting of the hardwood cuttings. With statistically significant higher percent of hardwood cuttings rooting is characterized the variety Tonda Romana (85.4%) (Fig.4.). Among the other five varieties is not noticed statistically significant difference. The variety Tonda Romana also is characterized with significantly higher percent of first class cuttings (92.9%), than the other hazelnut varieties. In some variety investigations with the rooting of semi-hardwood cuttings, the

variety Tonda Romana shown the lowest percent of rooting, which alluded that the time of taking the branches for the cuttings has different influence over the ability for rooting at the same varieties (Contessa et al, 2011). The variety Devianna is characterized with the lowest percent of rooting and with the lowest percent of first class rooted cuttings (37.7% and 38.8%) (Fig.4.).

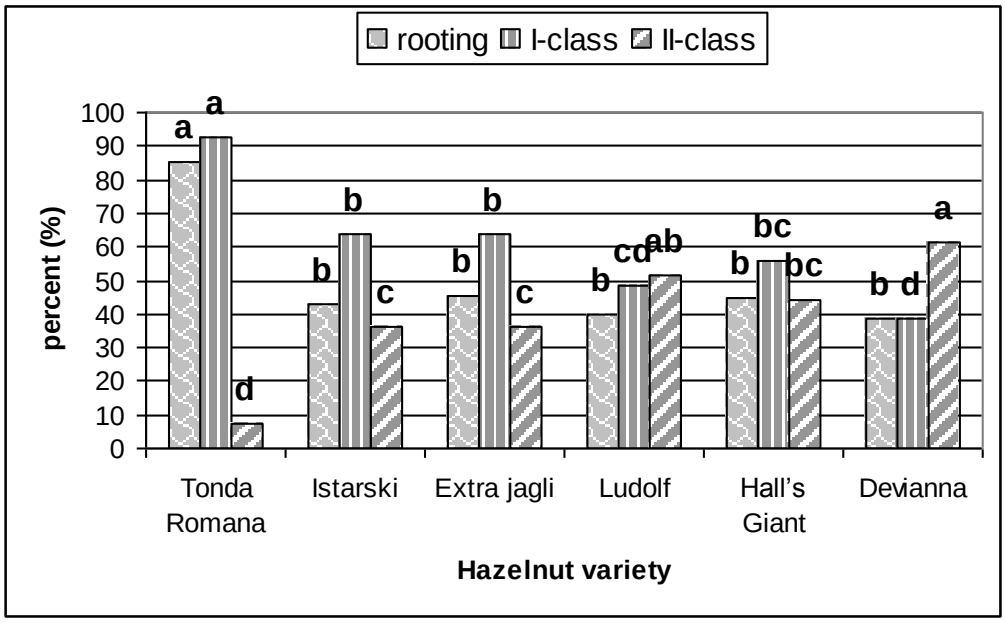

Figure 4. Influence of the genotype on rooting capability of the cuttings.
* The means followed by the same letter in similar column are not significantly different at $P \leq 0.05$ by Fisher's multiple comparisons test.

Figure 5. Different Hazelnut varieties rooting cuttings

Conclusions

The investigations show that the rooting of the hazelnut hardwood cuttings gives numerous and quality planting material with much better developed root system than in the usually most used propagating method-with suckers. The using of the auxin IBA (2%) contribute for the much higher rooting percent and for the better quality of the rooted cuttings. The variety Tonda Romana is especially suitable for propagation with hardwood cuttings due to the high rooting percent.

References

1. Agele, S.O., Aiyelari, O.P., Obi, E.A. (2013). Pattern of rooting and growth of cuttings of some species of insecticidal and medicinal importance as affected by growth promoting substances. Oct. Jour. Env. Res. Vol. 1(2): 151-160

2. Bacchetta, L., Aramini, M., Bernardini, C., Rugini. E. (2008). In vitro propagation of traditional Italian hazelnut cultivars as a tool for the valorization and conservation of local genetic resources. HortScience 43, 562-566.
3. Bassil, N.V., Proebsting, W.M., Moore, L.W., Lightfoot, D.A. (1991). Propagation of hazelnut stem cuttings using Agrobacterium zhizogenes. HortScience 26(8), 1058-1060.
4. Contessa C., Valentini N., Botta R. (2012). Decreasing the concentration of IBA or combination with ethylene inhibitors improve bud retention in semi-hardwood cuttings of hazelnut cultivar 'Tonda Gentile delle Langhe'. Scientia Horticulturae, Volume 131, 22 November 2011, Pages 103–106.
5. Contessa C., Valentini N., Caviglione M., Botta R. (2011). Propagation of *Corylus avellana L*. by Means of Semi-hardwood Cutting: Rooting and Bud Retention in Four Italian Cultivars. Europ.J.Hort.Sci., 76 (5/6). S. 170–175, 2011, ISSN 1611-4426.
6. Demchik M., McCown B., Fischbach J., Kern A., Zeldin E. (2011). A new Hazelnut development Program in the lake states. Agroforestry: A profitable land use.
7. Ercisli S. Read P.E. (2001): Propagation of hazelnut by softwood and semi-hardwood cuttings under Nebraska condition. Acta Hort. 556, 275–279.
8. Fiskobirlik, (2003). Records of Union of Agriculture Cooperatives for the Sale of Hazelnut. Giresun, Turkye. http://www.fiskobirlik.org.tr/
9. Lagerstedt H.B. (1983). The American nut industry-filberts (Corylus avellana L.), cultivars, culture production. North. Nut Grow. Assoc. Annu. Rep. 74: 179-185.
10. Serek, M., Woltering, E.J., Sisler, E.C., Frello, S., Sriskandarejah, S. (2006). Controlling ethylene at the receptor level. Biotechnol. Adv. 24, 368-381.