Ciência Rural, Santa Maria, v.48:08, e20180117, 2018
http://dx.doi.org/10.1590/0103-8478cr20180117
ISSNe 1678-4596
BIOLOGY

Rooting of Tineke and Natal Briar rose stem cuttings in different substrates

Giovana Ritter[1] **Ellen Toews Doll Hojo**[2] **Fabíola Villa**[1*] **Daniel Fernandes da Silva**[1]

[1]Universidade Estadual do Oeste do Paraná (Unioeste), 85960-000, Marechal Cândido Rondon, PR, Brasil. E-mail: fvilla2003@hotmail.com. [*]Corresponding author.
[2]Centro Universitário Fundação Assis Gurgacz (FAG), Cascavel, PR, Brasil.

ABSTRACT: *The commercial propagation of rose bushes is carried out asexually by the cutting method. The genetic material and the substrate are factors that interfere in the rhizogenic process of the cuttings. Thus, the aim of this work was to evaluate the effect of the substrate on the rooting of cuttings of two hybrid rose bushes. Floriferous branches of matrix plants were cut at the apex and at the base, approximately 8cm long and with two buds, and the basal leaf was removed. The experimental design was completely randomized, in a 2 × 3 factorial scheme (two cultivars, Tineke and Natal Briar × three substrates, carbonized rice husk, coconut fiber and TN Gold®) containing four replicates of 15 cuttings per replicate. The base of the cuttings was immersed for five seconds in IBA 2000mg L^{-1} solution (indole butyric acid). The cuttings were placed in trays with 24 cells previously filled with substrate and deposited on the floor in a transparent plastic tunnel, built inside a stove. After the 50-day experiment, rootstocks (%), sprouts (%) and dead (%), root length (cm), fresh and dry shoot biomass and roots (g) were evaluated. The rooting percentage of the Natal Briar cultivar was 75%, thus superior to the Tineke cultivar, which had a rooting percentage of 39%. The best substrates for the Tineke and Natal Briar rose cuttings are CAC and coconut fiber, which provided rooting percentages of 81% and 67% of the cuttings, respectively.*

Key words: *Rose sp., asexual propagation, cutting, plant regulator.*

Enraizamento de estacas de roseiras Tineke e Natal Briar em diferentes substratos

RESUMO: *A propagação comercial de roseiras é realizada assexuadamente, pelo método de estaquia. O material genético e o substrato são fatores que interferem no processo rizogênico das estacas. Diante do exposto, objetivou-se com o presente trabalho avaliar o efeito do substrato sobre o enraizamento de estacas de roseiras Tineke e Natal Briar. Foram utilizados ramos floríferos de plantas matrizes cortadas em bisel no ápice e na base, com aproximadamente 8cm e duas gemas, sendo retirada a folha basal. O delineamento experimental utilizado foi inteiramente casualizado, em um fatorial 2 x 3 (duas cultivares, Tineke e Natal Briar x três substratos, casca de arroz carbonizada, fibra de coco e TN Gold®), contendo quatro repetições de 15 estacas por repetição. A base das estacas foi imersa por cinco segundos em solução de 2000mg L-1 de IBA (ácido indol butírico). As estacas foram colocadas em bandejas com 24 células previamente preenchidas com substrato e depositadas no chão em túnel plástico transparente, construído dentro da estufa. Após 50 dias de experimentação avaliaram-se as estacas enraizadas (%), brotadas (%) e mortas (%), comprimento das raízes (cm), biomassa fresca e seca da parte aérea e raízes (g). A porcentagem de enraizamento da cultivar Natal Briar foi de 75%, superior à cultivar Tineke, que obteve 39% de estacas enraizadas. Melhores substratos para a estaquia de roseiras Tineke e Natal Briar são a CAC e fibra de coco que proporcionaram o enraizamento de 81 e 67% das estacas respectivamente.*

Palavras-chave: *Rosa sp., propagação assexuada, estaquia, regulador vegetal.*

INTRODUCTION

Worldwide, floriculture occupies an area estimated at 190 thousand ha and moves values close to US$ 60 billion per year, and the rosebush is considered the most significant ornamental plant. The cut flower industry has the greatest demand, followed by live plants, bulbs and foliage. The cultivated area in Brazil is increasing, both in open areas and in protected environments (MITSUEDA et al., 2011).

In Brazil, the rose is considered the main cut flower produced, both for the domestic and export markets (MARTINS et al., 2009). They are preferred in flower shops, especially for commemorative dates such as Mother's Day and Valentine's Day (PAIVA & ALMEIDA, 2014).

Received 02.17.18 Approved 06.09.18 Returned by the author 07.13.18
CR-2018-0117.R1

Rosebush propagation is generally carried out by grafting made by commercial cut flower producers, in addition to micropropagation and cutting (BAYANATI and MORTAZAVI, 2013). For production, the cutting method is most commonly used in the formation of seedlings of climbing rosebush and rootstock used for grafting (PIVETTA et al., 2004). For hybrid rosebushes, there is little information about the best propagation method to use. In cutting propagation, several endogenous (genetic and physiological) and environmental factors can influence the results as described by ZANÃO et al. (2016). The genotype and substrates used are factors that interfere in the rooting and production of seedlings (LONE et al., 2010).

Among the environmental factors that influence the adhesion and rooting of the cuttings, the substrate exerts a great influence on the support for the cuttings. The substrate ensures mechanical maintenance of the root system and plant stability, water and nutrient supply, oxygen and transport of carbon dioxide between roots and external air. It is desirable that the substrate be permeable, porous, well drained, free of pathogens, pests and weed propagules and have low density, as well as be easily available and have economic viability (KÄMPF et al., 2006). The ideal substrate for rooting depends on the species, cutting size, season, propagation method, cost and the availability of substrate components (HARTMANN et al., 2011).

Many materials can be used as a substrate and can be mixed. In addition, there are many commercial substrate options available that perfectly meet many of these requirements, but they are expensive. A solution is to mix materials that can be easily obtained with the same or superior performance, thus reducing production costs (ZANÃO et al., 2016).

Among the most frequently used materials for rooting ornamental plant cuttings are vermiculite and carbonized rice husk. Coconut fiber is also considered a good substrate for plants and has excellent physical characteristics for good root development. It has a varied texture, favoring balance between air and water, is easily available and has a high aeration capacity (RICKLI et al., 2012). Commercial substrates such as TN Gold®, PLantmax® and Hortmax® are commonly used on budding and rooting cuttings (ALMEIDA et al., 2008).

In view of the above information, the objective of this work was to evaluate the effect of different substrates on the rooting of cuttings of two rosebushes: Tineke and Natal Briar.

MATERIALS AND METHODS

The experiment was conducted for 60 days in a greenhouse on the school farm at the Centro Universitário FAG located in Cascavel City (PR), at the geographical coordinates 24º31'42"S e 54º01'45"W and an altitude of 781m. The greenhouse has dimensions of 10×5 meters and 3.5m tall, with the top covered with transparent plastic canvas and lateral sides with silver screen. For the preparation of semi-hardwood cuttings from rosebushes, flowering stems were used (commercial pattern) from the parent plants of the cultivars Tineke and Natal Briar, with white and pink flowers, respectively. The parent plants belong to a commercial cultivator located in the Rio do Salto district, 20km from Cascavel City, and both cultivars have high rusticity, favoring cultivation by small producers.

The cuttings were cut following the bisel method for apex and base, from the first leaf with five leaflets with an approximately 8cm length and two gemma, and the basal leaf was removed (MAHSA et al., 2014). After preparation, the cutting base was immersed in a solution of 2000mg L^{-1} IBA (idol butyric acid) for five seconds, according to PAIVA & ALMEIDA (2014). Each cutting had 1/3 of its length submerged into the substrates in the tray, each in a cell.

For the experimental assembly, all the substrates were placed in black polystyrene (59×59×65mm) trays, with 24 cells, totaling 200cm^3 of material per tray. The carbonized rice husk (CRH), purchased from a local producer, contained 0.7g L^{-1} of soluble salts, 0,7% nitrogen, 0.2% of phosphor e 0.32% of potassium. The coconut fiber (Amafibra® brand) is made from the coconut mesocarp, with pH=5.5 and 95% porosity. TN Gold is a commercial substrate recommended for flowers (Agrinobre® brand) composed of sphagnum, expanded vermiculite, dolomite limestone, agricultural gypsum, NPK fertilizers and micronutrients, and pH=5,0.

The trays with cuttings were placed on black canvas on the ground, positioned 5cm from the ground level under a transparent plastic (50µm thick) tunnel (1,80m width ×2,00m length ×0,70m height) built into the greenhouse. This structure was used to keep the humidity and temperature for the cuttings high. To keep the moisture in the substrates, a continuously applied irrigation blade was left approximately 1cm underneath them, making the base of the cells lie in the water. The water was changed every two days.

After 50 days, rooted cuttings (%), shoots (%) and dead (%), root length (cm), fresh and dry aerial and root part biomass (g), were evaluated as recommended by PIROLLA et al. (2016).

As a criterion for root count, all cuttings that contained at least one root with a length equal to or greater than 0,2cm were considered rooted. This measurement was performed with a ruler, and the average was taken of the length of the three largest roots. To evaluate the dry biomass, the material was allowed to dry in a drying oven with air circulation at 65°C until constant weight was achieved.

The experimental design was completely randomized, in a factorial scheme of 2×3 (two cultivars, Tineke and Natal Briar × three substrates, carbonized rice husk, coconut fiber and TN Gold®), with four replicates of 15 cuttings per replicate. The obtained data were submitted to an analysis of variance, and the data were later compared by a Tukey test to 5% probability of error using the statistical software Sisvar (FERREIRA, 2011).

Table 1 - Percentage of rooted and budded cuttings of rosebush (*Rosa* sp.) cultivars Tineke and Natal Briar. Unioeste, *Campus* Marechal C. Rondon, PR. 2018.

Rosebush cultivars	Rooted cuttings (%)	Budded cuttings (%)
Tineke	38.88b*	55.96b
Natal Briar	74.99a	74.99a
------------------------------Substrates-----------------------------		
CRH	81.23a	74.57a
TN Gold®	22.91b	46.87b
Coconut fiber	66.66a	74.99a
CV (%)	14.35	18.13

*Means followed by the same lowercase letter in the column do not differ by Tukey's test at 5% probability of error. CRH= Carbonized Rice Husk.

RESULTS AND DISCUSSION

Significance was verified separately for cultivars and substrates in rooted and sprouted cuttings. For the biomass of the dry buds, all three substrates were significant substrate. A significant interaction between cultivars and substrates was observed for the length of the largest root, the dry biomass of the roots and the live and dead cuttings.

For the Natal Briar cultivar, 75% of cuttings rooted (Table 1). A study conducted by OTIENDE et al. (2015) on two cultivars of hybrid rosebushes in Kênia also obtained a high percentage of rooted cuttings of the same cultivar. This cultivar represents 60-70% of hybrid rose cultivars cultivated in the world due to its vigor and rooting capacity (PARK & JEONG, 2015). The difference in percentage of rooted cuttings occurs due to differences in genotypes, where a cultivar may present greater rooting capacity (IZADI et al., 2014).

The best substrates used in the rooting of hybrid rose cuttings were CRH and coconut fiber. This is a consequence of the physical characteristics of these substrates (water retention capacity). Coconut fiber is considered a good substrate for ornamental plants, with excellent physical characteristics for good root development. It has a varied texture, favoring the balance between air and water, a good water holding capacity, is easily available and has a high aeration capacity (FARIA et al., 2010). CRH is a porous substrate with high drainage capacity and low water retention, facilitating root system formation in cuttings (KÄMPF et al., 2006).

The result for budded cuttings was the same as that observed for rooted cuttings (Table 1). The Natal Briar cultivar was highlighted again, along with CRH and coconut fiber. A positive correlation was observed between the percentage of budded and rooted cuttings. These results may be associated with the formation of roots that are able to capture water and nutrients, resulting in the formation of new tissue and auxin biosynthesis, promoting increased growth of buds (TAIZ e ZEIGER, 2017).

For the root length values, dry cutting biomass and mortality, there was a significant interaction between substrate and cultivar (Table 2).

When CRH and coconut fiber were used, the best root lengths were observed for Natal Briar. When TN Gold was used, there were no significant differences between cultivars. LONE et al. (2010) verified longer root lengths in azalea cuttings when using coconut fiber as a substrate. For the rooting of cuttings and formation of seedlings from ornamental plants, there is great potential in using coconut fiber as a substrate due to it physicochemical characteristics, highlighting the water retention capacity, good drainage, acidity and high salinity, mainly due to high levels of potassium and chlorine and the non-reaction with fertilization nutrients (KLEIN, 2015).

The best rooting rate may be related to the best contact of substrate particles with the base of the cuttings. TORRES et al. (2013) also described that carbonized rice husk associated with coconut fiber allowed for superior root length of *Sansevieria cylindrica*, probably due to low density and the

Table 2 - Largest root length, root and cutting dry biomass and rosebush (*Rosa* sp.) cutting mortality of cultivars Tineke and Natal Briar. Unioeste, *Campus* Marechal C. Rondon, PR. 2018.

---------------------Largest root length (cm)-----------------------			
Rosebush cultivars	CRH	TN Gold®	Coconut fiber
Tineke	31.25bA*	32.40aA	25.68bA
Natal Briar	68.10aA	24.78aB	58.18aA
CV (%)	---------------------21.08------------------		
---------------------Cuttings dry biomass (g)----------------------			
Tineke	33.85bA	24.63bB	37.43aA
Natal Briar	39.68aA	36.63aA	38.48aA
CV (%)		5.15	
-------------------------Dead cuttings (%)------------------------			
Tineke	2.08bB	4.17bB	73.32aA
Natal Briar	14.58aB	22.92aB	83.32aA
CV (%)	--------------------18.27---------------------		

*Means followed by the same uppercase letter in the line and lowercase in the column do not differ by Tukey's test at 5% probability of error. CRH = carbonized rice husk.

Table 3 - Shoot dry biomass of rosebush (*Rosa* sp.) cuttings of cultivars Tineke and Natal Briar. Unioeste, *Campus* Marechal C. Rondon, PR. 2018.

Substrates	Dry shoots biomass (mg)
CRH	29.44a*
TN Gold®	12.29b
Coconut fiber	33.91a
CV (%)	35.75

*Means followed by the same lowercase letter in the column do not differ by Tukey's test at 5% probability of error. CRH = carbonized rice husk.

percentage of major macropores that would facilitate the excess water flow, favoring root development.

Root system quality involves root number and root length, and these factors are desirable because they favor water and nutrient absorption and are related to seedling soil attachment ability influencing plant development after transplantation to soil (RANAWEERA et al., 2013). For root dry biomass, there were no significant differences between cultivars and substrates, and the general mean for substrates was 3,93g for carbonized rice husk, 4,31g for TN Gold and 2,82g for coconut fiber.

For dry biomass of Natal Briar cuttings, all substrates were ideal. For both cultivars, there was no significant difference when coconut fiber was used. ZIETMANN & ROBERTO (2007) did not obtain differences between the substrates tested for the dry biomass of guava cuttings. Lower mortality of cuttings from both cultivars was observed when CRH and TN Gold® were used. The same was observed in National Resedá cuttings (*Physocalymma scaberrimum Pohl.*) maintained in CRH (PRETI et al., 2012).

The CRH and coconut fiber stand out in relation to the dry biomass of the buds on rosebush cuttings (Table 3). This occurs because of the improved aeration and the greater drainage of the substrates.

CASTRO et al. (2012) also observed that the dry biomass of the buds on rosebush cuttings (Rosa *multiflora* L.) was greater when a mixture of tested substrates was used than when the commercial substrate was employed.

Future studies should be conducted to elucidate the other factors influencing the rhizogenesis process of cuttings, such as other concentrations and types of plant regulators, different substrate mixtures and genetic materials and physicochemical characteristics of substrates.

CONCLUSION

Among the two rosebush cultivars (*Rosa* sp.), the Natal Briar cultivar presents better rooting compared to Tineke.

Independent of the cultivar, the best substrates for rooting Tineke and Natal Briar cuttings are carbonized rice husk and coconut fiber.

DECLARATION OF CONFLICTING OF INTERESTS

We have no conflicts of interest to declare.

REFERENCES

ALMEIDA, E. F. A. et al. Different substrates and environments for mini-ixora rooting (*Ixora coccinea* compacta). **Ciência & Agrotecnologia**, v. 32, n. 5, p. 1449-1453, 2008. Available from: <http://www.scielo.br/pdf/cagro/v32n5/14.pdf>. Accessed: Jan. 08, 2018. doi: 10.1590/S1413-70542008000500014.

BAYANATI, M.; MORTAZAVI, S. N. Micropropagation from cultured nodal explants of *Rosa hybrida* cv. 'Black Bacara'. **International Journal of Agronomy and Plant Production**, Turkey, v.4, n.6, p.1381-1385, 2013. Available from: <https://www.researchgate.net/profile/Mina_Bayanati/publication/262182530_Micropropagation_from_Cultured_nodal_Explants_of_Rosa_hybrida_cv_'Black_Baccara'/links/02e7e536de48251f4d000000/

Micropropagation-from-Cultured-nodal-Explants-of-Rosa-hybrida-cv-Black-Baccara.pdf>. Accessed: Jan. 03, 2018.

CASTRO, A. M. C.et al. Rooting of rosewood graft cuttings with alternative materials in the composition of substrates. **Cultivando o Saber**, v.5, n.1, p.87-95, 2012. Available from: <https://www.fag.edu.br/upload/revista/cultivando_o_saber/5027cda3b93b5.pdf>. Accessed: Jan. 26, 2018.

FARIA, R.T. et al. **Orchid cultivation**. Londrina: Mecenas, 2010. 208p.

FERREIRA, D. F. Sisvar: a computer statistical analysis system. **Ciência & Agrotecnologia**, v. 35, n. 6, p. 1039-1042, 2011. Available from: <http://www.scielo.br/scielo.php?pid=S1413-70542011000600001&script=sci_arttext&tlng=pt>. Accessed: Dez. 26, 2017. doi: 10.1590/S1413-70542011000600001.

HARTMANN, H. T. et al. **Plant propagation**: principles and practices. 8ª ed. Boston: Prentice-Hall, 2011. 915p.

IZADI, Z. et al. Effect of time, cultivar and rootstock on success of rose propagation through stenting technique. **American Journal of Plant Sciences**, v. 5, p. 1644-1650, 2014. Available from: <http://file.scirp.org/pdf/AJPS_2014052017220661.pdf>. Accessed: Jan. 15, 2018. doi: 10.4236/ajps.2014.511178.

KÄMPF, N. A. et al. **Floriculture**: techniques of preparation of substrates. Brasília: LK Publishing and Communication, 2006, 132p.

KLEIN, C. Use of alternative substrates for seedling production. **Revista Brasileira de Energias Renováveis**, v. 4, p. 43-63, 2015. Available from: <http://revistas.ufpr.br/rber/article/view/40742/pdf_64>. Accessed: Jan. 20, 2018. doi: 10.5380/rber.v4i3.40742.

LONE, A. B. et al. Rooting of azalea cuttings (*Rhododendron simsii* Planch.) in the IBD and different substrates. **Ciência Rural**, v. 40, n. 8, p. 1720 - 1725, 2010. Available from: <http://www.scielo.br/pdf/cr/v40n8/a682cr2238.pdf>. Accessed: Jan. 16, 2018. doi: 10.1590/S0103-84782010000800008.

MAHSA, K. et al. The regulating effect of the growth of indole butyric acid and the time of stem cutting preparation on propagation of damask rose ornamental shrub. **Journals of Ornamental Plants**, v. 4, n. 4, p. 49-55, 2014. Available from: <http://jornamental.iaurasht.ac.ir/article_513302_577bc5d3b950d572c605cd3bd3517083.pdf>. Accessed: Jan. 09, 2018.

MARTINS, M. V. M. et al. Integrated Flowers Production in Brazil. **Informe Agropecuário**, v. 30, n. 249, p. 64- 66, 2009.

MITSUEDA, N. et al. Environmental aspects of agribusiness flowers and ornamental plants. **Revista em Agronegócios e Meio Ambiente**, v. 4, p. 9-20, 2011. Available from: <http://periodicos.unicesumar.edu.br/index.php/rama/article/view/617/1183>. Accessed: Jan. 03, 2018.

OTIENDE, M. A. et al. Effect of cutting position, auxins and rootstocks on flower yield of rose cultivar 'Inca'. **Academic Research International**, v. 6, n. 4, p. 9-16, 2015. Available from: <http://www.savap.org.pk/journals/ARInt./Vol.6(4)/2015(6.4-02).pdf>. Accessed: Jan. 15, 2018.

PAIVA, P. D. O.; ALMEIDA, E. F. A. **Produção de flores de corte**. Lavras, Minas Gerais: Ed. UFLA, 2014. v. 2.

PARK, Y. G.; JEONG B.R. Effect of rootstock on rooting and early yield of stenting-propagated cut roses. **Korean Journal of Horticultural Science and Technology**, v. 33, n. 1, p. 11-17, 2015. Available from: <http://www.dbpia.co.kr/Journal/ArticleDetail/NODE06187863>. Accessed: Jan. 15, 2018. doi: 10.7235/hort.2015.14033 .

PIROLA, K. et al. Indolbutyric acid on rooting of cuttings of mini rose bush. **Ornamental Horticulture**, v. 22, n. 1, p. 43-49, 2016. Available from: <https://ornamentalhorticulture.emnuvens.com.br/rbho/article/view/606/624>. Accessed: Jan. 09, 2018. doi: 10.14295/oh.v22il.606.

PIVETTA, K. F. L. et al. Morphologic characterization and evaluation of the productivity of nine rootstocks of rose bush (*Rosa* sp.). **Acta Horticulturae**, v. 630, p. 213-217, 2004. Available from: <https://www.actahort.org/members/showpdf?booknrarnr=630_26>. Accessed: Jan. 03, 2018. doi:10.17660/ActaHortic.2004.630.26.

PRETI, E. A. et al. Resedá-Nacional cuttings(*Physocalymma scaberrimum* Pohl.) on different substrates and concentrations of IBA. **Ciência Florestal**, v. 22, n. 2, p. 377-383, 2012. Available from: <http://www.redalyc.org/html/534/53423427016/>. Accessed: Jan. 26, 2018.

RANAWEERAA, K. K. et al. *Ex vitro* rooting: A low cost micropropagation technique for tea (*Camellia sinensis* (L.) O. Kuntz) hybrids. **Scientia Horticulturae**, v. 155, n. 2, p. 8-14, 2013. Available from: <https://www.sciencedirect.com/science/article/pii/S0304423813001039>. Accessed: Jan. 20, 2018. doi: 10.1016/j.scienta.2013.03.001.

RICKLI, H. et al. Rooting of patchouli cuttings on different substrates. **Revista Brasileira de Ciências Agrárias**, v. 7, n. 3, p. 446-450, 2012. Available from: <http://www.redalyc.org/pdf/1190/119024529012.pdf>. Accessed: Jan. 09, 2018.

TAIZ, L.; ZEIGER, E. **Fisiologia e desenvolvimento vegetal**. 6. Ed. Porto Alegre: Artmed, 2017, 858p.

TORRES, R. A et al. Effect of the substrate with different concentrations of carbonized rice bark and coconut fiber on the rooting of foliar cuttings of *Sansevieria cylindrica* Bojer - Fortaleza, CE, 2013. **Cadernos de Agroecologia**, [S.l.], v. 8, n. 2, 2013. Available from: <http://revistas.aba-agroecologia.org.br/index.php/cad/article/view/14116>. Accessed: Jan. 20, 2018.

ZANÃO, M. P. C. et al. Stake and substrate removal region in the vegetative propagation of rose bush. **Ornamental Horticulture**, v. 22, n. 1, p. 58-62, 2016. Available from: <https://ornamentalhorticulture.emnuvens.com.br/rbho/article/view/785/626>. Accessed: Jan. 05, 2018. doi: 10.14295/oh.v22il.785.

ZIETEMANN, C.; ROBERTO, R.F. Effect of different substrates and collection times on the rooting of herbaceous cuttings of guava, cvs. Paluma and the XXI Century. **Revista Brasileira de Fruticultura**. v. 29, p. 31-36, 2007. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-29452007000100009&lng=pt&tlng=pt>. Accessed: Jan. 26, 2018. doi: 10.1590/S0100-29452007000100009.