# Vegetative Propagation of *Prostanthera rotundifolia*©

**Mary Carmen Rodrigo Hernandez and Arne Skytt Andersen**
Royal Veterinary and Agricutural University, Department of Agricultural Sciences, Horticulture, Thorvaldsensvej 57, DK 1871 Frederiksberg C, Denmark

## INTRODUCTION

*Prostanthera rotundifolia*, R. Br., Australian mintbush, with attractive purple flowers in spring and fragrant foliage, has been reported in production in Australia and Europe (Erhardt and Erhardt, 1997; Philip, 1997). Because of its attractive flowers and scented foliage, Australian mintbush is a potential plant that can be introduced into the Danish market.

In the process of introduction of a new pot plant, one of the main prerequisites is to have enough plant material to carry out all the experiments required in the process (Christensen and Friis, 1987; Roh and Lawson,1987; von Hentig,1998; Wilkins and Erwin, 1998). Another criteria to bear in mind is that a potential new plant should be easy to propagate (Von-Hentig and Grüber, 1988; Armitage, 1990a and 1998; Masvidal, 1992). In most cases, little to nothing is known regarding the propagation requirements of the plant. However, in addition to such factors as the condition of the stock plants, the "positional effect" (influence of the cutting position of a future cutting on the stock plant), the time of year and many others, it is well known that the environmental conditions prior to and during the rooting phase are of special importance for successful propagation (Von-Hentig and Grüber, 1988; Moe and Andersen, 1988). In an attempt to ascertain whether *P. rotundifolia* can be propagated by cuttings and if cutting position has an influence on rooting, an experiment was designed with two clones of stock plants and cuttings from different positions.

## MATERIAL AND METHODS

Uneven top and stem cuttings from two *P. rotundifolia* stock plants were taken and placed randomly in 77-cell rooting trays. The stock plants were maintained under standard greenhouse conditions (>20°C, natural day length, and regular watering with fertilised water). No information is available regarding the origin of the plants.

Since the stock plants were flowering when the experiment started, the cuttings were divided into two groups according to whether they were removed from a flowering (referred to as Stock Plant 1) or nonflowering (Stock Plant 2) stem. The trays were filled with a commercial peat "Pindstrup® 2" which has a pH of 6 and an EC between 2.5 and 4.5.

Three-node top cuttings and two- to three-node stem cuttings were cut (Fig. 1). Prior to dipping in hormone and placing in the rooting medium the two lower leaves in both cuttings were removed. Previous to sticking the cuttings in the rooting medium all were dipped in a commercial hormone, Floramon® B, in order to enhance and obtain uniform rooting.

The trays were placed in the greenhouse under standard conditions: natural daylength; temperature setpoint was 23°C day and 21°C night; and a soil temperature set-point of 22°C, day and night. During the first stages of rooting the trays were covered by a poly-acryl tent to provide humid conditions and maintain cutting turgor. Due to the excessively moist environment and the development of rot

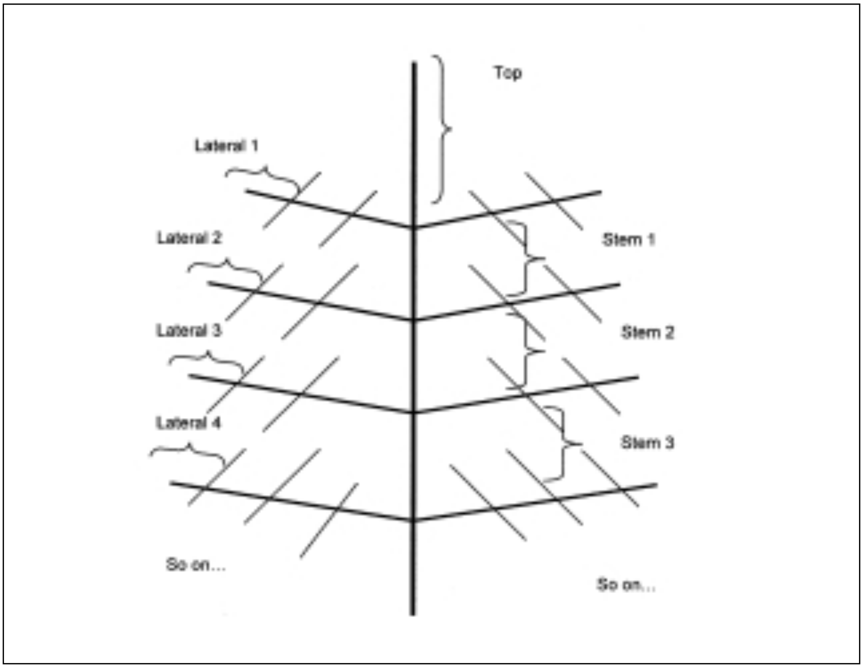


**Figure 1.** Detail of the shoot disposition in *Prostanthera rotundifolia*, and designation of the cuttings according to their branch position.

problems it was replaced by a white polyethylene cover placed 1 m above the cuttings until the end of the experiment. A week before the experiment ended the cuttings were hardened by the progressive removal of the cover for adaptation to the post-propagation conditions. After 7 weeks the rooting percentage, number of cuttings rooted per stock plant, and cutting position were recorded. Characteristics related to root quality: root invasion (characterized in Fig. 2), root color (white or brown), and root distribution (in how many sides of the plug the roots were observed) (Fig.3), visible roots (were the roots visible or not) were recorded as well, and a rooting index

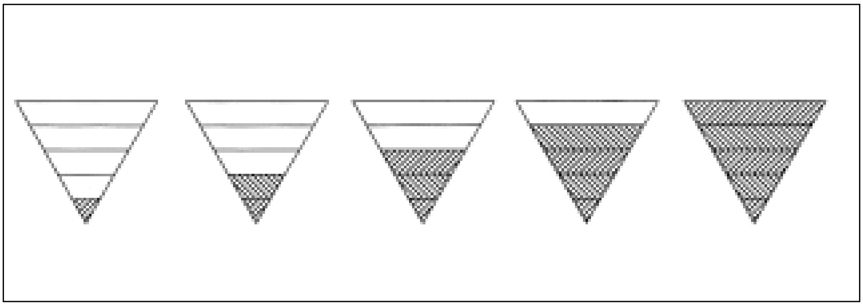

**Figure 2.** Root invasion in the plug sides according to the root vertical invasion, in order one to five.

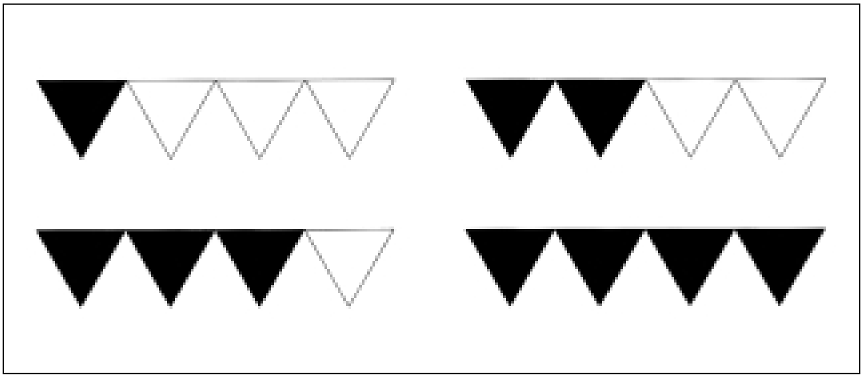

**Figure 3.** Root distribution (quantity) according to the sides where they can be seen, in order one to four.

was calculated according to the following formula:

Vi = (0.35* distribution)+(0.35*quantity)+(0.15*visible)+(0.2*color)

The rooted cuttings were transplanted into 10-cm black plastic pots filled with a standard growing medium. For each stock plant and cutting position survival after transplanting was recorded through 4 weeks.

The data were analysed with SAS version 6.12. Due to the characteristics of the data, based on counts, the statistical model used was $c^2$ test with a 5% significance. No statistical treatment was performed to the root quality data.

## RESULTS

The total number of top, stem, and lateral cuttings removed was higher in flowering stems than in nonflowering ones because the plants were flowering at the moment when the experiment started. As shown in Table 1 the number of top cuttings from both stock plants was by far lower than the stem and lateral cuttings removed from both stock plants.

Rooting percentage values from 30% to 100% were obtained from both stock plants. The rooting percentage is clearly inferior in cuttings taken from Stock Plant 1, 29% versus 78% in top cuttings and 41% versus 75% in lateral cuttings. The difference was not as obvious as in the previous kind of cuttings in stem cuttings where the rooting percentages were 73% and 79%, in Stock Plant 1 and Stock Plant 2, respectively.

For stem cuttings elevated rooting percentages, higher than 60%, were obtained in cuttings from both stock plants, with the exception of s6 in Stock Plant 2 (Table 1). With lateral cuttings values did not surpass 45% with the exception of l6 in Stock Plant 1, where 100% rooting was achieved.

The root quality was indicated by the Vi value, the higher the value, the better the root system development. Root quality is clearly higher in cuttings from Stock Plant 1 in cutting positions along the stock plant shoot when compared with Stock Plant 2 (Table 2). With the exception of l6 in Stock Plant 1, lower root system quality is apparent in lateral cuttings compared with stem and top cuttings in both stock plants.

For statistical processing two different approaches were taken: (1) The first one with all the cutting positions; (2) In the second one with the aim to reduce the volume of data to display, results related to the different positions from stem and lateral cuttings were reduced to two single groups to compare with top cuttings.

**Table 1.** Total number of top and stem cuttings removed from the two stock plants, number of transplanted cuttings and rooting percentage of *Prostanthera rotundifolia*, R. Br.

| | Cuttings removed | | Transplanting | | Rooting (%) | |
|---|---|---|---|---|---|---|
| Position | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 |
| TOP | 55 | 59 | 16 | 46 | 29.09 | 77.97 |
| S1 | 54 | 50 | 33 | 36 | 61.11 | 72.00 |
| S2 | 51 | 35 | 35 | 35 | 68.63 | 100.00 |
| S3 | 40 | 32 | 31 | 25 | 77.50 | 78.13 |
| S4 | 33 | 21 | 22 | 19 | 66.67 | 90.48 |
| S5 | 14 | 6 | 11 | 5 | 78.57 | 83.33 |
| S6 | 8 | 2 | 7 | 1 | 87.50 | 50.00 |
| ∑STEM | 200 | 146 | 139 | 121 | 73.33 | 78.99 |
| L1 | 31 | 43 | 13 | 38 | 41.94 | 88.37 |
| L2 | 38 | 45 | 5 | 23 | 13.16 | 51.11 |
| L3 | 47 | 28 | 12 | 25 | 25.53 | 89.29 |
| L4 | 19 | 18 | 7 | 18 | 36.84 | 100.00 |
| L5 | 9 | 21 | 2 | 9 | 22.22 | 42.86 |
| L6 | 2 | 4 | 2 | 3 | 100.00 | 75.00 |
| ∑LATERAL | 146 | 159 | 41 | 116 | 41.22 | 74.91 |
| TOTAL | 401 | 364 | 196 | 283 | 48.88 | 77.75 |
| | | 765 | | 479 | | 62.61 |

**Table 2.** Effect of cutting position on the roots quality quantified by Vi on *Prostanthera rotundifolia,* R. Br. cuttings.

| | Root quality | |
|---|---|---|
| Position | Stock plant 1 | Stock plant 2 |
| TOP | 1.67 | 1.03 |
| S1 | 1.44 | 1.40 |
| S2 | 1.68 | 1.42 |
| S3 | 1.94 | 1.73 |
| S4 | 2.27 | 1.77 |
| S5 | 1.76 | 2.05 |
| S6 | 1.70 | 1.54 |
| L1 | 1.81 | 0.96 |
| L2 | 1.48 | 0.68 |
| L3 | 1.75 | 0.72 |
| L4 | 1.33 | 0.45 |
| L5 | 1.72 | 0.72 |
| L6 | 2.75 | 0.45 |

Regarding to the number of rooted cuttings there is significant difference between the two stock plants of *P. rotundifolia* (P value 0.001 under 0.01). The position effect was obvious, as well; there was a significant difference between top, stem, and lateral cuttings (P value 0.001 under 0,01) in both treatments, a fact that can be verified with the rooting percentage shown in Table 1 and survival after transplanting was noticeably reduced after 2 weeks in the cuttings coming from Stock Plant 1 (Table 3). With the cuttings coming from Stock Plant 2 a successful transplanting was achieved, values closer to 100% in top and stem cuttings, as well as in lateral cuttings with the exception of l1 and l4. Survival after 3 weeks followed the same tendency as the previous one. After 4 weeks all the cuttings from Stock Plant 2 were completely established, it confirms the survival percentage 100% in roughly all the positions. Total number of rooted cuttings from Stock Plant 1 was by far reduced during the transplanting period (Table 3).

## DISCUSSION

The effect on root formation of cutting position on the stock plant is in agreement with the general statement by Hartmann et al., (1997) that the best rooting is usually found in cuttings taken from the basal portions of a shoot, as it happened with the high rooting percentages achieved by stem cuttings in both stock plants. Similar results have been reported by Hansen (1988, 1990) in *Stephanotis floribunda*; Hansen (1990) in *Schefflera arboricola;* and; Czekalski (1988) in *Hypocyrta glabra*, *Jacobinia carnea*, and *J. pohliana*.

**Table 3.** Survival after transplanting of *Prostanthera rotundifolia*, R. Br. cuttings.

| Position | Measure 6/5/2000 | | Survival (%) after 2 weeks | | Measure 17/5/2000 | | Survival (%) after 3 weeks | | Measure 24/5/2000 | | Survival (%) after 4 weeks | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 | Stock plant 1 | Stock plant 2 |
| TOP | 10 | 43 | 62.5 | 93.5 | 4 | 38 | 40.0 | 88.4 | 2 | 37 | 50.0 | 97.4 |
| S1 | 16 | 36 | 48.5 | 100.0 | 11 | 31 | 68.8 | 86.1 | 9 | 31 | 81.8 | 100.0 |
| S2 | 20 | 35 | 57.1 | 100.0 | 16 | 31 | 80.0 | 88.6 | 16 | 29 | 100.0 | 93.5 |
| S3 | 23 | 22 | 74.2 | 88.0 | 17 | 19 | 73.9 | 86.4 | 16 | 19 | 94.1 | 100.0 |
| S4 | 17 | 16 | 77.3 | 84.2 | 10 | 14 | 58.8 | 87.5 | 10 | 14 | 100.0 | 100.0 |
| S5 | 9 | 5 | 81.8 | 100.0 | 7 | 4 | 77.8 | 80.0 | 6 | 4 | 85.7 | 100.0 |
| S6 | 4 | 1 | 57.1 | 100.0 | 4 | 1 | 100.0 | 100.0 | 4 | 1 | 100.0 | 100.0 |
| L1 | 13 | 27 | 100.0 | 71.0 | 6 | 20 | 46.2 | 74.1 | 3 | 18 | 50.0 | 90.0 |
| L2 | 1 | 22 | 20.0 | 95.7 | 1 | 21 | 100.0 | 95.5 | 1 | 19 | 100.0 | 90.5 |
| L3 | 10 | 25 | 83.3 | 100.0 | 9 | 24 | 90.0 | 96.0 | 6 | 24 | 66.7 | 100.0 |
| L4 | 5 | 10 | 71.4 | 55.6 | 2 | 8 | 40.0 | 80.0 | 0 | 8 | | 100.0 |
| L5 | 1 | 8 | 50.0 | 88.9 | 0 | 8 | 0.0 | 100.0 | 0 | 8 | | 100.0 |
| L6 | 1 | 3 | 50.0 | 100.0 | 0 | 3 | 0.0 | 100.0 | 0 | 3 | | 100.0 |
| TOTAL | 136 | 243 | 69.4 | 85.9 | 87 | 222 | 64.0 | 91.4 | 73 | 215 | 83.9 | 96.8 |
| | | 379 | | 79.1 | | 309 | | 81.5 | | 288 | | 93.2 |

It has been suggested that hormone-like substances, rhizocalines, form in the developing buds and are transported through the phloem to the base of the cutting, where they stimulate root formation (Hartmann et al., 1997); that could explain the high quality values obtained in stem cuttings, as well as the elevated rooting percentages achieved in that kind of cuttings.

The high survival percentage is partly determined by the carbohydrate reserves which are likely to be greatest in the thickest cuttings (stem cuttings) which establish best (Howard, 1992). This might be due to the greater cutting thickness more carbohydrates and sugar content, therefore more growth (Awad et al., 1988).

A relationship between flower initiation and root development has been reported for several species, for example *Coleonema aspalathoides* (Heller et al., 1992). That relationship was explained as a drop in auxin level with flower induction. That might also explain the lowest results achieved in cuttings taken from flowering stems of *P. rotundifolia*. The basis for this is probably found in auxin relationships, since it is known that high auxin levels, which are favorable for adventitious root formation in stem cuttings, tend to inhibit flower formation (Hartmann et al., 1997).

Nevertheless the rooting percentages may suggest that *P. rotundifolia* is an easy to root species in which entirely satisfactory rooting is obtained regardless of the position of the cutting on the shoot.

## CONCLUSION

It is feasible to propagate *P. rotundifolia* by cuttings. The rooting is clearly affected by the stock plant from which the cuttings are removed and low rooting results if cuttings are taken from flowering stems. Therefore, it is recommended that propagation occur during the nonflowering period. Rooting obviously is influenced by the position effect in Stock Plant 1, stem cuttings root readily and uniformly in contrast to top and lateral cuttings. In Stock Plant 2, even though there are significant differences among the different positions, these results are not as obvious. The survival after transplanting achieved commercially acceptable values in cuttings taken from nonflowering stems.

Therefore, further research is required to determine when is the most suitable period of the year to propagate *P. rotundifolia* by uneven top and stem cuttings, whether in a nonflowering plant the position effect has an influence on rooting, as well as a screening of the hormone treatments to enhance stem cutting rooting, and whether it is feasible to propagate it under mist or fog systems. Additional trials on stock plant treatments to increase cutting production also should be carried out to obtain a general knowledge about *P. rotundifolia* propagation.

## LITERATURE CITED

**Armitage, A.M.** 1990. New herbaceous ornamental crops research, pp 453-456. In: J. Janick and J. E. Simon (eds). Advances in new crops. Proc. First National Symposium New crops: Research, development, economics. Timber Press, Portland, Oregon.

**Armitage, A.M.** 1998. Protocols for evaluating new crops: The new crop program at the University of Georgia. Acta Hort. 454:251-257.

**Awad, A. E., A.K. Dawh,** and **M.A. Attya.** 1988. Cutting thickness and auxin affecting the rooting and consequently the growth and flowering of *Bougainvillea glabra*, L. Acta Hort. 226:445-454.

**Christensen, O.V.** and **K. Friis.** 1987. Research and development of unknown new pot plants. Acta Hort. 205:33-37.

**Czekalski, M.I.** 1988. Propagation of *Hypocyrta glabra, Jacobinia carnea* and *Jacobinia pohliana* from cuttings. Acta Hort. 226:577-580.

**Erhardt, A.** and **W. Erhardt.** 1997. PPP Index. Pflanzen. Plantes. Plants. Plantas. Piante. Planten. Pflanzeneikaufsfürer für Europa. Guide d'achat des plantes en Europe. The European Plant Finder. Guía de compra de plantas en Europa. Guida all'acquisito delle piante in Europa. De Europese plantenvinder. Eugen Ulmer Verlag. Stuttgart.

**Hansen, J.** 1988. Effect of cutting position on rooting, axilary break and shoot growth in *Stephanotis floribunda*. Acta Hort. 226:159-165

**Hansen, J.** and **K. Kristensen**.1990. Axillary bud growth in relation to adventitious root formation in cuttings. Physiol. Plantarum 79:39-44.

**Hartmann, H.T., D.E. Kester, F.T. Davies,** and **R.L. Geneve.** 1997. Plant propagation. Principles and practices. 6th ed. Prentice Hall. New Jersey.

**Heller, A., A. Borochov,** and **A.H. Halevy**. 1992. Factors affecting rooting of *Coleonema aspalathoides* cuttings. Acta Hort. 314:323-329.

**Howard, B.H.** 1992. Small diameter as a marker for high rooting potential in leafy and leafless cuttings. Acta Hort. 314:213-220.

**Masvidal, L.** 1992. Investigación y desarrollo de nuevos cultivos ornamentales I. Horticultura 74:13-19.

**Moe, R.** and **A.S. Andersen.** 1988. Stock plant environment and subsequent adventitious rooting, pp. 214-234. In: T.D.Davis et al. (Ed.), Aventitious root formation in cuttings. Dioscorides Press, Portland, Oregon.

**Roh, M.S.** and **R.H. Lawson.** 1987. Research and development on new crops in the United States. Department of Agriculture. Symposium on the development of new floricultural crops. Acta Hort. 205:39-48

**Von Hentig, W.U.** and **G. Grüber.** 1988. Influence of rooting hormones on the propagation of several “new” ornamentals. Acta Hort. 226:479-488.

**Von Hentig, W.U.** 1998. Strategies of evaluation and introduction of “new ornamental plants”. Acta Hort. 454:65-77

**Wilkins, H.F.** and **J. Erwin.** 1998. Necessary considerations to introduce a new taxa. Acta Hort. 454:81-83.