Specific Differences in Shoot Tip Culture of Roses

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Twenty rose taxa (species, cultivars, and rootstocks) that were growing on farms at Gifu University and Gifu Rose Garden Ltd. were propagated in vitro by shoot tip culture. The shoot tips from all 20 rose taxa survived and elongated on all media. Fourteen of them were 100% viable on media of suitable concentration. *Rosa rugosa* 'Alba' and 'Rubra', *R. multiflora*, and *R.* ×*odorata* produced 4.1- to 8.2-mm-long shoots, but those of *R. canina* and its cultivars and *R. pimpinellifolia* were shorter (1.0 to 2.2 mm). *Rosa rugosa* and *R. banksiae* were intermediate.

INTRODUCTION

In order to breed rose cultivars that are resistant to crown gall disease, we developed an in vitro test method to evaluate resistance, which we reported at the third IPPS-Japan Annual Conference in 1996 (Zhou et al., 1996). Culturing rose plantlets in vitro is essential for this method. In the study presented here we propagated 20 rose taxa (species, cultivars, and rootstocks) by shoot tip culture. This paper reports the growth characteristics of these shoot-tip cultures.

MATERIALS AND METHODS

Shoot segments (3 cm) with an axillary bud were excised from shoots of 20 rose taxa (species, cultivars, and rootstocks) (Table 1) growing on farms at Gifu University and Gifu Rose Garden Ltd. The shoot tips were sterilized for 10 min in 1% sodium hypochlorite solution containing 0.01% Tween 20. The shoot tips (1 mm) were excised from the shoot segments and transferred to media. The basal medium was Murashige and Skoog (MS) medium containing 3% sucrose and 0.2% Gelrite. The plant growth regulators added to the basal medium were gibberellin A_3 (GA_3) 0.1 µM and 6-benzylaminopurine (BAP) in the range of 0.01 to 10 µM. All media were adjusted to a pH 5.7. Cultures were kept at 25C with a 16-h light period. Data was taken after 6 weeks in culture.

RESULTS AND DISCUSSION

The shoot tips for all rose taxa survived and elongated on all media. However, viability, shoot length, and most suitable medium for each plant was different (Table 1).

Rosa rugosa 'Alba' gave the best results, with a viability of 100% on all media. *Rosa canina* and six of its cultivars, 'Brogs Stachellose', 'Heinsohns Rekord', 'Pfander', 'Entree', 'Kuiper', and 'Uniform', as well as *R. multiflora* 'K2', *R. coriifolia* 'Froebelii', *R. banksiae*, *R.* ×*odorata*, *R. rugosa*, and *R. rugosa* 'Rubra' were 100% viable on media of suitable concentration, but the viability of *R. canina* 'Pollmers' and *R. canina* 'Veendam' was under 75%.

Table 1. Growth of rose species and cultivars after 6 weeks in shoot-tip culture.

Species/cultivars	Most suitable medium*	Viability(%)	Most suitable medium	Shoot length (mm)
Rosa canina	A	100	A	1.5
R. canina 'Brögs Stachellose'	B	100	B	2.1
R. canina 'Entree'	F	100	F	2.3
R. canina 'Heinsohns Rekord'	C	100	C	1.3
R. canina 'Kuiper'	C	100	C	1.9
R. canina 'Pfänder'	C	100	C	1.0
R. canina 'Pollmers'	D	75	F	1.0
R. canina 'Schmid's Ideal'	E	95	F	2.2
R. canina 'Uniform'	F	100	E	2.3
R. canina Veendam'	B	65	B	1.9
R. rugosa	C	100	C	2.5
R. rugosa 'Alba'	D	100	D	8.2
R. rugosa 'Rubra'	E	100	E	7.7
R. multiflora	C	95	C	4.9
R. multiflora 'Matsushima No. 3'	F	95	E	2.5
R. multiflora 'K2'	D	100	E	1.9
R. coriifolia 'Froebelii'	A	100	A	1.5
R. banksiae	D	100	D	2.6
R. ×odorata	C	100	C	4.1
R. pimpinellifolia	B	90	B	2.2

*Most suitable medium: MS medium with plant growth regulators added to the medium as follows:

A: GA_3 1.0×10^{-7} M, BAP 1.0×10^{-5}.
B: GA_3 1.0×10^{-7} M, BAP 3.2×10^{-6}.
C: GA_3 1.0×10^{-7} M, BAP 1.0×10^{-6}.
D: GA_3 1.0×10^{-7} M, BAP 1.0×10^{-7}.
E: GA_3 1.0×10^{-7} M, BAP 3.2×10^{-8}.
F: GA_3 1.0×10^{-7} M, BAP 1.0×10^{-8}.

Rosa rugosa 'Alba' and 'Rubra', *R. multiflora*, and *R.* ×*odorata* produced 4.1- to 8.2-mm-long shoots, but those of *R. canina* 'Pfander' and *R. canina* 'Pollmers' were shorter (1.0 mm). Other species and cultivars were intermediate (1.3 mm to 2.6 mm).

Of the six species, *R. multiflora* and *R.* ×*odorata*, with an average shoot length of 4.9 mm and 4.1 mm, respectively, were comparatively long, while *R. canina*, with 1.5-mm shoot length, was the shortest. *Rosa rugosa* (2.5 mm), *R. pimpinellifolia* (2.2 mm), and *R. banksiae* (2.6 mm) were intermediate.

With *R. canina* and its nine cultivars, shoot elongation was slow as a group. *Rosa canina,* and *R. canina* 'Brogs Stachellose', 'Schmid's Ideal', 'Entree', 'Uniform', 'Veendam', and 'Kuiper' had shoot lengths of 1.5 to 2.3 mm, while those of the other cultivars were 1.0 to 1.3 mm. For *R. rugosa* and its two cultivars, the shoot length of 'Alba' and 'Rubra' was longer than that of the species. Among *R. multiflora* and its two cultivars, the shoots for *R. multiflora* and 'Matsushima No.3' were long, but short on 'K2'.

Murashige and Skoog medium with BAP and GA_3 was suitable for the shoot tip culture of these rose species and cultivars. The most suitable concentrations for these roses are shown in Table 1. The most suitable medium for maximum viability and maximum shoot length was in most cases the same for a given species and its cultivars, but differed when compared with other species and their cultivars.

Shoot tip multiplication of roses has been reported in *R. hybrida* (Davies, 1980; Skirvin and Chu, 1979) and old world roses (Khosh-khui and Sink, 1982), however, only a small number of species and rootstock cultivars were evaluated in these studies. In our study, 20 taxa consisting of species cultivars and rootstock were used, and all species and cultivars had high viability and growth. Our results indicate that it is feasible to propagate these roses with selected media. For different rose species, shoot tip growth in vitro is different because of physiological and genetic differences (Cai et al., 1984), and Arnold et al. (1992) reported that BA and NAA both had significant effects on the proportion of viable plantlets and on multiplication rates while low or high concentrations of these growth regulators in the medium generally caused a reduction of plant material. In our study, of seven rose species, *R. multiflora, R.* ×*odorata, R. rugosa*, and *R. banksiae*, which are of east Asian origin, shoot tip growth was strong. However, for *R. canina* of European origin, shoot tip growth was weak. Our interpretation is that the geographical and climatic conditions of the place of origin produce special characteristics in these rose species.

LITERATURE CITED

Arnold, N.P., M.R. Binns, N.N. Barthakur, and **D.C. Cloutier.** 1992. A study of the effect of growth regulators and time of plantlet harvest on the in vitro multiplication rate of hardy and hybrid tea roses. J. Hort. Sci. 67:727-735.

Cai, J., M.Y. Cai, and **D.L. Qian.** 1984. Induction of multiple shoots and rapid propagation of clones of China rose (*Rosa chinensis*). Plant Physiol. Commun. 5:37-38.

Davies, D.R. 1980. Rapid propagation of roses in vitro. Scientia Hort. 13:385-389.

Khosh-khui, M. and **K.C. Sink.** 1982. *Micropropagation of new and old world rose* species. J. Hort. Sci. 57:315-319.

Skirvin, R.M. and **C. Chu.** 1979. In vitro propagation of forever yours rose. HortScience. 14:608-610.

Zhou, L., H. Fukui, and **S. Matsumoto.** 1996. In vitro inoculation test for resistance to crown gall disease on roses. Comb. Proc. Intl. Plant Prop. Soc. 46:750-754.