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The effect of rutin and pyrogallol upon rooting of softwood cuttings of magnolias and of *Syringa meyeri* Schneid.

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Abstract

Rutin and pyrogallol applied, using the quick-dip method, in concentrations 500 - 1500 mg/liter promoted rooting markedly, provided auxin was given simultaneously. The fungicide Captan used as an admixture to auxin promoted rooting only occasionally. SADH used separately was inactive.

INTRODUCTION

It was shown by Hess (1964) that polyphenols promote rooting of softwood cuttings of several plant species and exhibit a synergistic effect with auxins. Tomaszewski (1964) suggests that this synergism is due to polyphenol induced inhibition of indoleacetic acid oxidase. There are few further reports of the use of phenolic substances to promote rooting of cuttings. Poapst and Durkee (1967) used rather high concentrations of phenolic substances to promote root formation in *Phaseolus* cuttings. Basu et al. (1969) have shown that several phenolic substances are most active in as low concentrations as 1 mg/liter. Hackett (1970) reported a mixture of catechol and IAA to improve rooting of light grown *Hedera helix* stem tips. Lee and Tukey (1971) applied rutin with indolebutyric acid (IBA) using a quick-dip method to promote rooting of *Evonymus* cuttings.

The scope of this work was to test root promoting properties of two polyphenols: rutin and pyrogallol and of a retardant SADH on cuttings of the three ornamental plants: *Magnolia* × *soulangeana* Soul., *Magnolia stellata* Maxim. and *Syringa meyeri* Schneid.

MATERIALS AND METHODS

The cuttings of magnolias with only one node (Fig. 1) and cuttings of *Syringa* with an uninjured apex and 3 - 4 pairs of unrolled leaves were dipped for 5 sec. with their lower ends in a solution of phenolic substances or SADH in 50% ethanol. Then, they were treated with auxin or

Fig. 1. Cutting of magnolia

a fungicide Captan or both in talc powder (P i ą t k o w s k i et al. 1973). The fungicide Benlate was applied as a solution in 50% ethanol. The cuttings were planted in a rooting medium consisting of a compost soil covered with 2 cm layer of peat and 4 cm layer of washed sand. The temperature of the greenhouse was 20°C at night and 20 - 30°C during the day. Intermittant mist was applied. The experiment was set up in 4 randomized blocks with 15 cuttings per plot.

Several weeks after the time of planting the number of healthy rooted cuttings was checked. The root system was evaluated according to 5 classes and the results were expressed as "rooting coefficients" calculated separately for each plot (P i ą t k o w s k i et al. 1973):

$$\frac{\Sigma \text{ (number of cuttings in a given class} \times \text{class number)}}{\text{number of cuttings in a plot}}$$

The "rooting coefficient" expresses jointly: the number of rooted cuttings per plot and the size of the root systems formed. Besides of that the results were also presented as the numbers of rooted cuttings per plot. These numbers were transformed for statistical analysis according to F r e e m a n and T u k e y's transformations for binominal and Poisson distributions (M o s t e l l e r and Y o u t z 1961; C a l i ń s k i 1964).

Results concerning the number of rooted cuttings and rooting coefficients were evaluated using the method of analysis of variance employing Duncan's multiple range test for significance.

RESULTS

The evaluation of rooting response to the different treatments was based mainly on "rooting coefficients" (Table 1 and 2). Since the coef-

Table 1

The effect of different treatments upon rooting of cuttings of magnolias. Treated on July 20 checked on September 23. The results presented are averages of 4 plots with 15 cuttings each

The concentrations of phenolic substances and Alar in mg/liter. The auxins, Benlate and Captan used in talc powder. NAA used only in a concentration of 0.2%

Treatments	*Magnolia soulangeana*		*Magnolia stellata*	
	Rooting coefficients	Numbers of rooted cuttings per 15	Rooting coefficients	Numbers of rooted cuttings per 15
Control untreated	1.22_{ab}*	8.66_{bcd}	0.43_{abc}	4.97_{ab}
Captan 10% (Cp)	1.15_{ab}	7.31_{abc}	0.36_{ab}	4.11_{a}
NAA	1.04_{ab}	7.14_{abc}	0.86_{fg}	7.16_{abc}
NAA + Cp	1.42_{bc}	8.00_{bcd}	0.59_{cd}	6.35_{abc}
Benlate 0.5% + NAA	0.43_{a}	4.30_{a}	0.48_{abc}	6.46_{abc}
Rooting powder	—	—	0.33_{a}	4.42_{ab}
Rutin 500	—	—	0.53_{bcd}	5.67_{abc}
1000	—	—	0.51_{bcd}	5.52_{abc}
1500	—	—	0.57_{cd}	5.46_{abc}
Rutin 500 + NAA	1.64_{bc}	7.66_{bcd}	1.26_{h}	9.30_{cd}
1000 + NAA	1.53_{bc}	9.47_{bcd}	2.16_{i}	12.05_{d}
1500 + NAA	2.51_{d}	11.00_{de}	0.77_{ef}	7.75_{abc}
1500 NAA + Cp	2.15_{cd}	9.36_{bcd}	—	—
Pyrogallol 500 + NAA	1.53_{bc}	9.01_{bcd}	—	—
1000 + NAA	2.84_{d}	12.37_{de}	—	—
1000 + NAA + Cp	2.08_{cd}	10.45_{cde}	—	—
IBA 0.2% (i)	—	—	0.42_{abc}	4.23_{a}
0.1% + Cp	—	—	0.44_{abc}	5.43_{ab}
0.2% + Cp	—	—	0.67_{de}	5.43_{ab}
Pyrogallol 1000 + i	1.64_{bc}	8.00_{bcd}	—	—
1000 + i + Cp	1.26_{ab}	9.00_{bcd}	—	—
Rutin 1500 + i + Cp	—	—	0.96_{g}	8.32_{bc}
Alar (85% of SADH) 1250	0.79_{ab}	6.16_{ab}	—	—
5000	1.13_{ab}	8.50_{bcd}	—	—

* Numbers marked with the same letter in a given column do not differ significantly.

Table 2

The effect of different treatments upon rooting of *Syringa meyeri* Schneid cuttings. Treated on June 21, results checked on August 14. Other details as in Table 1

Treatment	Rooting coefficients	Numbers of rooted cuttings per 15
Control untreated	0.68_{ab}*	4.34_{abc}
Captan 10% (Cp)	0.67_{ab}	5.39_{bcd}
NAA	2.03_{cde}	10.15_{de}
NAA + Cp	2.55_{de}	11.02_{ef}
Rutin 500	0.84_{ab}	5.28_{bcd}
1000	0.26_{a}	2.00_{ab}
1500	1.37_{bc}	8.33_{cde}
Rutin 500 + NAA	2.80_{ef}	12.54_{ef}
1000 + NAA	2.78_{ef}	11.39_{ef}
1500 + NAA	3.38_{f}	14.49_{f}
1500 + NAA + Cp	2.09_{cde}	11.43_{ef}
Pyrogallol 1000 + NAA	2.00_{cde}	9.65_{cde}
1500 + NAA	2.63_{de}	11.50_{ef}
IBA 0.4%	2.40_{de}	11.01_{ef}
0.2% + Cp	2.16_{de}	10.58_{de}
0.4% + Cp	1.89_{cd}	10.39_{de}
0.8% + Cp	2.26_{de}	10.14_{de}
Alar (85% SADH) 1500	0.33_{a}	0.84_{a}
2500	0.23_{a}	2.00_{ab}

* Numbers marked with the same letter in a given column do not differ significantly.

ficients make possible precise comparison. The average numbers of rooted cuttings per 15 pieces are also given in the tables (Tables 1 and 2) in order to make possible a comparison of our results with those of other authors.

Magnolias: *M.* × *soulangeana* Soul. cuttings rooted markedly better than those of *M. stellata* Maxim. Naphthaleneacetic acid (NAA) in concentration 0.2% in talc was ineffective with *M.* × *soulangeana* but promoted rooting of *M. stellata* cuttings. Indolebutyric acid (IBA) alone was ineffective when used on *M. stellata* cuttings. Captan alone or as an admixture to NAA did not stimulate rooting but seemed to increase the effect of some concentrations of IBA. Benlate used only in one concentration did not increase the effect of NAA. The commercial preparate "Rooting powder" did not improve rooting of *Magnolia stellata*.

Rutin used separately did not promote adventitious root formation. However, rutin and pyrogallol applied with auxin showed a markedly better effect on rooting than auxin alone.

Alar — the commercial preparate of SADH used separately as a quick-dip treatment in concentrations of 1250 - 5000 mg/liter had no effect upon rooting.

Syringa meyeri Schneid.: The cuttings of this species responded markedly to NAA or IBA. Captan used separately or in combination with auxins did not improve rooting. Treatment with rutin (1500 mg/liter) and with NAA promoted the formation of adventitious roots much more than did NAA alone. Captan used with auxin and rutin decreased the effect of these two substances. Pyrogallol with auxin was less effective than rutin with auxin, however, it is possible that both these polyphenols were used in concentrations lower than optimal. SADH had no beneficial effect on root formation in cuttings of this species.

DISCUSSION

The results presented in this paper confirm the data of the previous authors (Hess 1964; Tomaszewski 1964; Basu et al. 1969; Bojarczuk and Jankiewicz, in press) that polyphenols together with auxins markedly promote the formation of adventitious roots in cuttings. The quick-dip method of treatment applied for polyphenols first by Lee and Tukey (1971) has given good results in our experiments both with rutin as well as with pyrogallol. The polyphenols with auxins stimulated the rooting of cuttings of all 3 species investigated. Since the highest concentrations of polyphenols: 1000 - 1500 mg/liter were most promotive it seems advisable in the future to use still higher concentrations as well. It would also be advisable to use phenolic substances and auxin in one solution. We hope that phenolic substances applied with the quick-dip method may soon be introduced into nursery practice and may markedly improve the results of rooting in comparison with using auxins alone (Sonnenfeld 1961).

Rutin used without auxin did not promote root formation — this corroborates the results of all previous authors (Lee and Tukey, 1971).

In our and in Basu et al. (1969) and in Lee and Tukey (1971) experiments phenolic substances showed a synergistic effect with synthetic auxins such as IBA or NAA. This synergism can not be explained by the polyphenol induced inhibition of indoleacetic acid oxidase, since IBA is very slowly oxidized as compared with IAA (Kenten 1955). Furthermore, when radioactive IAA and NAA were applied to plant tissues only IAA was seriously decarboxylated (Donoho et al. 1962; Hejnowicz and Tomaszewski 1969). Therefore other possible mechanisms for the action of polyphenols should be looked for.

The fungicide Captan used alone or in a mixture with auxin was ineffective in this experiment (with one exception). In the earlier work of van Doesburg (1964), van Elk (1969) and Piątkowski et al.

(1973) performed mostly with other species of plants Captan markedly improved the effect of auxin upon rooting. It seems interesting that in our experiments Captan applied with auxin and polyphenol diminished, sometimes significantly, the effect of these two substances upon rooting. Another fungicide, Benlate, applied at a concentration 0.5% in talc did not increase the effect of NAA. In the experiments of Fiorino et al. (1969) this fungicide showed beneficial effects on rooting.

SADH in our experiments showed a lack of effect upon rooting. The ability of this compound to promote root formation reported by Read and Hoysler (1969) is then probably confined only to some species of plants.

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Wpływ rutyny i pirogallolu na zakorzenianie się sadzonek zielnych dwóch gatunków magnolii i *Syringa meyeri Schneid.*

Streszczenie

Traktowanie sadzonek związkami fenolowymi: rutyną lub pirogallolem w połączeniu z auksynami powodowało znacznie silniejsze pobudzanie zakorzenienia, niż wtedy, gdy auksyny stosowano same. Polifenole bez auksyn nie pobudzały zakorzenienia. Polifenole stosowano metodą roztworów stężonych, łatwą do stosowania w praktyce. Substancje grzybobójcze Captan i Benlate na ogół nie zwiększały stopnia zakorzenienia sadzonek zarówno wtedy gdy stosowano je same, jak i wtedy gdy podawano je z auksynami. SADH (Alar) nie powodował silniejszego zakorzenienia sadzonek.