Rooting Oak Cuttings from Gibberellin-treated Stock Plants

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Abstract. Rooting of *Quercus ithaburensis* Deche. cuttings decreased significantly with increasing stock plant age. Gibberellin (GA₃) applied as bark treatment on leafless pruned stems of 3-year-old stock plants improved rooting percentage 6- to 7-fold. GA₃ application also enhanced bud release and particularly shoot growth, thus increasing the number of cuttings per stock plant.

Oaks (*Quercus* spp.) are highly heterozygous and exhibit high genetic variation. Attempts to propagate oaks from stem cuttings for obtaining clonal material have had limited success. Juvenile cuttings taken from oak seedlings root quite easily but oaks lose juvenility very rapidly, resulting in reduced rooting capability (Morgan and McWilliams, 1976). Stock plant etiolation and blanching before cutting propagation (Eshed, 1991) and use of rooted cuttings as stock plants (Morgan et al., 1980) have improved the rooting of oak cuttings.

Gibberellins are often associated with juvenility, and application of gibberellins to several species in the mature phase induces some juvenile characteristics (Hackett, 1985). GA₃ treatment of mature stock plants of avocado (*Persea americana* Mill.) (Cutting and Van Vuuren, 1988) and citrus (Sagee et al., 1990) significantly improved the rooting of cuttings. The aim of the present study was to examine the possibility to improve rooting of *Quercus ithaburensis* cuttings by treating stock plants with gibberellin. *Quercus ithaburensis* was chosen as representative of the East Mediterranean oaks.

Materials and Methods

One-, 2-, and 3-year-old seedlings of *Q. ithaburensis* were grown in an open nursery in 3-L containers using a mixture of 7 peat : 3 perlite (v/v). Seedlings were fertilized with 7N-3P-7K at 100 mg·L⁻¹ through the drip irrigation system.

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GA₃ (Sigma Chemical Co., St. Louis) was applied in April by means of a lanolin (BDH, Poole, England) paste. The lanolin paste was prepared by heating the lanolin to 50 °C and adding the desired concentration (w/w) of GA₃, dissolved in methanol, with constant stirring. Immediately after complete top pruning to about 10 cm above the growing medium, leaving one leafless stem, the paste was applied 1) on top of the cut surface (≈250 mg) or 2) around the stem to a length of 2 cm (≈400 mg) 2 to 3 cm above the growing medium (bark treatment). Ten stock plants were used for each treatment.

The number of shoots was recorded 4 weeks after pruning and 60 apical and subapical cuttings were harvested. The two types of cuttings were pooled because Eshed (1991) has shown that apical and subapical cuttings of *Q. ithaburensis* root similarly. Cuttings were ≈10 cm long and 4 to 6 mm thick, with about four leaves. The base of the cuttings was treated with commercial rooting powder containing 0.8% indole-3-butyric acid (IBA).

Fig. 1. Rooting percentage of cuttings from nontreated stock plants of *Quercus ithaburensis* as affected by stock plant age. Bars followed by the same letter are not significantly different at $P \leq 0.05$ ($n = 60$).

Cuttings were rooted in an even mixture of vermiculite : perlite (v/v) and held at 24 ± 1 °C. Cuttings were misted for 5 s every 10 min. The rooting percentage was recorded after 6 weeks. Experiments were repeated several times over 3 years.

Analysis of variance was performed on arcsin-transformed square roots of proportion.

Results and Discussion

Stock plant age had a significant effect on rooting of cuttings. Rooting percentage of cuttings from nontreated stock plants dropped from 30% in cuttings from 1-year-old plants to 7% in cuttings from 3-year-old plants (Fig. 1). Cuttings from 9-year-old stock plants showed the same rooting ability as those from 3-year-old plants (data not shown).

All GA₃ concentrations applied as bark treatment to 3-year-old stock plants increased rooting over the control by 6- to 7-fold (Fig. 2). No significant difference was found between GA₃ at 500, 1000, and 2000 mg·L⁻¹. Application of GA₃ to the cut surface of pruned stems immediately after pruning did not significantly increase the rooting of cuttings (data not shown).

There was a trend for increasing number of new shoots formed following treatment with increasing GA concentrations. However, the difference between the treatments and the control was not statistically significant. In addition, the percentage of long shoots (longer than 10 cm, the minimum length of cutting) was significantly higher in GA₃-treated plants. GA₃ at 500 and 1000 mg·L⁻¹ increased the percentage of long shoots from 35% in control plants to ≈60%.

Quercus ithaburensis quickly loses its rooting ability with increasing stock plant age (Fig. 1). GA₃ treatment of stock plants not only restored the rooting ability but significantly increased it above the control (Fig. 2). Since GA₃ treatment was effective in 3-year-old oak seedlings, which, according to their rooting

Fig. 2. Effect of GA₃ concentration on rooting percentage of 3-year-old cuttings of *Quercus ithaburensis*. Bars followed by the same letter are not significantly different at $P \leq 0.05$ ($n = 60$).

ability, were probably in the mature phase, it is reasonable to assume that the rooting-promotive effect of GA₃ resulted from a rejuvenation effect. This assumption is supported by the observations that GA₃ induces morphological and physiological changes characteristic of the juvenile phase in mature plants of several species (Hackett, 1985). The rooting-promotive effect of GA₃ following application to stock plants should be distinguished from its inhibitory effect on rooting when applied to cuttings before rooting (Hartmann et al., 1990).

Our study points to the possibility of using GA application to oak stock plants to improve

rooting of cuttings. This method seems to have an advantage over those previously reported, such as etiolation (Eshed, 1991) and use of rooted cuttings as stock plants (Morgan et al., 1980), since GA₃ not only improves rooting but also increases the number of cuttings available from the stock plants.

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