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Research Note

Rooting Leafy Non-Etiolated Avocado Cuttings from Gibberellin-Injected Trees

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ABSTRACT

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Gibberellin was injected into several small nursery trees to induce a "juvenile" vigour in the subsequent growth flush. The resultant vegetative flush was vigorous and showed diminished apical dominance. After hardening off, cuttings with at least 2 leaves were taken, treated with a commercial rooting powder (0.2 or 0.3% IBA) and placed in a mist-bed with bottom heat.

After 60 days, the cuttings displayed basal swelling and 80% of the cuttings showed rootlet initiation. After 120 days several cuttings had started to root, and after 150 days the trial was terminated. Cuttings were removed from the mist-bed and scored for rooting. Sixty-eight percent of the cuttings produced at least 1 root and were assessed for survival ability.

Keywords: avocado; growth regulators; rooting.

Abbreviations: GA_3 = gibberellic acid; IBA = indole-3-butyric acid.

Several countries which cultivate the commercially-important avocado (*Persea americana* Mill.) cultivars rely heavily upon clonal rootstocks tolerant to the root pathogen *Phytophthora cinnamomi* (Zentmyer, 1984; Coffey, 1985; Brokaw, 1987; Kotze et al., 1987). This requires the production of rooted cuttings to ensure the uniformity of the required genetic characteristic (Hartmann and Kester, 1975). Much research effort has been devoted to the rooting of green, leafy avocado cuttings (Hass, 1937; Gustafson and Kadman, 1969; Kadman and Gustafson, 1970; Hendry and Van Staden, 1982; Ernst, 1984; Ernst and Holtzhausen, 1987). However, results have been inconsistent or poor.

Successful rooting of the avocado has been obtained using stem etiolation prior to rooting (Frolich and Platt, 1972; Moll and Wood, 1981; Reuveni and Raviv, 1981; Moll et al., 1987). The most common etiolation technique makes use of a "nurse" seed (Frolich and Platt, 1972), and production of rooted plants is therefore limited by the availability of suitable disease-free seed. Production

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of rooted plantules in tissue culture has been reported (Rosas and Garcia, 1984; Pliego Alfaro et al., 1987). However, according to the latter, the survivability of the rooted tissue-cultured avocado plants remains a problem.

This note reports upon growth-regulator-induced manipulation of avocado trees to produce cutting material more likely to root without the necessity for etiolation.

Two-year-old 'Fuerte' and 'Duke 7' trees in 20-kg pots were injected with 10 ml 2000 $\mu g\ l^{-1}$ GA_{4+7} in water (Fig. 1). After uptake, the plug holes were treated with a commercial tree seal and the trees left to flush. After the resultant vigorous vegetative flush had hardened off (about 3 months after injection), cuttings of pencil thickness with 2 or 3 leaves were taken and the bases were treated with commercial rooting powder (0.2 or 0.3% IBA in talc). Twenty-five cuttings for each treatment were then placed in a mist-bed with bottom heat (29°C) and left to root. Twenty cuttings from an untreated tree of each cultivar which had flushed about 2 months earlier were treated with 0.3% IBA and placed in the mist-bed as a control. Treatments were in blocks with no randomization. The cuttings were assessed for rooting after 60, 90, 120 and 150 days. After 150 days, any cutting that had a least 1 root of 10 mm or longer was

Fig. 1. Method used for the direct injection of gibberellin in water into young nursery trees. The water was injected under pressure into a hole drilled into the xylem. Trees were injected during mid-morning and uptake took from 1 to 3 h.

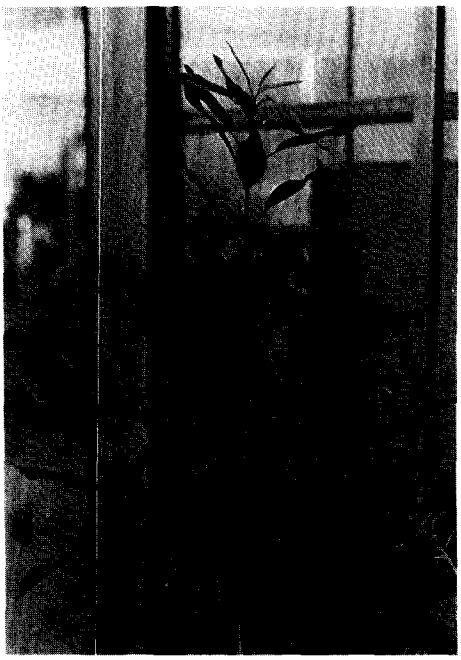

Fig. 2. Vigorous vegetative flush in response to GA_{4+7} injection, showing long internodes and reduced apical dominance.

TABLE 1.

Rooting characteristics of IBA-treated cuttings from avocado trees injected with GA_{4+7}. Control cuttings had 0.3%, IBA dip but, were not given a prior gibberellin treatment. Duke and Fuerte results are combined (means of 50 cuttings per treatment)

Treatment	Period in mist-bed (days)					
	0	30	60	90	120	150
Control						
With root initials (%)	0	0	0	0	0	0
With roots (%)	0	0	0	0	0	0
0.2% IBA						
With root initials (%)	0	0	56	72	80	80
With roots (%)	0	0	0	4	54	68
0.3% IBA						
With root initials (%)	0	0	36	48	56	60
With roots (%)	0	0	0	0	16	44

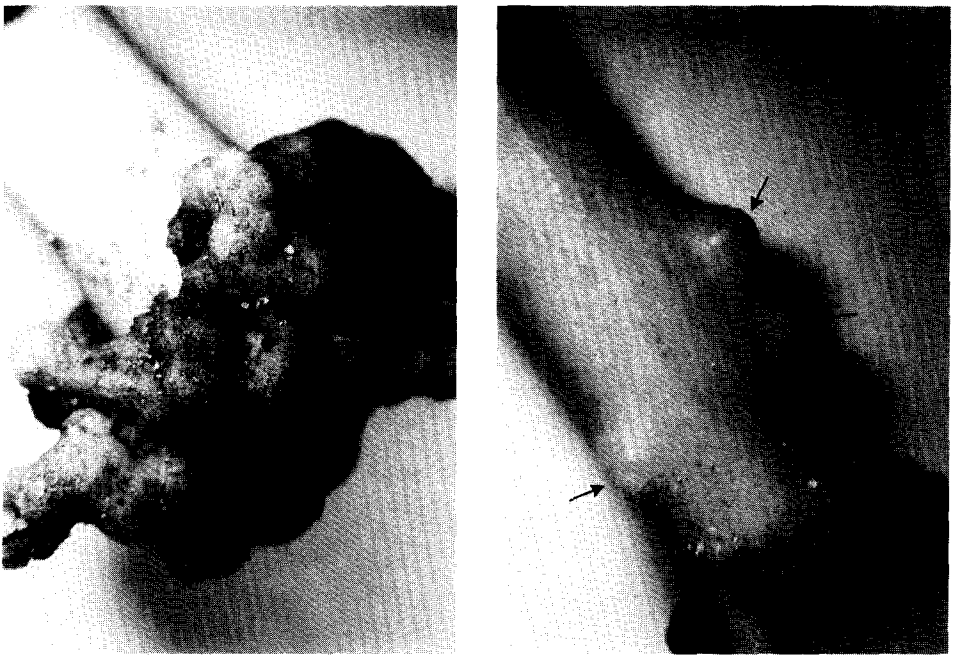

Fig. 3. Excess callus production at the base of an avocado cutting in response to treatment with 0.3% IBA.

Fig. 4. Root initials beginning to form at the base of an avocado cutting.

scored as having rooted. Twenty percent of the rooted cuttings were assessed for survival ability and the trial was then terminated. Survival was determined by the ability of the rooted cutting to produce and expand a new leaf.

The GA_{4+7} in water was taken up in under 2 h and the trees did not appear to suffer any setback. The trees began flushing 2–3 weeks after injection and produced a vigorous vegetative flush which showed reduced apical dominance (Fig. 2). The trees continued to flush for 6–8 weeks and the flush hardened off about 3 months after injection. Untreated trees did not flush. The rooting results are presented in Table 1, from which it is clear that none of the control cuttings rooted. The concentration of IBA in the talc affected rooting, with 0.2% giving better rooting. The 0.3% IBA stimulated the production of excess callus (Fig. 3). Basal callusing began after 30 days and was associated with all the cuttings that rooted. Root initials arose from 5 to 10 mm above the callus and were noticeable when the cuttings were inspected 90 days after being placed in the mist-bed (Fig. 4). Typically, the roots that emerged were 1–2 mm in diameter and there were normally 2–4 roots per cutting (Fig. 5). All the 0.2%-IBA-treated cuttings and 92% of the 0.3%-IBA-treated cuttings that rooted survived. These early results indicated a high survival rate for those cuttings

Fig. 5. Typical rooting occurring 150 days after being placed in a mist-bed with 29°C bottom heat. The cuttings were non-etiolated and treated with 0.2% IBA. The roots did not arise from the callus but from 5–10 mm above the basal callus.

that rooted, but further research with larger numbers and more cultivars needs to be undertaken before recommendations can be given.

The results of this trial indicate that avocado cuttings from vigorous flushes can be rooted with success without the necessity for etiolation. Vigorous growth was achieved with a gibberellin treatment. The response of reduced apical dominance and bud break due to gibberellin treatment is well known (Hillman, 1985).

In contrast to other research, no roots emerged from the callus (Rosas and Garcia, 1984; Ernst and Holtzhausen, 1987), and while all the cuttings that rooted showed callus development, weaker or reduced rooting was associated with excess callus production. Callus production is at least partially controlled by the applied IBA (Ernst, 1984), and this study has shown the necessity of using the correct IBA concentration.

The technique for rooting avocado cuttings reported here took 8–9 months from injection to the rooted cutting. This saves 3–5 months over the nurse seed–etiolation technique (Frolich and Platt, 1972). However, the major advantage of this technique is the elimination of the nurse seed, thereby preventing the spread of the seed-borne sun blotch virus (Da Graca, 1985).

Research is underway to evaluate this technique on all the commercial avocado rootstock cultivars currently in use in South Africa.

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