Increased Rooting in Difficult-To-Root Hibiscus Cuttings by Heat Shock

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Treating the bases of cuttings with hot water (40C = 104F) for 15 to 60 min dramatically increased the rooting of difficult-to-root hibiscus cuttings.

INTRODUCTION

In the basal part of a cutting, all cells are differentiated structurally as well as biochemically. Therefore, potential sites for root formation have to dedifferentiate, i.e., lose their previously developed characteristics, if they are to become root initials. Adventitious roots are normally initiated close to preexisting vascular systems (Lovell and White, 1986). Several factors are known to influence the ability of cuttings to root. Successful rooting starts with having stockplants growing under optimal conditions (Andersen and Moe, 1986). Factors, such as light intensity, temperature, and nutrients, are not only affecting the growth of stockplants, but also the ease by which their cuttings root. These factors have been well studied and, while they may give better and faster rooting in easy-to-root cuttings, the effect is less in more difficult-to-root plants. Growth hormones have also been shown to have a major role in the rooting process. They have been used in propagation since their discovery in 1934, but they have not been able to significantly increase rooting in difficult-to-root cuttings (Wilson, 1994). At the I.P.P.S. meeting in Cleveland in 1990, a now retired plant propagator—John Wilde—told me about how propagators in the "old days" used hot-water treatments on difficult-to-root cuttings. Today, many effects of heat shock (i.e., from hot water) have been elucidated. However, these affects are at the molecular level where it has been shown, that heat shock turns on some of those genes that are controlling cell division. In Copenhagen, we have been working with some difficult-to-root cultivars of hibiscus. I, therefore, decided to reinvestigate the effect of heat shock on difficult-to-root hibiscus cuttings.

MATERIAL AND METHODS

Three cultivars of *Hibiscus rosa-sinensis* were used: Holiday (easy-to-root), "a red-flowered form" (intermediate rooting ability), and Casablanca (difficult-to-root). The stockplants were 1 year old and grown in a greenhouse at a minimum temperature of 20C. For additional information on growing conditions see Bertram (1991). Apical cuttings were taken from non-floral shoots, and excised just above the node of the second fully developed leaf. The base of the cutting was stuck through a small hole in a styrofoam plate (30 cm × 40 cm). The styrofoam plate was placed in a water bath at 20C or 40C for up to 2 h. Each treatment consisted of 20 cuttings and was repeated three times. After the heat treatment, the cuttings were rooted hydroponically as described by Bertram (1990).

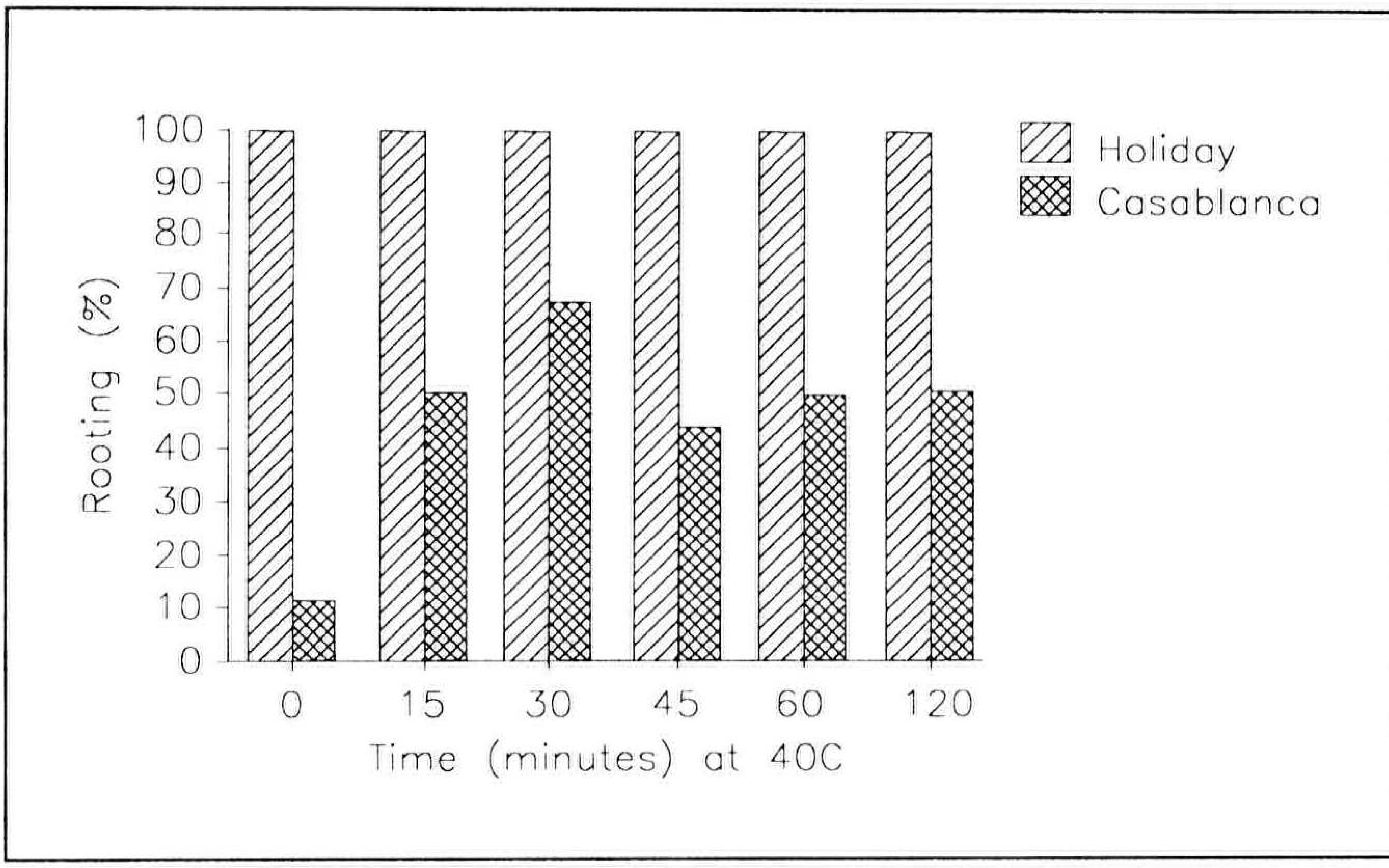

Figure 1. The effect of duration of a heat treatment on rooting of two cultivars of *Hibiscus rosa-sinensis*. The base of the cuttings were heated in hot water for the times indicated, whereafter the cuttings were transferred to room temperature. All cuttings were rooted hydroponically. Rooting percentage was determined after 26 days of rooting.

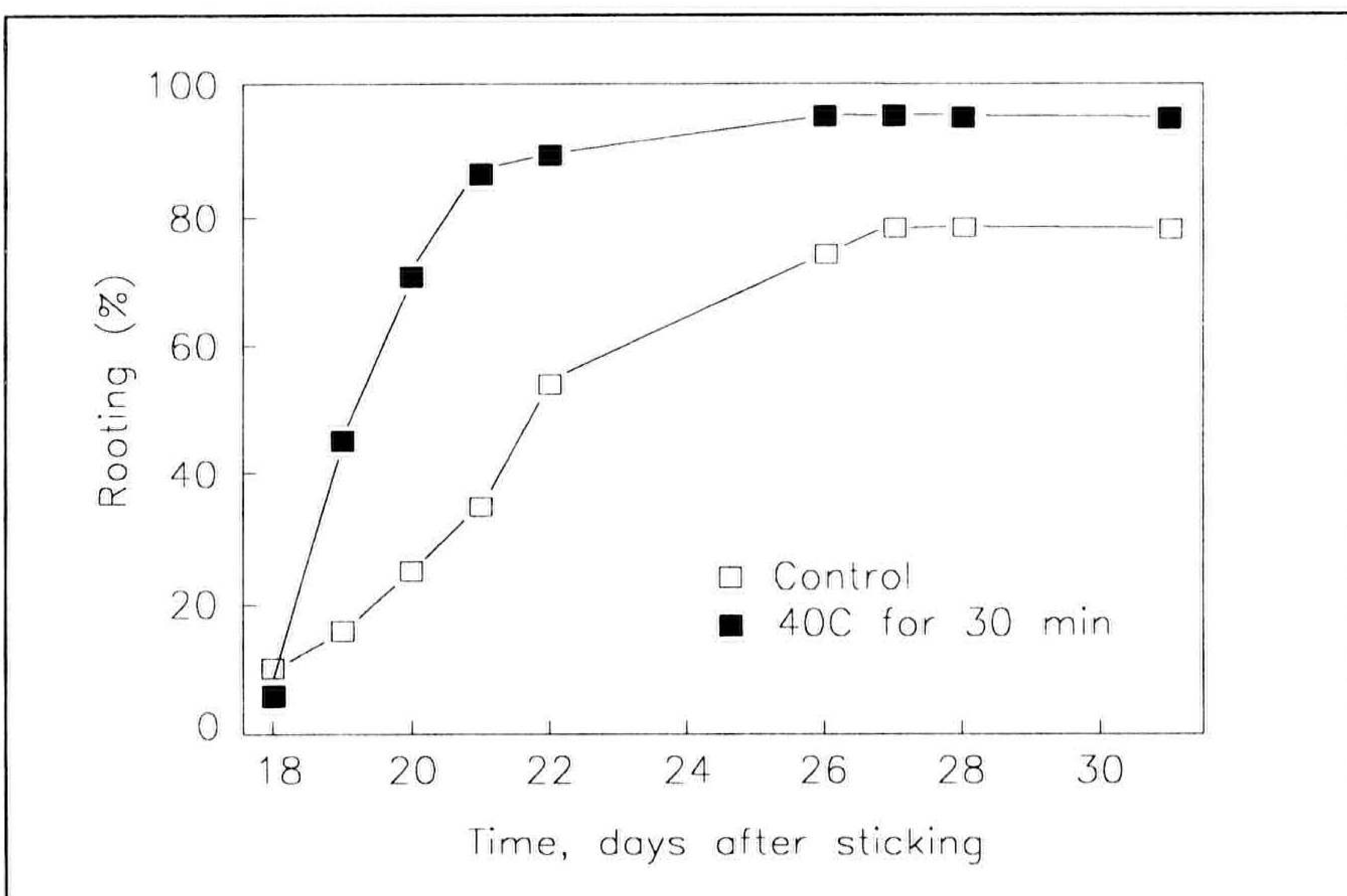

Figure 2. The effect of a 30-min heat treatment (40C) on rooting percentage of an intermediate-rooting cultivar of hibiscus (*Hibiscus rosa-sinensis* L., "a red-flowered form"). The bases of the cuttings were heated in hot water for the times indicated, whereafter, the cuttings were transferred to room temperature. All cuttings were rooted hydroponically. Rooting percent was determined during 30 days of rooting.

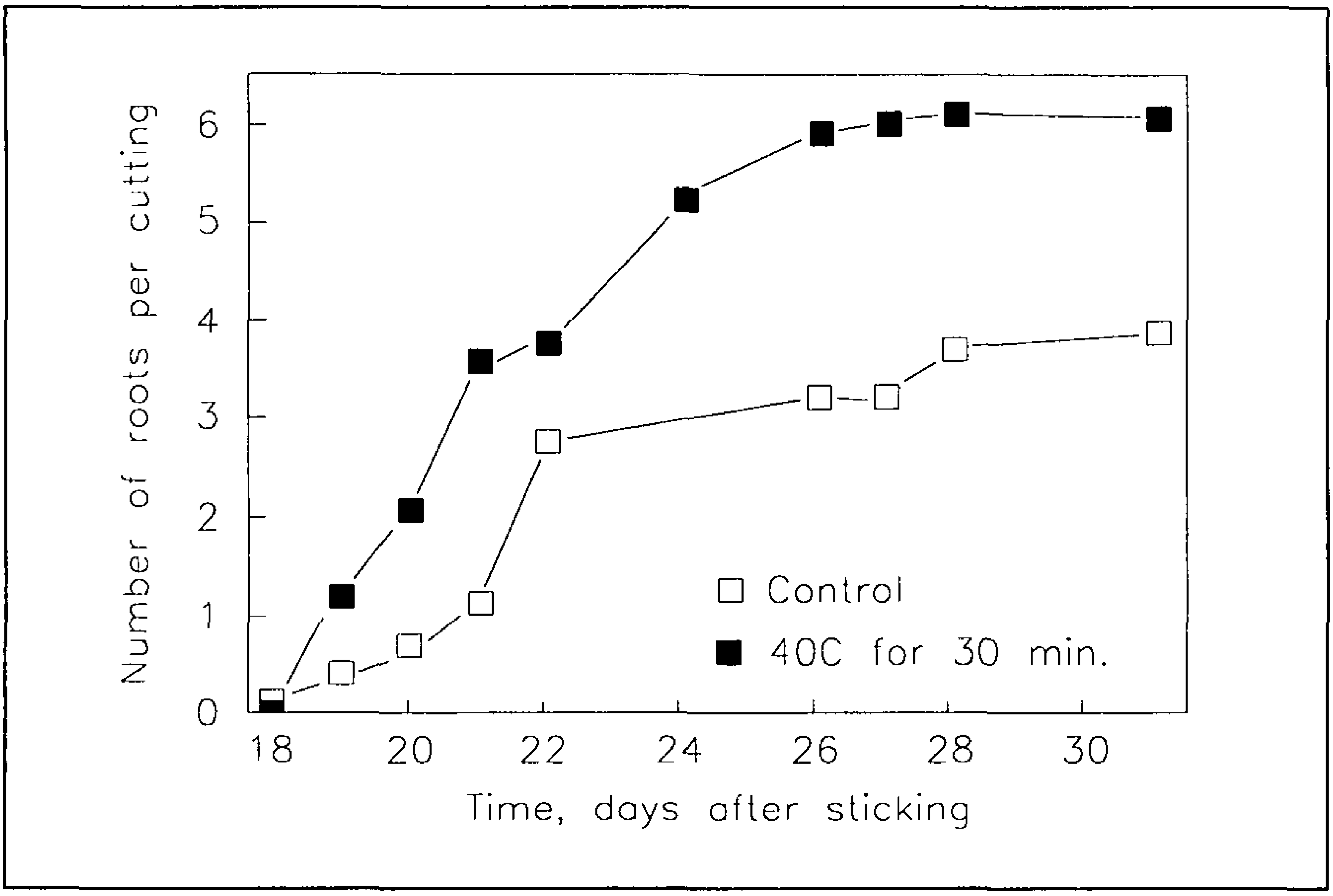

Figure 3. The effect of a 30-min heat treatment (40C) on the number of roots formed per rooted cutting from an intermediate-rooting cultivar of hibiscus (*Hibiscus rosa-sininsis* L., "a red-flowered form") The base of the cuttings was heated in hot water for the times indicated, whereafter, the cuttings were transferred to room temperature. All cuttings were rooted hydroponically. Root number was determined during 30 days of rooting.

RESULTS

The rooting of the difficult-to-root 'Casablanca' increased from 11% to 69% after a heat shock treatment of 40C for 30 min (Fig. 1), whereas the rooting of the easy-to root 'Holiday' did not respond to the heat treatment. Increasing the heat treatment time did not increase rooting of 'Casablanca'. The same effect was observed for the intermediate-rooting red-flowered form. A time course study on this cultivar showed both an increase in the rooting percentage and a decrease in rooting time from 26 to 21 days (Fig. 2). Concurrently with an increase in number of cuttings rooted, the number of roots per rooted cutting increased from 3.8 to 6.2 (Fig. 3).

DISCUSSION

Rooting temperature has been known to affect the rooting of cuttings since the beginning of this century, with optimal rooting most often found at temperatures from 18C to 25C. However, as far back as 1918, Curtis (1918) observed increased rooting in cuttings treated with 40C or 45C hot water. Although the effect of hot water treatment was well documented during the next decades, the practical use of this treatment ceased when rooting hormones and mist propagation became widely practiced. In recent years, I have not been able to find the documented use of hot-water treatments. Previous work on the propagation of hibiscus cuttings showed the importance of stock-plant condition (Bertram, 1991). However, even under optimized conditions, it was not possible to get satisfactory rooting in the difficult-to-root cultivar Casablanca. When the bases of these cuttings were treated with hot water, rooting was stimulated (Fig. 1). As little as 15 min was enough to stimulate rooting over control. The molecular changes that occur in plants from heat shock are now well documented (Howarth, 1991). A new set of genes are activated, while most of the previously active genes are turned off. These changes have been observed after a heat shock of as short as 10 min. (Lin et al., 1984). It is interesting to note, that some of the genes turned on by heat shock are key genes for the very early changes within the cell which must occur before the cell can start to divide. Because there was no effect of heat shock on the easy-to-root cultivar, heat shock may be that missing link in difficult-to-root plants that Wilson (1994) is calling the rooting morphogen. That heat shock stimulates early events in the rooting process may also be deducted by the fact that it accelerates the speed of rooting (Fig. 2). This happens because dedifferentiation of target cells occurred faster. It was also evident that more cells had become susceptible to division followed by differentiation into root meristems, because the heat shock treatment also increased the number of roots per rooted cutting (Fig. 3).

LITERATURE

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