ROOTING OF MANGO CUTTINGS UNDER INTERMITTENT MIST

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Abstract

The effect of different factors on rooting of mango cuttings under intermittent mist was studies on cuttings taken from young seedlings of four polyembryonic cultivars. Best results were obtained by retaining 4 - 6 leaves on semi-hardwood cuttings and dipping the cutting bases in talcum powder containing 1% Benomyl and 1% potassium salt of indole-3-butyric acid. Aerated media [e.g. peat: polystyrene shredded flakes (1:1/v:v)] and bottom heat of 25^0 to 30^0C were optimal.

Under optimal rooting conditions, differences were found in the rooting capability of various clones, ranging from 75 to 100% for cuttings taken from young seedlings and from 0 to 100% for cuttings taken from grafted stock plants of selected clones.

Introduction

Mango trees can thrive under a wide range of climatic conditions, in areas with scanty rainfall and also in very wet regions. One of the major factors limiting distribution and production is the lack of suitable well adapted rootstocks. For example, in many arid areas the existence of calcareous soils and saline irrigation water is a limiting factor for establishment of this crop. Some promising rootstocks for such conditions were selected (Gazit and Kadman, 1980; Kadman, 1985).

Vegetative propagation of rootstocks can be achieved using polyembryonic seeds. Since not all potential selected rootstocks are polyembryonic, other methods for vegetative propagation have to be considered, such as rooting of cuttings. Although mango rootstocks can be propagated by air layering (Mukherjee and Majumdar, 1963), the practice has not been adopted commercially. Attempts to induce rooting of cuttings did not meet with appreciable success. Of the different kinds of cuttings that were treated with rooting hormones and under intermittent mist with bottom heating, only juvenile shoot cuttings gave a consistently high rooting percentage (Rajan and Ram, 1983)

One aim of the present work was to study the optimal conditions for rooting mango cuttings. For this purpose, it was necessary to use cuttings with a rooting capability. Therefore, easy-to-root cuttings taken from young seedlings of polyembryonic cultivars were used. Another aim was to obtain information about the rooting capability of different mature clones.

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Material and methods

Semi-hardwood cuttings were taken from 8-17 month-old container-grown seedlings of four polyembryonic cultivars, 'Turpentine' (TUR), 'Gumera' (GUM), 'Sabre' (SAB) and 13/1 (ONE); and from 3-year-old container-grown plants of different clones grafted on 'ONE' and cut back from time to time to induce branching.

Cuttings were arranged under mist in four randomised blocks, and in four split randomised blocks when taken from seedlings of different cultivars. The cultivars used and the total number of cuttings per treatment are listed below. Data were obtained on rooting percentage and on the number of roots produced per cutting in a survey carried out at the end of a 4-week period under mist, when no further significant changes in rooting occurred. The data were submitted to statistical analysis. Mean separation within columns in tables is according to Duncan's Multiple Range Test, P=0.05.

Cutting bases were dipped in talcum powder containing benomyl (Benlate) and the potassium salt (1%) of indole-3-butyric acid (K-IBA). To determine the optimal concentration of K-IBA (Table 1), 16 cuttings/treatment of 'TUR', 'GUM', 'SAB' and 'ONE' cultivars were used. The optimal number of entire or halved leaves to be retained per cutting was tested using 16 cuttings/treatment of 'TUR', 'GUM', 'SAB' and 'ONE' cultivars (Table 2). Six leaves per cutting were retained in the experiment studying K-IBA concentration (Table 1), and five leaves per cutting in all other experiments. The effect on rooting of media (Table 3) with different aeration capacities was studied by mixing different proportions of peat with vermiculite, perlite and shredded polystyrene foam flakes (polystyrene). The air content of the media was measured 24h after saturation with water (Tinus and McDonalds, 1979). In these experiments 32 cuttings/treatment of 'TUR' and 'ONE' were used. In all other experiments peat and polystyrene (1:1/v:v) were used as the rooting medium. The effect of bottom heat temperature (Table 4) was studied during the winter, when the rooting medium could be maintained at relatively low temperatures (20-25^{0}C). Thirty-two cuttings/treatment of 'TUR', 'GUM', 'SAB' and 'ONE' were used. In all other experiments, the bottom heat temperature was kept at 30^{0}C.

Sixteen cuttings/clone were used for studying the rooting capability of ten selected grafted clones (Table 5).

Results

Effect of K-IBA on rooting

The different auxin concentrations affected mainly the number of roots produced per cutting (Table 1). A high auxin concentration (2.0%) had a negative effect on the number of roots produced by cuttings of 'ONE' (data not presented). A concentration of 1.0% K-IBA in the rooting powder was found optimal for all cultivars.

Leaf retention

Leaf retention was important for rooting and even two halved leaves per cutting was sufficient to induce a high percentage of rooting (Table 2). The main effect of retained leaves was on number of roots per cutting. There was no advantage to retaining more than six leaves per cutting. Halved leaves led to a decrease in number of roots per cutting, as compared with the same number of entire leaves (Table 2). Significant differences were found among cultivars (date not presented), mainly in number of roots per cutting. All non-rooted cuttings with at least two halved leaves belonged to the 'SAB' and 'ONE' cultivars. Since most mango flushes have at least six leaves, it is recommended to take cuttings at a length of one flush and leave all the leaves, in order to induce proper rooting.

Composition of the rooting medium

After 16 days under mist a high rate of rooted cuttings and a large number of roots per cutting were found (Table 3). In one medium [peat:polystyrene (1:2/v:v)], a decrease in rooting was found which was, however, compensated for after 2 weeks (Table 2). A difference in rooting among cultivars found in the first survey diminished in the second one (data not presented). No significant differences in rooting were found when commonly employed rooting media (Hartman and Kester, 1983) were used. The extent of medium aeration in the range compared (11-19%) did not influence rooting. It is thus concluded that the choice of medium components can be determined by their availability and price, as long as a certain degree of aeration is achieved.

Bottom heat temperature

Following 2 weeks under mist, 10% of the cuttings rooted at temperatures of 20 and 35°C, and 20% rooting was recorded at temperatures of 25 and 30°C. After an additional 2 weeks, the advantage of 25 and 30°C bottom temperature was seen (Table 4). At a temperature of 35°C, many bases of the cuttings, were damaged and rooting occurred at a higher position on the stem. As found in previous experiments, there were differences among cultivars in regard to speed and rate of rooting as well number of roots produced per cutting. The sensitivity to the higher temperatures (30-35°C) was in the following order: 'ONE' > 'SAB' > 'GUM' > 'TUR' (data not presented).

In general, the number of roots per cutting was not influenced significantly by the medium temperature, except for differences among cultivars at the higher temperatures. It can be concluded that temperatures > 20°C accelerate rooting and those > 35°C suppress it. Temperatures in range of 25 to 30°C were optimal for all cultivars compared.

Clonal differences

There was a wide range in rooting capability (nil to 100%) of cuttings taken from 30 selected grafted clones. The different clones could not be compared in one run, due to a lack of enough uniform cuttings at one time. Therefore, comparisons were made in a few experiments. The results are presented of one comparison (Table 5), which showed considerable variability in rooting capability. Another general finding was that the number of roots per cutting was higher in the easy-to-root clones. The same pattern (Table 6) of less roots per cutting was found in the juvenile cuttings of cultivars with a lower rooting capability used in different experiments (Tables 1,2 and 4).

Discussion

The results obtained demonstrated that it is possible to root mango cuttings under intermittent mist in a relatively short time. To carry out mass propagation of specific clones, suitable cuttings have to be produced. This can be achieved by grafting selected clones on rootstocks from which cuttings can be taken for rooting and initiation of stock plants to be grown on their own roots as stock plants. By cutting them back in order to induce branching, ample cuttings can be produced. The advantages to rooting cuttings taken from such stock plants are well known from other plants (Hartman and Kester, 1983).

A wide range of aerated media can be used for rooting (Table 3), depending on their availability and cost under various conditions. The need for intermittent mist and bottom heat can be reduced by using reliable intermittent mist controllers and rooting in the appropriate season: in the tropics without bottom heat all year round, and in the subtropics during summer, when the temperature of the medium will be close to optimal (Table 4). Treating the cutting bases with an auxin was essential to accelerate rooting and increase root production.

Four to six entire leaves should be retained in order to promote the number of roots produced per cutting (Table 2). The contribution of leaves to the rooting process could be due to the continuation of photosynthesis under mist, which leads to an accumulation of carbohydrates at the base of the cuttings. The importance of high carbohydrate content at the site of rooting has been shown in many other cuttings (Reuveni and Raviv, 1980). Since there was no serious leaf shedding from mango cuttings under mist, as reported for avocado (Reuveni and Raviv, 1980), no shortage of carbohydrates is expected at the cutting bases of cuttings which are difficult-to-root. Application of auxin to such cuttings did not improve their rooting (Table 5) and therefore other factors may be involved. Leaves have been suggested as the source of several factors, other than auxin, essential for rooting (Raviv and Reuveni, 1984). Further study is needed to determine whether rate of biosynthesis in leaves, translocation and accumulation at the base of cuttings differs (Raviv et al., 1987) in easy and difficult-to-root cuttings.

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Table 1. Effect of benonyl (Benlate) and K-IBA rooting percentage and roots per cutting of mango.

Treatment	Rooting (%)	Roots (no.)
None (control)	81 a	4.3 a
Benlate (1%)	88 a	5.2 a
K-IBA (0.5%) + Benlate (1%)	94 a	9.6 ab
K-IBA (1.0%) + Benlate (1%)	94 a	13.5 b
K-IBA (2.0%) + Benlate (1%)	81 a	14.4 b

Table 2. Effect of number of entire and halved leaves on rooting percentage and roots per cutting of mango.

Treatment	Rooting (%)	Roots (no.)
No leaves	6 a	0.2 a
2 halved leaves	88 b	5.3 b
2 entire leaves	88 b	6.8 bc
4 halved leaves	94 b	8.6 bc
4 entire leaves	100 b	12.2 c
6 halved leaves	100 b	9.1 bc
6 entire leaves	94 b	14.0 d
8 halved leaves	100 b	10.7 bc
8 entire leaves	100 b	14.1 d

Table 3. Effect of rooting medium composition on rooting percentage after 16 and 30 days, and on roots per cutting of mango after 16 days.

Medium Composition (v/v)		Air (%)	Rooting (%) day 16	Rooting (%) day 30	Roots (No.)
Peat:Vermiculite,	1:2	11	84	100 a	7.3
Peat:Polystyrene,	1:1	12	75	91 a	7.1
Peat:Polystyrene,	1:2	16	63	91 a	5.9
Peat:Perlite,	1:2	19	81	97 a	7.0

Table 4. Effect of bottom heat temperature on rooting percentage and on roots per cutting of mango.

Temperature (°C)	Rooting (%)	Roots (no.)
20	40 a	7.4
25	70 b	6.8
30	70 b	6.1
35	30 a	5.6

Table 5. Rooting percentage and number of roots per cutting obtained with different mango clones.

Clone	Rooting (%)	Roots (No.)
YOT - 97	88	9.3
HAV - 4	88	4.7
YOT - 13	56	7.3
HAV - 5	50	3.9
JASMIN	44	2.0
YOT -142	32	2.7
BSR - 1	32	1.2
YOT - 26	13	1.4
BSR - 32	13	4.0
EIN - 3	13	2.0

Table 6. Rooting percentage and number of roots per cutting obtained in different experiments with cuttings of young seedlings of different cultivars.

Cultivar	Rooting (%)	Roots (No.)
Turpentine	86 a	10 a
Gumera	80 a	9 a
Sabre	75 ab	7 ab
13/1	60 b	5 b