Kasetsart J. (Nat. Sci.) 42 : 207 - 214 (2008)

Improvement of Propagation by Hardwood Cuttings with and without Using Plastic Pavilions in Fig (*Ficus carica* L.)

Narongchai Pipattanawong[1*], Sawitree Tiwong[2], Benjarach Thongyean[1], Rungtiwa Darak[2], Pornprasert Thamin[2] and Wet Techa[1]

ABSTRACT

Improvements of fig (*Ficus carica* L.) cutting propagation with and without using plastic pavilions were conducted at the Inthanon Royal Project Research Station (Khun Huai Hae area) as experiment 1 and at Pang Dah Royal Project Research Station as experiment 2, both in Chiang Mai province, at the elevation of 1,300 and 720 m above mean sea level, respectively. From experiment 1, larger cutting sizes in comparison with those of 0.6 – 0.8 and 1.0 – 1.2 cm was partially attributable to increased bud and root growth, as indicated by the number of emerged buds and roots in the "Brown Turkey" cultivar. In experiment 2, "Brown Turkey" was the most feasible cultivar for the region when using plastic pavilion, followed by "Dauphine" and "Lisa". Comparison between treatments with and without the pavilions among cultivars suggested that cuttings placed in pavilions increased the number of emerged buds and roots earlier than those without pavilions. The results indicated that using plastic pavilion increased the temperature that promotes early callus formation of buds and roots in the propagation of fig cutting in cool area such as the Inthanon Royal Project Research Station.

Key words: fig, pavilion, hardwood cutting

INTRODUCTION

The fig (*Ficus carica* L., Moraceae family) is native to western Asia and has been cultivated for thousands of years in Mediterranean countries of Europe and North Africa (Manago, 2006). Today the cultivation of fig is extensive, particularly in Spain, Turkey and Italy, but more limited in the United States. Figs are especially good sources of fiber which aid in the body's elimination process. Fresh figs contain 1.2% fiber whereas dried ones contain 5.6%. The increased interest in the nutritional aspects of foods should result in more information being obtained for figs (Bolin and King, 1980).

In Thailand, the research on figs as a replacement crop for opium poppies was carried out more than 20 years ago under the Royal Project Foundation (Punsri and Thongtham, 1983). The study was conducted on the morphology and growth of some fig cultivars and focused on their adaptability and yielding ability in the environment of highland areas. There have no report focusing on the influence of vegetative characteristics that might permit further optimization of the hardwood cutting propagation to increase the number of

1 Agro-Ecological System Research and Development Institute, Kasetsart University, Bangkok 10900, Thailand.
2 Royal Project Foundation, Chiang Mai 50000, Thailand.
* Corresponding auther, e-mail: rdinap@nontri.ku.ac.th

Received date : 14/02/07 Accepted date : 09/11/07

plants. Nowadays, Thai consumer demand on dried figs (for health benefits) has resulted in significant imports of dried figs from the USA, Turkey, and others. Although dried figs are available throughout the year, there is nothing like the unique taste and texture of fresh figs. In tropical areas, generally, figs can thrive at elevation levels from 800 to 1,800 m (Morton, 1987) and can tolerate frost, down to –8°C (Samson, 1986). However, the inhibition of growth, as with other temperate fruits, was found when fig plants were placed at low temperatures. No data are available on the propagation of figs by hardwood cuttings in these tropical highland areas, including the north of Thailand, where cool climate is observed almost throughout the year. Furthermore, there is no information on the influence of using the small plastic pavilions on the rapid increase in number of fig plants. Under the recent marketing situation of fresh figs, the experiments were carried out with the objective of improving the propagation of figs by hardwood cuttings with, or without, the use of small plastic pavilions for the hill tribes' extension in the highland areas.

MATERIALS AND METHODS

The study was conducted at the Inthanon Royal Project Research Station (Khun Huai Hae area) and Pang Dah Royal Project Research Station (Chiang Mai province) at elevation of 1,300 and 720 m above mean sea level, respectively.

Experiment 1. At the Inthanon Royal Project Research Station (Figure 1), one-year-old hardwood cuttings from the fig tree cultivar "Brown Turkey" grown at this station, with 0.6 - 0.8, 1.0 - 1.2, 1.4 - 1.6, and 1.8 – 2.0 cm stem diameters (measured 10 cm from the bottom) and 30 cm length were used. Cuttings were planted on 1 Feb. 2006 in 8.75 × 30 cm (1,650 cm^3) plastic bags containing a medium consisting of 1:1:1 (by volume) of field soil, rice-hull ash, and manure. Cuttings were placed in a nursery under a natural environment and equally divided into two groups,

Figure 1 Fig cuttings from experiment 1 were placed inside and outside the plastic pavilions in nursery at the Inthanon Royal Project Research Station (Khun Huai Hae area), Chiang Mai province, at an elevation level of 1,300 m above mean sea level.

one for the control outside plastic pavilion and the other was put inside small plastic pavilions, with 100 cm diameter and 150 cm height. After the treatments, the data of first studies were recorded at 10-days intervals, while others were recorded only at 20, 40, and 60 days after the beginning of the experiment. Both sets of data were recorded in terms of the number of emerged buds per cutting, percentage of bud emergence, number of emerged roots per cutting, percentage of root emergence, and average longest root length. Water was applied as needed but no fertilizer or chemicals were applied during the experiment. A completely randomized design was used with three replications with four cuttings per experimental unit. The mean differences were tested by DMRT (Duncan's multiple range test).

At Pang Dah Royal Project Research Station (Figure 2), the experiment was based on experiment 1 and was conducted on 11 Feb. 2006. The treatments and plant materials were the same as previously described in experiment 1 with the following modifications: one-year-old hardwood cuttings of "Brown Turkey", "Dauphine" and "Lisa" cultivars were grown at this station with 1.0 – 1.2 cm stem diameter and 30 cm length. Cuttings were planted into a medium in plastic bags and small plastic pavilions were used as described in experiment 1. Data were also recorded as described for experiment 1 at two-week intervals. A completely randomized design was used with three replications with four cuttings per experimental unit. The mean differences were tested by DMRT (Duncan's multiple range test).

RESULTS

There was a response detected on the with and without plastic pavilion treatments in this study (Table 1). The 1.4 - 1.6 cm stem diameter cuttings without plastic pavilion had the highest average number of emerged buds at 10 days after treatment, while the 1.4 – 1.6 cm cuttings with plastic pavilion had a higher number than did the

Figure 2 Cuttings of 3 fig cultivars from experiment 2 were placed inside and outside the plastic pavilions in nursery at Pang Dah Royal Project Research Station, Chiang Mai province, at an elevation level of 720 m above mean sea level.

others at 30 and 40 days. The 1.8 – 2.0 cm cuttings under pavilions had the greatest percentage of bud emergence at 30 days. However, this result showed that 0.6 – 0.8 and 1.0 – 1.2 cm cuttings without pavilions had commonly less emerged buds in 4 different periods. After 10 to 20 days from starting the experiment, there was no visible root emergence in every treatment. At 30 and 40 days, the number of emerged roots of 1.0 – 1.2 and 0.6 – 0.8 cm cuttings with pavilions were 7.3 and 18.5 roots, respectively, resulted in significantly higher than those of the others. The results showed that the highest percentage of root emergence were 75 and 81 % were from 0.6 – 0.8

Table 1 The effects of small plastic pavilions on vegetative growth characteristics of fig cuttings as compared with the controls at the Inthanon Royal Project Research Station. Data were recorded at 10-day intervals.

Treatments	No. of emerged buds /cutting	% bud emergence	No. of emerged roots/cutting	% root emergence	Average longest root length (cm)
10 Days					
0.6-0.8 cm(with pavilions)	1.0 c[1]	35.0 bc	-[2]	-	-
1.0-1.2 cm(with pavilions)	1.50 b	37.50 b	-	-	-
1.4-1.6 cm(with pavilions)	1.28 bc	32.54 bc	-	-	-
1.8-2.0 cm(with pavilions)	1.25 bc	42.71 ab	-	-	-
0.6-0.8 cm (control)	0 d	0 d	-	-	-
1.0-1.2 cm (control)	1.0 c	25.0 c	-	-	-
1.4-1.6 cm (control)	2.0 a	50.0 a	-	-	-
1.8-2.0 cm (control)	0 d	0 d	-	-	-
20 Days					
0.6-0.8 cm(with pavilions)	2.36 a	59.51 b	-	-	-
1.0-1.2 cm(with pavilions)	2.50 a	71.81 ab	-	-	-
1.4-1.6 cm(with pavilions)	3.11 a	68.68 ab	-	-	-
1.8-2.0 cm(with pavilions)	2.08 a	75.69 ab	-	-	-
0.6-0.8 cm (control)	0 b	0 c	-	-	-
1.0-1.2 cm (control)	0 b	0 c	-	-	-
1.4-1.6 cm (control)	2.0 a	83.33 a	-	-	-
1.8-2.0 cm (control)	2.50 a	83.34 a	-	-	-
30 Days					
0.6-0.8 cm(with pavilions)	2.11 b	73.57 b	2.17 bc	75.00 ab	3.99 ab
1.0-1.2 cm(with pavilions)	2.08 b	52.50 c	7.25 a	50.00 c	5.0 a
1.4-1.6 cm(with pavilions)	3.22 a	74.81 b	2.83 bc	66.67 b	4.67 a
1.8-2.0 cm(with pavilions)	2.50 b	85.42 a	1.72 c	81.25 a	3.75 ab
0.6-0.8 cm (control)	0 d	0 e	3.0 b	25.00 d	3.20 b
1.0-1.2 cm (control)	0 d	0 e	0 d	0 e	0 c
1.4-1.6 cm (control)	1.25 c	50.0 c	0 d	0 e	0 c
1.8-2.0 cm (control)	1.0 c	37.50 d	0 d	0 e	0 c
40 Days					
0.6-0.8 cm(with pavilions)	2.08 c	68.15 ab	18.50 a	87.50 b	8.29 a
1.0-1.2 cm(with pavilions)	2.00 c	57.78 bc	15.67 b	75.00 e	4.67 b
1.4-1.6 cm(with pavilions)	3.00 a	71.14 a	14.17 bc	83.33 bc	8.42 a
1.8-2.0 cm(with pavilions)	2.33 b	78.13 a	12.88 c	100.00 a	8.13 a
0.6-0.8 cm (control)	2.00 c	50.00 c	0 e	0 e	0 c
1.0-1.2 cm (control)	0 e	0 e	0 e	0 e	0 c
1.4-1.6 cm (control)	2.00 c	75.00 a	4.00 d	50.00 d	0.50 c
1.8-2.0 cm (control)	1.00 d	25.00 d	0 e	0 e	0 c

[1] Means with the same letter in the same column are not significantly different at 5 % probability.

[2] No visible root emergence.

and 1.8 – 2.0 cm cuttings with pavilions, after a periods of 30 days. Whereas the treatment of 1.8 – 2.0 cm cuttings with pavilions had the highest percentage of root emergence at 40 days. The stems grown under the plastic pavilions consistently showed longer root length, compared to those without pavilions at both 30 and 40 days.

The hardwood cuttings which were not pulled up until 20, 40, and 60 days after planting showed the visible bud emergence, except the treatment of 1.0 – 1.2 cm stems without pavilions (Table 2). There were no differences in number of emerged buds among treatments at 20 days, with the exception of 0.6 – 0.8 and 1.0 – 1.2 cm stems placed the outside which had no emerged buds. The 1.4 – 1.6 cm stems with pavilions had the greatest number of emerged buds at 40 days. At the period of 40 days, there were no differences in the percentage of bud emergence among the treatments of 0.6 – 0.8, 1.0 – 1.2, and 1.8 – 1.2 cm cuttings with pavilions, and 1.4 – 1.6 cm cuttings without pavilions. In addition, the 0.6 – 0.8 and 1.0 – 2.0 cm cuttings without pavilions had no emerged roots at 40 days after treatment. At 60 days after treatment, the 1.0 – 1.2 cm cuttings without pavilions had neither emerged buds nor emerged roots.

The effects of using plastic pavilions on

Table 2 The effects of small plastic pavilions on vegetative growth characteristics of fig cuttings as compared with the controls at the Inthanon Royal Project Research Station. Data were recorded at 20, 40, and 60 days after the treatments.

Treatments	No. of emerged buds /cutting	% bud emergence	No. of emerged roots/cutting	% root emergence	Average longest root length (cm)
20 Days					
0.6-0.8 cm (with pavilions)	2.46 a[1]	66.37 b	-[2]	-	-
1.0-1.2 cm (with pavilions)	2.17 a	59.72 b	-	-	-
1.4-1.6 cm (with pavilions)	2.54 a	95.00 a	-	-	-
1.8-2.0 cm (with pavilions)	2.00 a	84.72 ab	-	-	-
0.6-0.8 cm (control)	0 b	0 c	-	-	-
1.0-1.2 cm (control)	0 b	0 c	-	-	-
1.4-1.6 cm (control)	2.00 a	100.00 a	-	-	-
1.8-2.0 cm (control)	2.50 a	66.67 b	-	-	-
40 Days					
0.6-0.8 cm (with pavilions)	2.36 bc	83.85 a	13.44 b	75.00 a	9.44 a
1.0-1.2 cm (with pavilions)	2.50 b	76.11 ab	18.87 a	87.50 a	9.17 ab
1.4-1.6 cm (with pavilions)	3.00 a	62.55 bc	13.50 b	83.33 a	7.11 c
1.8-2.0 cm (with pavilions)	2.33 bc	85.42 a	15.83 b	87.50 a	8.33 b
0.6-0.8 cm (control)	2.00 c	50.00 c	0 d	0 c	0 e
1.0-1.2 cm (control)	0 e	0 e	0 d	0 c	0 e
1.4-1.6 cm (control)	2.00 c	75.00 ab	4.00 c	50.00 b	3.00 d
1.8-2.0 cm (control)	1.00 d	25.00 d	0 d	0 c	0 e
60 Days					
0.6-0.8 cm (with pavilions)	1.44 d	61.27 b	15.42 c	100.00 a	14.33 b
1.0-1.2 cm (with pavilions)	2.88 a	71.94 b	29.75 b	50.00 c	16.25 b
1.4-1.6 cm (with pavilions)	2.52 bc	70.35 b	34.29 b	83.33 b	16.42 b
1.8-2.0 cm (with pavilions)	2.67 a	92.36 a	43.63 a	100.00 a	21.75 a
0.6-0.8 cm (control)	2.00 c	58.33 b	6.50 d	25.00 d	9.00 cd
1.0-1.2 cm (control)	0 e	0 c	0 e	0 e	0 e
1.4-1.6 cm (control)	2.50 ab	100.00 a	8.00 d	50.00 c	7.50 d
1.8-2.0 cm (control)	2.75 a	57.92 b	5.33 d	25.00 d	11.00 c

[1] Means with the same letter in the same column are not significant differently at 5 % probability.

[2] No visible root emergence.

the bud and root emergence of "Brown Turkey", "Dauphine" and "Lisa" fig cultivars are shown in Table 3. At two weeks, there were emerged buds only in the cuttings placed in pavilion, and "Brown Turkey" had the highest percentage of emerged buds. At the same period, there was no bud or root emergence in all three cultivars without pavilions. At four weeks, "Lisa" cuttings under pavilions had the highest percentage of emerged buds, whereas its number of roots was less than those of "Brown Turkey" and "Dauphine". No root systems of all three cultivars placed outside were found in this period. Only "Dauphine" cuttings placed outside a pavilion had no root emergence at neither 6 nor 8 weeks. The number of roots in all cultivars hardwoods was affected by using plastic pavilions, when compared to untreated cuttings. The results showed that "Brown Turkey" cuttings in pavilions tended to have earlier bud and root emergence than the others.

DISCUSSION

The fig tree is commonly propagated by cuttings of mature wood that is one year of age, which should be as thick as a finger or 1.5 to 2.0

Table 3 The effects of small plastic pavilions on vegetative growth characteristics of three cultivars of fig cuttings as compared with the controls at the Pang Dah Royal Project Research Station. Data were recorded at two-week intervals.

Cultivars/Treatments	No. of emerged buds /cutting	% bud emergence	No. of emerged roots /cutting	% root emergence	Average longest root length (cm)
2 weeks					
Brown Turkey (with pavilions)	2.42 a[1]	41.39 a	-[2]	-	-
Dauphine (with pavilions)	1.56 a	27.49 b	-	-	-
Lisa (with pavilions)	1.67 a	20.00 b	-	-	-
Brown Turkey (control)	0 b	0 c	-	-	-
Dauphine (control)	0 b	0 c	-	-	-
Lisa (control)	0 b	0 c	-	-	-
4 weeks					
Brown Turkey (with pavilions)	2.72 ab	50.83 b	11.17 a	66.67 a	7.47 a
Dauphine (with pavilions)	2.06 b	44.55 b	10.94 a	43.75 b	6.54 a
Lisa (with pavilions)	3.14 a	64.05 a	6.50 b	50.00 a	6.75 a
Brown Turkey (control)	2.50 ab	44.29 b	0 c	0 c	0 b
Dauphine (control)	1.0 c	11.11 c	0 c	0 c	0 b
Lisa (control)	1.0 c	15.48 c	0 c	0 c	0 b
6 *weeks*					
Brown Turkey (with pavilions)	2.92 a	64.17 a	18.38 a	100.0 a	17.29 a
Dauphine (with pavilions)	2.67 a	36.20 bc	18.61 a	65.50 bc	12.75 b
Lisa (with pavilions)	3.39 a	71.49 a	8.17 b	75.00 b	12.59 b
Brown Turkey (control)	2.42 a	42.78 b	7.17 b	58.33 c	7.67 c
Dauphine (control)	2.00 a	25.00 c	0 c	0 d	0 d
Lisa (control)	2.78 a	44.35 b	6.44 b	75.00 b	6.30 c
8 weeks					
Brown Turkey (with pavilions)	2.75 a	60.00 a	25.25 a	100.0 a	18.06 a
Dauphine (with pavilions)	2.50 a	54.66 a	24.88 a	62.50 b	19.50 a
Lisa (with pavilions)	2.86 a	50.85 ab	13.67 b	83.33 a	13.85 b
Brown Turkey (control)	2.53 a	39.24 b	6.13 c	62.50 b	5.88 c
Dauphine (control)	1.00 a	12.50 c	0 d	0 d	0 d
Lisa (control)	2.67 a	39.29 b	4.75 c	33.33 c	8.38 c

[1] No visible root emergence.

[2] Means with the same letter in the same column are not significantly different at 5 % probability.

cm thick and 25 to 30 cm long (Manago, 2006). For experiment 1, greater bud and root growth of 1.4 – 1.6 and 1.8 – 2.0 cm cutting was partially attributable to cutting sizes, as indicated by number of emerged buds and roots in "Brown Turkey" cultivar. In addition, the effect of using plastic pavilion on bud emergence was apparent from 10 days after treatment, with even more bud and root emergence from 30 days, compared to those without plastic pavilions. For one-year-old hardwood cuttings of the "Bursa Siyahi" fig cultivar, Seferoğlu and Tekintas (1997) found that the callus xylem formation in callus tissue was observed at least 20 day after planting. Whereas the formation of callus xylem was developed and the bud and leaf traces connected to pith were observed at 40 days after planting. The worst results for root number and root length were a result of decreased humidity (Tekintas and Seferoğlu, 1997). The temperature data in Table 4 indicated that using plastic pavilion increased the inside temperature thus promoting the early callus formation of buds and roots in fig cutting propagation in tropical highland areas, which are cool throughout the year.

The study of the cutting propagation performed on different three fig cultivars with and without plastic pavilions was performed in experiment 2. "Brown Turkey" was the most feasible cultivar for the region, followed by "Dauphine" and "Lisa", for the cuttings that used plastic pavilions. Morton (1987) reported that the "Brown Turkey" cultivar is well adapted to warm climates and the most reliable cultivar (RHS, 1986). It has also been reported that one-year-old hardwood cuttings of 3 fig cultures were planted in perlite and some important differences were obtained due to cultivars and periods (Karadeńyz, 2001). However, only the number of emerged buds was observed at two weeks after planting, whereas the root emergence was found at four weeks in this study. The results indicated that using plastic pavilions was essential to bud and root formation. No callus or root development was observed at 4 weeks after treatment. Comparison between treatments with and without the pavilions in three cultivars suggested that cuttings in pavilions had an increased number of emerged buds and roots earlier than did those without pavilions. Results from our recent study may assist with the choice of a good method for fig propagation.

ACKNOWLEDGEMENTS

The authors extend acknowledgement to the Royal Project foundation for funding and facilitating the research.

Table 4 Maximum, minimum, and average temperatures (°C) inside and outside plastic pavilions during January to May 2006 at the Pang Dah Royal Project Research Station.

Treatments	Maximum	Minimum	Average
Inside plastic pavilions			
February	35.67	13.09	24.38
March	38.82	17.62	28.22
April	41.82	20.83	31.32
Outside plastic pavilions			
January	28.76	11.22	20.49
February	30.44	13.87	22.17
March	33.73	18.06	25.91
April	31.73	20.18	26.40
May	28.76	19.85	24.32

LITERATURE CITED

Bolin, H.R. and A.D. King, Jr. 1980. Figs, pp. 492 – 505. *In* S. Nagy and P.E. Shaw (eds.). **Tropical and Subtropical Fruits**. THE AVI PUBLISHING COMPANY, INC. Westport, Connecticut.

Karadeńyz, T. 2001. A study on some fruit characteristics and propagation of method by hardwood cuttings of local fig cultivars in Ordu (Turkey), p. 34. *In* **International Symposium on Fig**. Program and abstracts, 7 – 11 May, Caceres, Spain.

Manago, N. 2006. Fig, pp. 106 – 110. *In* The Japanese Society for Horticultural Science (eds.). **Horticulture in Japan 2006**. Shoukadoh Publication, Dept. of Publishing of Nakanishi Printing Co., Ltd.

Morton, J. 1987. Fig, pp. 47 – 50. *In* J.F. Moton (ed.). **Fruits of warm climates**. Miami, Fl.

Punsri, P. and ML. C. Thongtham. 1983. Research on the common fig (*Ficus carica* L.). **Exotic Fruit Production as a Substitute for Opium Poppy in the Highlands of Thailand** 1: 37 – 40.

Samson, J.A. 1986. Fig, pp. 307 – 308. *In* G. Wrigley (ed.). **Tropical Fruits**. Longman Singapore Publishers (Pte) Ltd.

Seferoğlu, G. and F.E. Tekintas. 1997. Anatomical and histological development of rooting on the fig hardwood cuttings, pp. 115 – 117. *In* U. Aksoy (ed.). **First International symposium on Fig**. Izmir, Turkey.

Tekintas, F.E. and G. Seferoğlu. 1997. Propagation of fig by hardwood cuttings in the field conditions (*Ficus carica* L.), pp. 119 – 120. *In* U. Aksoy (ed.). **First International symposium on Fig**. Izmir, Turkey.