EFFECT OF PRE–GERMINATION SEED TREATMENTS ON GERMINATION OF FOUR FICUS TREE SPECIES

By

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CHAPTER ONE
INTRODUCTION

Some trees species are exceptionally ornamentals in terms of their flowers, fragrance, form and habit, foliage, color and beauty of their barks. Ornamental trees are either deciduous or evergreen. Deciduous species generally produce their blooms immediately after shedding of leaves or just after being clothed with fresh foliage.

In Sudan, the period between February and June is remarkable for the flush of bloom of many ornamental trees. Some of them, however, flower in August and September during the rain season. Others flower intermittently throughout the year (El Amin, 1981).

Ornamental trees are mainly grown for their beautiful and, or fragrant flowers. Also they can be grown for their richness and attractiveness of their foliage or form or both, and surely for their shade.

Ficus sp., belongs to the family Moraceae, about 800 spp. of monoecious or dioecious trees, shrubs and woody root–clinging vines, with milky sap, native to tropics, but chiefly old world. The genus includes edible figs and species yielding fodder, natural rubber, bark cloth, and host plant for the lac insect.

Many species of *Ficus* are widely used for shade and ornament out-doors in the tropics and subtropics. A number of these also make satisfactory ornamentals for the home or conservatory.

Ficus can propagated by asexual means. The ornamental, arboreal species usually propagated by air-layering and the trailing species by division of the root system. Sexual propagation of Ficus species is of particular importance, for both ornamental and landscape purposes, as it may lead to variability and changes in characteristics or features, therefore, another varieties with different traits can be obtained. But seed propagation is difficult for some Ficus species.

Gibberellic acid applied to fresh seeds of *Ficus benghalensis* and *Ficus religiosa* significantly stimulated seed germination performance, (a function of germination rate and percent germination).

Studies on the effect of pre-germination treatments on germination of Ficus species seeds are not so many. The objective of this research is to investigate the effect of some treatments on germination of some Ficus species seeds.

CHAPTER TWO

LITERATURE REVIEW

2.1 Botanical Features:

Ficus leaves are thick or stiff, mostly persistent, often large and showy, flowers minute, unisexual. Seeds are inside a globose, oblong or pear–shaped fleshy receptacle or fig which has an ostiole (small opening) at its apex. Some figs, such as Banyan *(Ficus benghalensis),* send down aerial roots forming trunks to support the canopy, thus enabling the tree to extend over several acres. Others, the strangler figs, begins as epiphytes, later strangling their host with their heavy inarching aerial roots and eventually becoming self-supporting, independent trees (Bailei and Bailei 1976).

2.2 Seed Germination:

The initiation of germination requires that three conditions must be fulfilled (Ching 1972; Jann and Amen 1977).

First the seed must be viable.

Second, the seed must not be dormant and the embryo is quiescent.

Third, the seed must be subjected to the appropriate environmental conditions; available water, proper temperature, supply of oxygen, and sometimes light.

2.3 Seed Dormancy :

The term dormancy has broad application in plant physiology. It refer to lack of growth in any plant part resulting from either internally or externally induced factors (Vegis 1964). On the other hand, seed technologists define dormancy in a somewhat narrower sense as a result of conditions within the seed (other than non–viability) that prevent germination (Schopmeyer 1974; USDA 1952 and Villiers 1972).

Dormant seeds include those that fail to germinate even–though the embryo is alive and moisture is available. Various types of seed dormancy result from controlling mechanism within the seed. The first system was formulated by Crocker (1916), who described seven types of seed dormancy. More recently Nikolaeva (1977), has defined a system based predominantly on the physiological cause of dormancy. Atwater (1980), has shown that the morphological characteristics, in terms of embryo development and type of seed coverings, are associated with specific dormancy categories.

2.3.1 Secondary Dormancy:

Secondary dormancy is acquired after the seed has been separated from the plant (Croker 1916). Although the term might be applied to seed coat effects such as hardseededness that could develop by dehydration during storage (USDA 1952), the term is best applied to a kind of embryo dormancy that can develop gradually if the intact seeds are exposed to environmental conditions that allow imbibition but prevent germination (Karssen 1980/81). This type of dormancy develops after imbibition of water by seed and before emergence of the radicle. Such conditions can include high temperature, low oxygen supply and lack of light (Thompson 1973).

2.4 Germination Inhibitors:

Chemicals that act as seed germination inhibitors have been extracted from various plant parts and identified (Evenari 1949). Such chemicals are produced and accumulate in the fruit as in seed coverings. The thin layer of seed coat, as in fleshy fruits in some perennial trees, contain mucilagenous materials that inhibit seed germination in such way as chemical dormancy that prevent seeds germination. Hartmann and Kester (1983).

Germination inhibitors are reported to be widespread in seeds of tropical species (Nikolaeva 1977). These inhibitors are leached out of the seeds by heavy rains, which would, in turn, provide sufficient soil moisture to insure survival of the seedlings, since a light rain shower is insufficient to cause leaching (Hardman and Kester 1983).

Seed inhibitors may be a more serious problem in seed testing laboratories than in the field. These inhibitors, which interfere with germination in laboratories, can be leached or absorbed by soil particles, thus, overcome their inhibition effect (Went 1949). Control of dormancy resulting from internally located inhibitors is more complex than simple leaching. Some of these inhibitors are phenols, coumarin and abscisic acid (Hardman and Kester 1983).

In nature, seed coverings are softened by various agents of the environment. One of the most common agents is passing of seeds through digestive tracts of birds. The mechanical abrasion of stomach of birds may sometimes contain small particles of sand, which may act as physical scarification.

Inhibitors have been found in the seeds of such families as Polygonaceae, Chenopodiaceae (Atriplex), Portulaceae (portulaca). Seeds of a group of such families as Cruciferae (Mustard), Linaceae (Flax), Violaceae (Violet), Labitae (Lavendula) have a thin seed coat with a mucilagenous inner layer that contains inhibitors (Atwater 1980).

Imbibing seeds of *Prunus cerasus* in 20 mg/ml ABA prevented germination and increased ABA content of the seeds 15 folds (James and Stoner 1983).

Suparana *et a1.* (1977) demonstrated the presence of inhibitory and/or stimulatory to the germination of rice in the fruits of *Ficus bengha1ensis* (Inhibitors) and *Acacia erio1oba* (inhibitors and stimulators).

Mohamed (1981), suggested that the relative proportions of dormant or non-dormant seed components may be correlated with seed coat thickness.

Leakage of inhibitor substances outside the seed coat and/or the endosperm maybe one of the main causes that breaks seed chemical dormancy and initiates germination of seeds.

2.5 Effect of Temperature:

Temperature is the most important factor affecting both initiation and rate of germination. At high temperatures, the seeds not only fail to germinate, but some also revert to secondary dormancy (Abbott 1955; Schander 1955 and Schopmeyer 1974), but the exact temperature varies with different species and different stages of after ripening (Semeniuk and Stewart 1962).

The response of partially after-ripened apple seed to germination temperatures varies with temperature. At low temperatures, the seed germinate slowly but the percentage is high. At higher temperatures, germination rates are faster, but the germination percentage decreases in proportion to the increase in temperature (De Hass and Schander 1952; Schander 1955).

The time required to after-ripen dormant seeds of most woody perennial species is from one to three months. Although, for certain species five to six months are necessary(Hardman and Kester 1983). The time required is characteristic of the species and a general correlation exists between the chilling requirements of the seeds (Kester1969; Kester *et a1.* 1977, Westwood and Bjornstad 1948).

Thermotolerance was studied in *Combretum aplicum* seeds. All seeds germinated well when incubated for 5 days under moderate temperature (25–33°C) (Chikono and Choinski 1992). Temperatures of (25–30°C) appeared most suitable for optimal germination, and higher temperatures caused excessive fungal growth and rotting (Dalling and Staden 1999).

2.6 Effect of Gibberellins:

Gibberellins (GA) are beneficial as a control hormone of dormancy. Gibberellic acid (GA_3) is the most widely used experimentally and commercially. It occurs at relatively high level in developing seeds but usually drop to a lower level in mature dormant seeds, particularly in dicotyledonous plants (Hartmann and Kester 1983).

Applied gibberellins can function in relieving many types of dormancy including physiological dormancy, photodormancy, and thermodormancy.

Gibberellins appear to play a role at two different stages of germination. In stage (1), it has been suggested that gibberellins act at the initial stage of enzymes induction in transcription from the chromosomes. Second stage in which gibberellins involved is the activation of enzymes involved in the food mobilizing system (Hartmann and Kester 1983).

2.7 Germination of Ficus Seeds:

Availability of healthy seeds is an important factor for raising planting stock on large scale. Germination depends greatly upon seed health, that generally refers to the presence or absence of disease causing microorganisms. Mohammed *et a1.* (1996) discussed indicated that the main problem faced by forestry seeds is the high incidence of saprophytic fungi.

Serio – Silva and Rico – Gray (2002) reported that a variety of microclimatic factor influence the success of seed germination in the strangler figs, *Ficus perfurata* and *Ficus lundelli* when compared at two canopy heights in two study sites.

Seeds of Ficus species eaten by birds, or even domestic animals, have the ability to germinate better than those never been eaten. This investigation has demonstrated clearly that seeds passage through the digestive tract of birds is very important.

Serio – Silva and Rico – Gray (2002), reported that germination of *Ficus perfurata* and *Ficus lundelli* seeds was facilitated by consumption by howler monkeys.

Rai, *et al*. (1988), reported that Gibberellic acid applied to fresh seeds of *Ficus benghalensis* and *Ficus religiosa* significantly stimulated seed germination performance, (a function of germination rate and percent germination).

Lucero (1994), demonstrated that. immersing seeds of some Ficus species in boiling water gave the poorest results and negatively affected seed germination compared to the untreated seeds.

hot water at 60°C increased seed germination moderately when fresh seeds of different Ficus species, including both *Ficus benghalensis* and *Ficus religiosa*, were soaked for 10 minutes. Rai, *et al.* (1988).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experiment One:

A laboratory experiment was conducted to study the effect of some pre-germination treatments on germination of both fresh and dry seeds of four Ficus species namely; *Ficus benghalensia, Ficus religiosa, Ficus benjamina* and *Ficus altissima* in the laboratory of the department of Horticulture, Faculty of Agriculture, Shambat.

3.1.1 Source of seeds:

Ripe fruits of the four species were collected from Shambat campus, University of Khartoum.

3.1.2 Seed treatments:

Seeds were subjected to four pre-germination soaking treatments before germination. These included hot water at 60°C for 10 minutes (H.W), 100 ppm gibberellic acid for 2 hours (GA_3), fresh Tomato juice for 24 hours (SH.T.J), fermented Tomato juice for 24 hours, (FR.T.J) and the control (CO) untreated seeds.

3.1.3 Seed preparation:

Fresh seeds:

Ripe fruits were squeezed in water and the floating seeds were collected and dried in the shade for two days before treatments, (known as fresh seeds in this study).

Dry seeds:

Ripe fruits were dried in the shade for three days and were hand-crushed to a powder which was sieved to separate the seeds. The seeds were stored in perforated plastic bags for six weeks at room temperature (32°C), (known as dry seeds in this study).

3.1.4 Experimental Design:

The treatments were arranged in a complete randomized design (CRD). Each treatment was replicated three times. The total number of experimental plots were 120 (2 types of seeds x 4 Ficus species x 5 treatments x 3 replicates). Each plot contained 100 seeds.

3.1.5 Germination Test:

Seeds were germinated on one layer of filter papers in 9 cm plastic petri dishes. The filter papers were kept moist throughout the test duration, by addition of distilled water, to secure adequate amount of water for seed germination. Seeds were subjected to seven hours per day supplementary lighting, from 9.00 am to 4.00 pm; Room temperature was ranging between 23°C and 32°C.

The parameters studied were germination percentage and germination rate.

The number of germinated seed was counted daily for four weeks.

3.2 Experiment Two:

A laboratory experiment was conducted to study the effect of some pre-germination treatments on germination of fresh seeds of four Ficus species*: Ficus benghalensis, Ficus religiosa. Ficus benjamina* and *Ficus altissima,* at the Ministry of Agriculture and Forestry seeds laboratory – Khartoum.

3.2.1 Source of seeds:

Ripe fruits of the different species were collected from Shambat Campus, University of Khartoum.

3.2.2 Seed preparation:

Ripe fruits were squeezed in water and the floating seeds were collected and dried in the shade for two days before treatments, (known as fresh seeds in this study).

3.2.3 Seed treatments:

The seeds were subjected to four soaking pre-germination treatments before germination as mentioned in experiment one.

3.2.4 Experimental Design:

The treatments were arranged in a complete randomized design (CRD). Each treatment was replicated three times. The total number of experimental plots were 60 (4 Ficus species x 5 treatments x 3 replicates). Each plot contained 100 seeds .

3.2.5 Germination test:

Seeds were germinated on one layer of filter paper in 9 cm glass petri dishes. Each plot contained 100 seeds. The filter papers were kept moist throughout test duration by addition of distilled water to secure adequate amount of water for seed germination. Seeds were subjected to 24 hours per day, supplementary lighting. Room temperature was ranging between 20°C to 25°C. The data were collected on daily basis for four weeks. The parameters studied were germination percentage and germination rate.

CHAPTER FOUR

RESULTS AND DISCUSSION

The effect of some pre-germination soaking treatments on seed germination was studied on four Ficus species including *Ficus benjamina, Ficus altissima*, *Ficus religiosa*, and *Ficus benghalensis*.

4.1 Effect of type of seeds:

Experiment One:

Germination started after 8 – 9 days and was completed within 15 days. Significant difference was found between germination of the two types of seeds (Fresh and Dried) in *Ficus religiosa*. No significant difference was registered between seed type in *Ficus benghalensis*.

Fresh seeds of *Ficus religiosa* showed higher germination percentages compared to the dried one, due to the permeability of their seed coat to water. This means that no physical dormancy occurred at this stage of seed development; i.e. at ripening stage.

On the other hand, the seed coat in case of dried seeds of *Ficus religiosa* represented a physical barrier that restricted water permeability, so water absorption was insufficient to trigger the biochemical reaction, including the enzymes activities, that lead to the emergence of radicle as a sign of seed germination. The storage of dry seeds of *Ficus religiosa* for several weeks resulted in desiccation of the seed coat. Hardseededness was developed rapidly by dehydration of seeds, and caused some changes in the physical properties of the seed coat that become more stiff and impermeable to water. Findings obtained by USDA (1952), reported that hardseededness could developed by dehydration during storage. Adequate amount of water is of vital important for seed to start the germination process.

This result is supported by the findings of Rai, *et a1*. (1988), who reported that hot water at 60°C increased seed germination moderately when fresh seeds of different *Ficus species*, including both *Ficus bengh1ensis* and *Ficus religiosa*, were soaked for 10 minutes. But hot water could be of negative effect.

The storage of dry seeds of *Ficus benghalensis* did not affect of the germination of seeds, no significant difference in the effect of seed type was obtained in this species. The rate of seed dehydration was slower than that of *Ficus religiosa*. The mucilage layer that coated the seed may decrease water loss or evaporation to the minimum. So seeds of *Ficus benghalensis* were partially affected by storage that often accompanied by dehydration or desiccation of seed coat. Thus the seed coat was able, to some extend, to absorb water and to start germination processes.

4.2 Effect of pre-germination treatments on germination percentage:

Experiment One:

No germination occurred for *Ficus benjamina* and *Ficus altissima* in all treatments except in hot water for fresh seeds of *Ficus benjamina*

(0.6%) (Table 1). There were no significant differences between all pre-germination treatments for *Ficus religiosa* and *Ficus benghalensis*. Higher germination percentage was obtained from fresh untreated seeds, (the control); (34%) for *Ficus religiosa* and (25.6%) for *Ficus benghalensis* (Table 1).

The highest germination percentage from pre-germination treatments was obtained from seeds soaked in fermented tomato juice (32.3%) for *Ficus religiosa* followed by gibberellic acid (21.3%) for *Ficus benghalensis* (Table 1). Other pre-germination treatments either had slight effect, gibberellic acid (18%) for *Ficus religiosa*, or reduced germination, hot water (5.3%) for *Ficus benghalensisjs* compared to the control (Table 1).

The dried seeds of *Ficus religiosa,* and *Ficus benghalensis* showed a sharp decline in germination percentages for all pre–germination treatments; except hot water treatment which increased the germination percentage to (11.6%) and gibberellic acid (16.3%) compared to the control (4.3%) for *Ficus benghalensis*, (Table 1).

The lowest germination percentage was registered for the untreated seeds (the control) of *Ficus benghalensis* (4.3%). (Figs 1 and 2).

Table 1. Effect of pre– germination treatments on germination percentage of Dry and Fresh *Ficus* spp. seeds (Exp One)

Ficus species	Type of seeds	**Germination percentage**				
		CO	GA_3	H.W.	FR.T.J	SH.T.J
Ficus benghalensis	Fresh	25.6%	21.3%	6%	6.3%	5%
	Dry	4.3%	16.3%	11.6%	4.6%	6%
Ficus religiosa	Fresh	34%	18%	5.3%	32.3%	8.3%
	Dry	0	6.3%	0	0	0.6%
Ficus benjamina	Fresh	0	0	0.6%	0	0
	Dry	0	0	0	0	0
Ficus altissima	Fresh	0	0	0	0	0
	Dry	0	0	0	0	0

CO = Control GA_3 = Gibbrellic acid

H.W= Hot water FR.T.J = fermented tomato juice

SH.T.J = fresh tomato juice

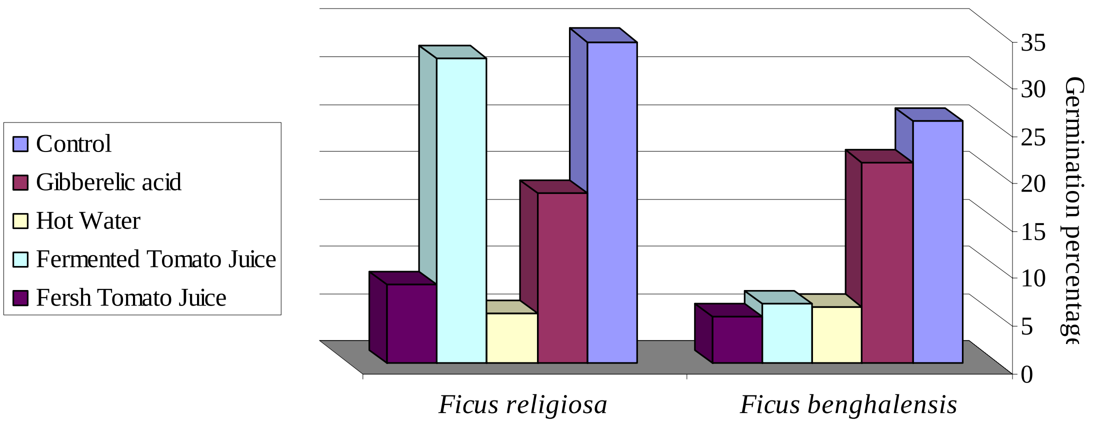


Fig.1 Exp.I Effect of pre-germination treatments on germination percentage of Fresh seeds of *Ficus Spp*.

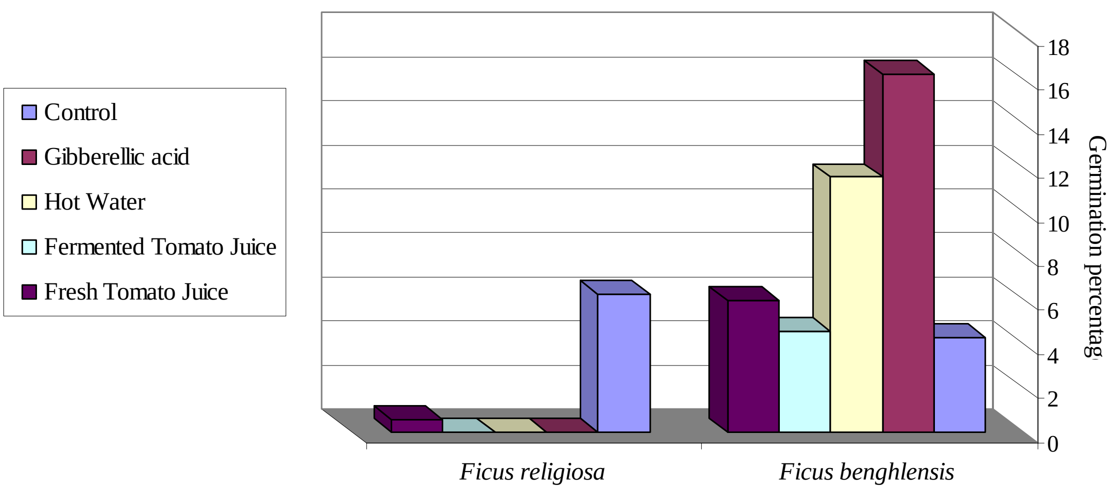


Fig.2 Exp.I Effect of pre-germination treatments on germination percentage of Dry seeds of *Ficus Spp*.

Experiment Two:

Germination started after 13-14 days and was completed within 15 days. No germination occurred for *Ficus altissima* and *Ficus benjamina* for all treatments, (Table 2). There were no significant differences between pre-germination treatments for both *Ficus religiosa* and *Fiucs benghalensis* fresh seeds.

The highest germination percentage was obtained from seeds soaked in Gibberellic acid (GA_3), (28%), (23.6%) for *Ficus religiosa* and *Ficus benghalensis* respectively, (Table 2). Hot water (H.W) treatment gave (20.6%) for *Ficus benghalensis* and (17.6%) for *Ficus religiosa*, (Table 2). Germination percentage from the untreated seeds (the control) was (18.6%) for *Ficus benghalensis* and (17.6%) for *Ficus religiosa* (Table 2). Fresh tomato juice (SH.T.J) treatment gave (18.6%) for *Ficus religiosa* and (12.3%) for *Ficus benghalensis*, (Table 2). The lowest germination percentages were obtained from fermented tomato juice (FR.T.J), (15.3%) for *Ficus benghalensis* and (12%) for *Ficus religiosa*, (Table 2), (Fig 3).

Some Ficus species were characterized by very low germination percentages, dried seeds of both *Ficus religiosa* (6.3%), and *Ficus benghalensis* *(*4.6%), whereas others had relatively high germination percentages, fresh seeds of *Ficus religiosa* (34%). The amount of water available to freshly harvested seeds of some Ficus species may be enough to secure humidity for germination of seeds.

Gibberellic acid (GA_3), as growth regulator, seemed to be an appropriate method for germination of fresh seeds of the two Ficus species. The thin layer of seed coat, as in fleshy fruits in some perennial trees, contain mucilagenous materials that inhibit seed germination in such way as chemical dormancy that prevent seeds germination.

Fig.3 Efect of pre-germination treaments on germination percentage of Fresh seed of *Ficus Spp*

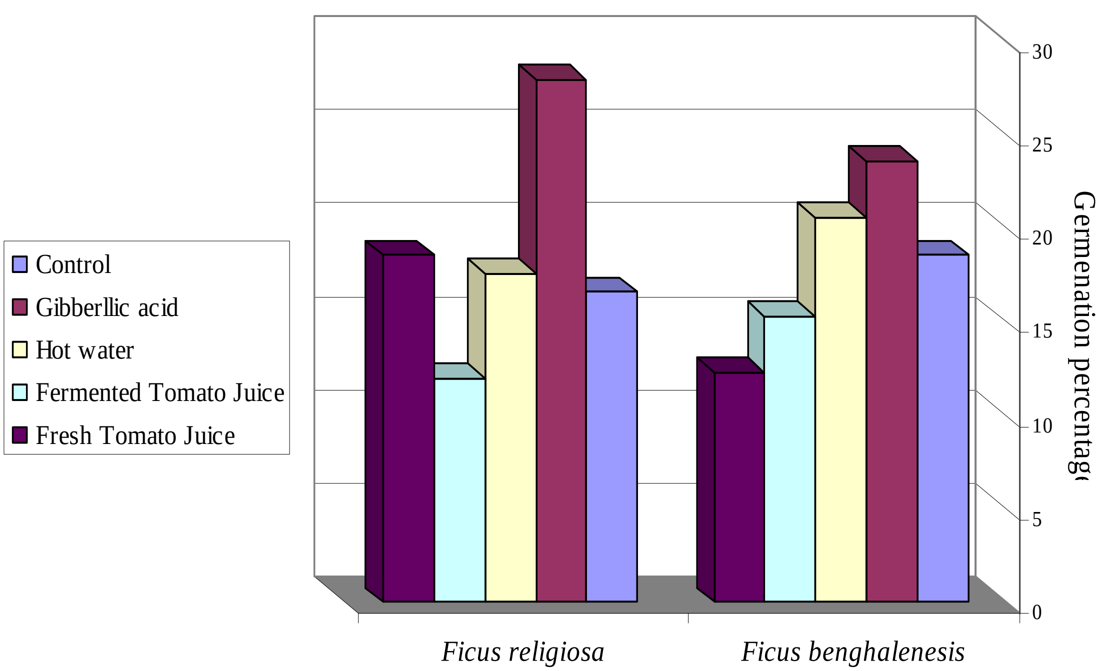


Table 2. Effect of species and pre-germination treatments on germination percentage of fresh seeds of *Ficus* spp.

(Exp Two)

Ficus species	**Germination percentage**				
	CO	GA_3	H.W	FR.T.J	SH.T.J
Ficus benghalensis	18.6%	23.6%	20.6%	15.3%	12.3%
Ficus religiosa	16.6%	28%	17.6%	12%	18.6%
Ficus benjamina	0	0	0	0	0
Ficus altissima	0	0	0	0	0

CO = Control GA_3 = Gibbrellic acid

H.W= Hot water FR.T.J = fermented tomato juice

SH.T.J = fresh tomato juice

Gibberellic acid (GA_3) decreases the inhibitory effect caused by these mucilagenous materials. Rai, *et al*. (1988), reported that Gibberellic acid applied to fresh seeds of *Ficus benghalensis* and *Ficus religiosa* significantly stimulated seed germination performance, (a function of germination rate and percent germination).

Hot water (H.W) at 60°C may soften the seed coat of some Ficus species enabling water imbibition to take place, thus seed could start germination processes. This effect could be determined as physical scarification, as only the seed coat was affected by this treatment. This result was confirmed by Rai, *et al*. (1988), who reported that hot water at 60°C increased seed germination moderately when fresh seeds of different Ficus species, including both *Ficus benghalensis* and *Ficus religiosa*, were soaked for 10 minutes. But boiling water could reduce germination as reported by Lucero (1994), who demonstrated that. immersing seeds of some Ficus species in boiling water gave the poorest results and negatively affected seed germination compared to the untreated seeds.

Fresh tomato juice (SH.T.J), acted as chemical scarification treatment on the seed coat of the different Ficus species that were tested. The acidic contents of fresh tomato juice is relatively high, may be similar to that of the digestive tracts of birds that swell the seeds of both *Ficus religiosa* and *Ficus benghalensis* when they feed on their ripened fruits. Rai, *et* *al*. (1988) reported that a concentration of (0.3%) of HCL reduced seed germination when applied to *Fiucs benghalensis* seeds.

Fermented tomato juice (FR.T.J), may also act as a source of enzymes which were secreted by the microorganisms that caused fermentation of the juice.

These microorganisms worked on the chemical constituents of tomato juice (pectin, cellulose, and polysaccharides). The enzymes secreted by these microorganisms acted similarly to those been found in the digestive tracts of birds which have a chemical effects on the constituents of some Ficus species seeds that may include inhibitor substances. These findings agree with those of James and Stoner (1983), who reported that Abscisic acid (ABA) fell about 10–fold during fermentation to remove mucilagenous tissues.

4-3 Effect of pre- germination treatments on germination rate:

Experiment One:

Germination rate of both fresh and dried seeds was significantly affected by Pre–germination soaking of *Ficus benghalensis.* (Pr. = 0.0245 for fresh seeds, Pr. = 0.0561 for dry seeds).

This experiment was conducted under fluctuation of temperature ranging between 25–36°C. The rate of germination was faster for seeds that were treated compared to the untreated seeds (control). The beginning of germination was earlier and completed within 17 and 15 days for fresh and dried seeds, respectively.

The high temperature encouraged seed germination of the two types of seeds of *Ficus benghalensis*. Thus, decreased the number of days required to germination (Fig 4).

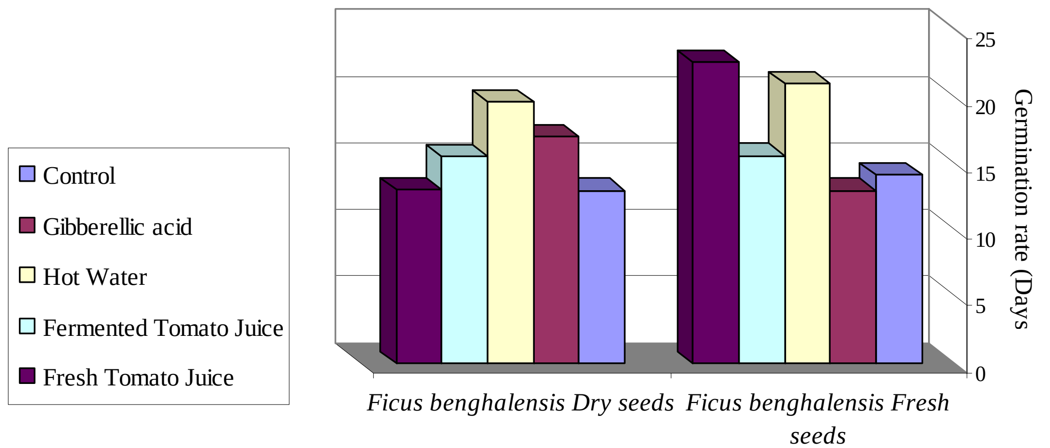
Experiment Two:

There was no significant effect of pre-germination soaking on germination rate of fresh seeds of the two Ficus species. (Pr. = 0.15 for *Ficus religiosa*, Pr. = 0.277 *Ficus benghalensis*).

This experiment was carried out under stable temperature (20-25°C). This range of temperature may not be optimum for germination of both *Ficus bengha1ensis* and *Ficus religiosa* seeds. Germination of seeds of the two Ficus species started 6–7 days later than those conducted under higher temperature, (25–36°C). The rate of germination was also affected negatively by this range of temperature (20–25°C), i.e. the rate of germination responded negatively as the temperature was lowered. (Fig. 5).

The most significant outcome from these investigations was that as temperature increased the germination rate increased too. Abbott (1955), Schander (1955), and Schopmeyer (1974), reported that temperature is the most important factor affecting both initiation and rate of germination. At high temperatures, the seeds not only fail to germinate, but also revert to secondary dormancy. De Hass and Schander. (1952); Schander (1955) reported that at low temperatures, the seed germinated slowly but the percentage is high while at higher temperatures, germination rates were faster, but the germination percentage decreased in proportion to the increase in temperature. But the exact temperature varies with different species and different stages of after ripening (Semeniuk and Stewart 1962).

Fig.4 Effect of pre- germination treatments on germination rate of Fresh and Dry seeds of *Ficus Spp.*



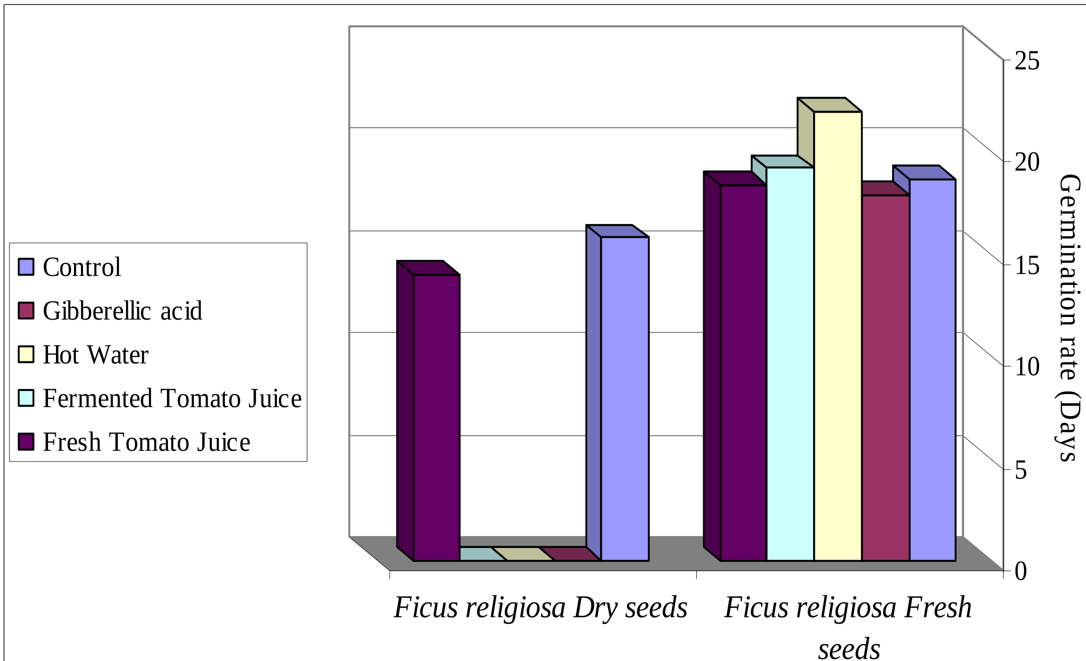
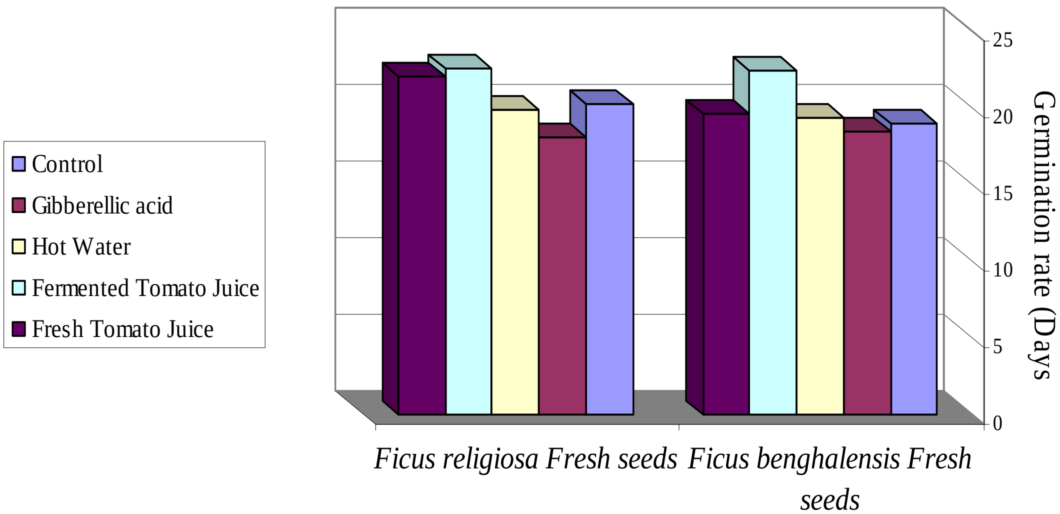


Fig.5 Exp.II Effect of pre-germination treatments on germination rate of Fersh seeds of *Ficus Spp*.



CONCLUSION

Ficus benghalensis and *Ficus religiosa* can be propagated by seeds. Seeds should be obtained from ripe fruits and sown immediately. Storage of seeds may lead to seed dormancy, so appropriate Pre – germination treatments should be applied to the seeds of the two *Ficus species*. Optimum environmental conditions can encourage germination of seeds.

Ficus altissima and *Ficus benjamina* are difficult to propagate by seeds. Pre – germination treatments, other than those being used in this study, should be applied to the seeds. Viability test is of vital important to make sure of the viability of the seeds. Certainly, appropriate environmental conditions should be taken into consideration.

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APPENDIXES
ANALYSIS OF VARIANCE

EXERIMENT ONE

Ficus benghalnsis

Appendix 1

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F.value	Pr. >F
Seeds type	1	168.03	168.03	2.82	1.109
Treatment	4	467.33	119.08	2.00	0.133
Seeds type* treatment	4	1028.4 7	270.62	4.55	0.009
Residual	20	1190.67	59.56		
Total	29	2917.50			

Appendix 2

***Ficus benghalnsis* - fresh seeds**

Source of variation	d.f	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Treatment	4	476.33	119.08	1.22	0.328
Residual	25	2441.17	97.65		
Total	29	2917.50			

Appendix 3

Ficus relgiosa

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Seeds type	1	2784.0	2784.0	17.91	<.00
Treatment	4	1686.5	412.9	2.71	0.059
Seeds type* treatment	4	988.1	247.0	1.59	0.216
Residual	20	3109.3	155.5		
Total	29	8569.0			

Appendix 4

Ficus religiosa - Fresh seeds

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Treatment	4	2583.3	645.8	2.11	0.154
Residual	10	3058.0	305.8		
Total	14	5641.3			

Appendix 5

Ficus benghalnsis – Dry seeds

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Treatment	4	397.07	99.27	6.50	0.008
Residual	10	152.67	15.27		
Total	14	549.73			

Appendix 6

***Ficus religiosa* - Dry seeds**

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Treatment	4	92.267	23.067	4.49	0.025
Residual	10	51.333	5.133		
Total	14	143.600			

EXPERIMENT TWO

Appendix 7

***Ficus religiosa* - Fresh seeds**

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Treatment	4	2532.2	633.05	2.10	0.15
Residual	3006.9	300.6			
Total	14	5539.1			

Appendix 8

***Ficus benghalensis* - Fresh seeds**

Source of variation	d.f.	Total sum of squire	Mean sum of squire	F. value	Pr. >F
Treatment	4	425.23	106.3	1.11	0.277
Residual	25	2390.07	95.6		
Total	29	2815.3			

EXPERIMENT ONE

Appendix 9

Effect of Pre – germination treatments on germination rate of Fresh seeds of *Ficus benghalensis*

Source of variation	d.f.	Mean sum of squire	F. value	Pr. >F
Treatment	4	55.263	4.5	0.0245
Error	10	12.288		
Total	14	67.551		

R^2 = 0.64 CV: 20.28
Mean Ger. rate = 17.286

Appendix 10

Effect of Pre – germination treatments on germination rate of Dry seeds of *Ficus benghalensis*

Source of variation	d.f.	Mean sum of squire	F. value	Pr. >F
Treatment	4	20.230	0.79	0.0561
Error	8	25.509		
Total	12	45.739		

R^2 = 0.28395 CV: 3.638
Mean Ger. rate = 15.96

Appendix 11

Effect of Pre – germination treatments on germination rate of Fresh seeds of *Ficus regligiosa*

Source of variation	d.f.	Mean sum of squire	F. value	Pr. >F
Treatment	4	5.28	0.24	0.9059
Error	8	22.04		
Total	12	27.32		

R^2 = 0.107 CV: 24.499
Mean Ger. Rate = 19.16

Appendix 12

Effect of Pre – germination treatments on germination rate of Dry seeds of *Ficus religiosa*

Source of variation	d.f.	Mean sum of squire	F. value	Pr. >F
Treatment	4	2.439	0.17	0.7229
Error	2	14.661		
Total	3	17.100		

R^2 = 0.0767 CV: 24.94
Mean Ger. rate = 15.3525

EXPERIMENT TOW

Appendix 13

Effect of Pre – germination treatments on germination rate of Fresh seeds of *Ficus benghalensis*

Source of variation	d.f.	Mean sum of squire	F. value	Pr. >F
Treatment	4	6.911	0.56	0.694
Error	10	12.26		
Total	14	29.171		

R^2 = 0.184 CV: 17.67
Mean Ger. rate = 19.81

Appendix 14

Effect of Pre – germination treatments on germination rate of Fresh seeds of *Ficus religiosa*

Source of variation	d.f.	Mean sum of squire	F. value	Pr. >F
Treatment	4	9.659	1.78	2.2086
Error	10	5.4134		
Total	14	15.0724		

R^2 = 0.4164 CV: 11.26
Mean Ger. rate = 20.65