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## **Effect of Giberellic Acid, Hot water, Fresh & Fermented Tomato Juice on the Germination of some Ficus Species Seeds**

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### **Abstract**

Two separate experiments were carried out to study the effect of some pre-germination soaking treatments on seed germination of four different Ficus species including: Ficus benjamin, Ficus altissima, Ficus religiosa, and Ficus benghalensis. Two experiments were conducted under laboratory conditions. pre-germination soaking treatments used included: soaking in GA3 (100 p.p.m) for two hours; soaking in fresh tomato juice for 24 hours, soaking in fermented tomato juice for 24 hours, and soaking in hot water (at 600 C) for 10 minutes. The initiation of germination requires that three conditions must be fulfilled [1, 2]. The results of the first experiment showed that there were significant differences in seed germination between the two types of seeds of Ficus reilgiosa only. Best results were obtained for fresh seeds. No significant differences were registered for all pre-germination treatments that were used for both fresh and dried seeds of Ficus benghalensis and Ficus religiosa. A significant difference was obtained for the rate of germination for the two types of seeds of Ficus benghalensis (17.28 for fresh seeds, 15.96 for dry seeds), fresh seeds were the best. Best results for pre-germination treatments was fermented tomato juice (32.3%) for Ficus religiosa and gibberellic acid (2 1.3%) for Ficus benghaiensis. In the second experiment, the result showed no significant difference between the pre-germination treatments used for fresh seeds of both Ficus religiosa and Ficus benghalensis. Best results were registered for gibberellic acid (28%) for Ficus religiosa and (23.6%) for Ficus benghalensis.

**Keywords:** Ficus species, germination, Giberellic acid, fresh and fermented tomato juice.

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## **1. Introduction**

Ornamental trees are mainly grown for their beautiful and, 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 dioeciously 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 lace insect.

Many kinds of *Ficus* sp. are widely been 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 be easily 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 different *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, other varieties with different traits can be obtained.

But seed propagation is somewhat difficult for some *Ficus* species as a result of their seed dormancy. The term dormancy has broad application in plant physiology to refer to lack of growth in any plant part resulting from either internally or externally induced factors [3]. On the other hand, seed technologists define dormancy in somewhat narrower sense as a result of conditions within the seed that prevent germination [4].

More recently [5], has defined a system based predominantly on the physiological characteristics, in term of embryo development and type of seed coverings, are associated with specific dormancy categories. The first system was formulated by [6], who described seven types of seed dormancy.

Studies on the effect of pre-germination treatments on germination of *Ficus* species seeds are not so many. Germination inhibitors are reported to be widespread in seeds of tropical species.

The objective of this research is to investigate the effect of some treatments on germination of some *Ficus* species seeds.

Objectives: To investigate the effect of soaking fresh and dried seeds of the four species Gibberellic acid (GA<sub>3</sub>), hot water (H.W), fresh tomato juice (SH.T.J), and fermented tomato juice (FR.T.J) on seed germination.

## **2. Materials and Methods**

### ***2.1 Experiment One***

This experiment was performed on summer 2012. 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 benghalensis*, *Ficus religiosa*, *Ficus benjamina* and *Ficus altissima* in the laboratory of the department of Horticulture, college of Agricultural studies.

### **2.1.1 Source of seeds**

Ripe fruits of the different species were collected from Khartoum National Botanical Garden.

### **2.1.2 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 (GA3), fresh Tomato juice for 24 hours (SH.T.J), fermented Tomato juice for 24 hours, (FR.T.J) and the control (CO) untreated seeds.

### **2.1.3 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. if the intact seeds are exposed to environmental conditions that allow imbibitions but prevent germination [6].

**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).

### **2.1.4 Experimental Design**

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

### **2.1.5 Germination Test**

Seeds were germinated on one layer of filter papers in 9 cm plastic Petri dishes. Each dish contained 100 seeds. 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. [7] Suggested that the relative proportions of dormant and non-dormant seed components may be correlated with seed coat thickness.

The parameters studied were germination percentage and germination rate. The number of germinated seed was counted daily for four weeks.

## **2.2 Experiment Two:**

### **2.2.1 Seed preparation**

Ripe fruits were squeezed in water and the floating seeds were collected and dried in the shade for two days before treatments.

### **2.2.2 Seed treatments**

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

### **2.2.3 Experimental Design**

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

### **2.2.4 Germination test**

Seeds were germinated on one layer of filter paper in 9 cm glass Petri dishes. Each dish 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.

## **3. 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. The experiment executed twice.

### **3.1 Experiment One:**

#### **3.1.1 Effect of type of seeds**

Germination started after 8-9 days and was completed within 15 days. The statistical analysis showed a significant difference between germination of the two types of seeds (Fresh and Dried) in Ficus religiosa only. No significant difference was registered between seed type in Ficus benegalensis.

Fresh seeds of Ficus religiosa showed better results. 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. This type of dormancy develops after imbibitions of water by seed and before emergence of the radical. Such conditions can include high temperature, low oxygen supply and lack of light [8].

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 radical as a sign of seed germination. The storage of dry seeds of Ficus religiosa for several weeks resulted in desiccation of the seed coat. Hardheadedness 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.

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 benegalensis* compared to the control (Tab.1).

The dried seeds of *Ficus religiosa*, and *Ficus benegahlensis* 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 benegalensis* (4.3%). (Figs 1 and 2).

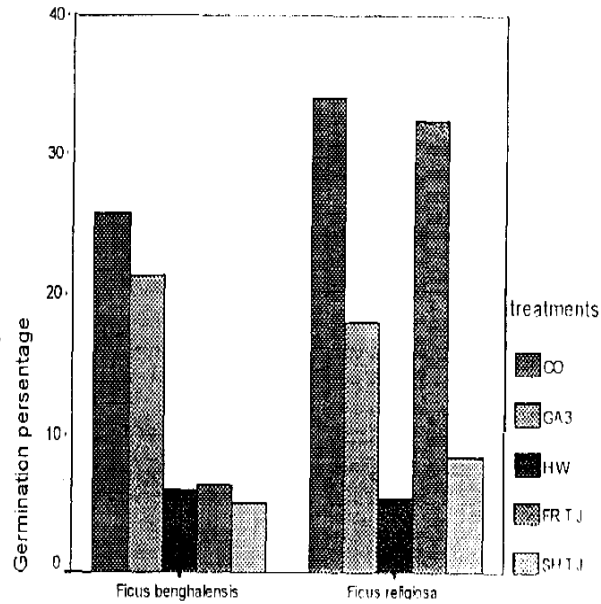
Table 1. Effect of species, seed type, and pre— germination treatments on germination percentage of *Ficus* seeds. (Exp. One)

Ficus species	Type of seeds	Germination percentage				
		CO	GA3	H.W.	FR.T.J	SH.T.J
<i>Ficus benghalensis</i>	Fresh	25.6	21.3	6	6.3	5
	Dry	4.3	16.3	11.6	4.6	6
<i>Ficus religiosa</i>	Fresh	34	18	5.3	32.3	8.3
	Dry	0	6.3	0	0	0.6
<i>Ficus benjamina</i>	Fresh	0	0	0	0	0
	Dry	0	0	0	0	0
<i>Ficus altissima</i>	Fresh	0	0	0	0	0
	Dry	0	0	0	0	0

### 3.2 Experiment Two

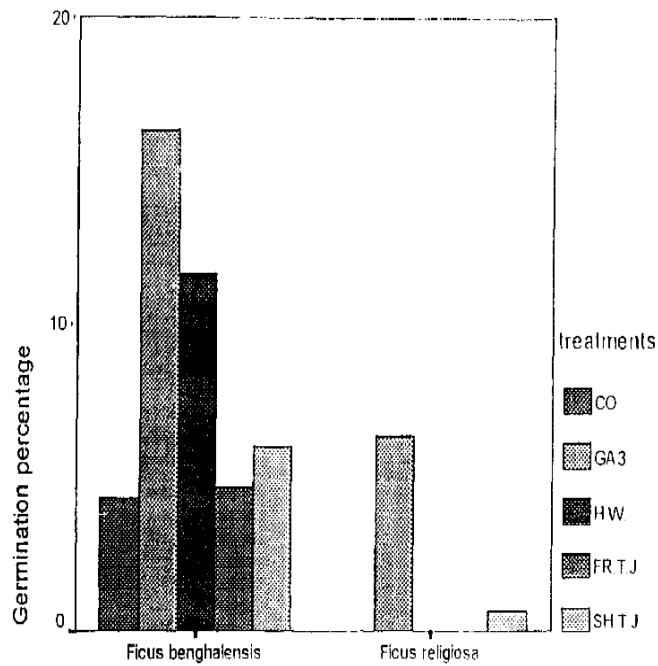
The highest germination percentage was obtained from seeds soaked in Gibberellic acid (GA3), (28%). (23.6%) for *Ficus religiosa* and *Ficus benghaiensis* respectively, (Table 2). Hot water (H.W) treatment gave (20.6%) for *Ficus benghaiensis* and (17.6%) for *Ficus religiosa*, (Table 2). Germination percentage from the untreated seeds (the control) was (18.6%) for *Ficus benghalensis* and (17.6%) for *Feces religiosa* (Table 2). Fresh tomato juice (SH.T.J) treatment gave (18.6%) for *Ficus religiosa* and (12.3%) for *Ficus benghaiensis*, (Table 2). The lowest germination percentages were obtained from fermented tomato juice (FR.T.J), (15.3%) for *Ficus bengliailensis* and (12%) for *Ficus religiosa*, (Table 2), (Fig 3).

Fig 1



Exp I Effect of pre-germination treatments on germination percentage of Fresh seeds

Fig 2

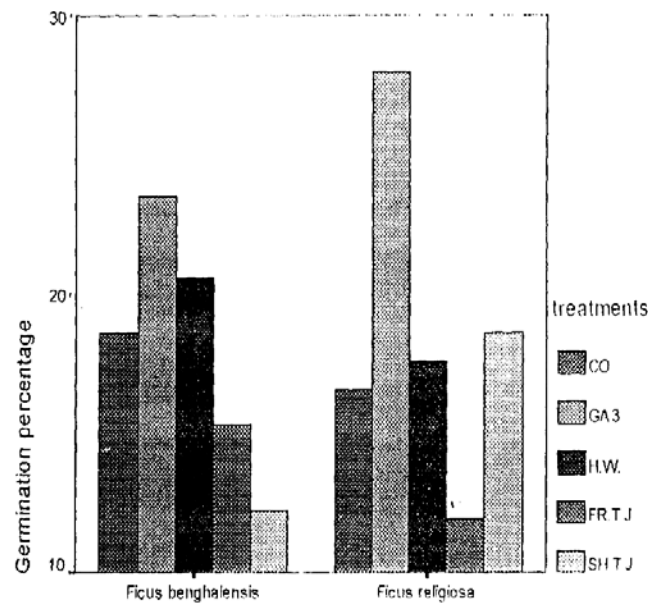


Exp I Effect of pre-germination treatments on germination percentage of Dry seeds

Some *Ficus* species were characterized by high dormancy which was expressed by the 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 optimum humidity for germination of seeds. This optimum humidity may not be available to dry seeds of the same *Ficus* species. Obviously, seed germination ability was quite different for the untreated seeds (the control) of the two types of seeds tested. (Table1).

Gibberellic acid (GA3), as growth regulator, seemed to be an appropriate method for germination of both fresh and dried 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



**Exp II Effect of pre-germination treatments on germination percentage of Fresh seeds**

Table 2. Effect of species and pregermination treatments on germination percentage of fresh seeds of Ficus.

(Exp.Two)

Ficus species	Germination percentage				
	CO	GA <sub>3</sub>	H.W	I FR.T.J	SH.T.J
<i>Ficus benghalensis</i>	18.6	23.6	20.6	15.3	12.3
<i>Ficus religiosa</i>	16.6	28	17.6	12	18.6
<i>Ficus benjamina</i>	0	0	0	0	0
<i>Ficus altissima</i>	0	0	0	0	0

Gibberellic acid (GA<sub>3</sub>) decreases the inhibitory effect caused by these mucilaginous materials. [9], 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). Gibberellic acid (GA<sub>3</sub>) is the most widely used experimentally and commercially. It occurs at a relatively high level in developing seeds but usually drops to a lower level in mature dormant seeds, in dicotyledonous plants [10].

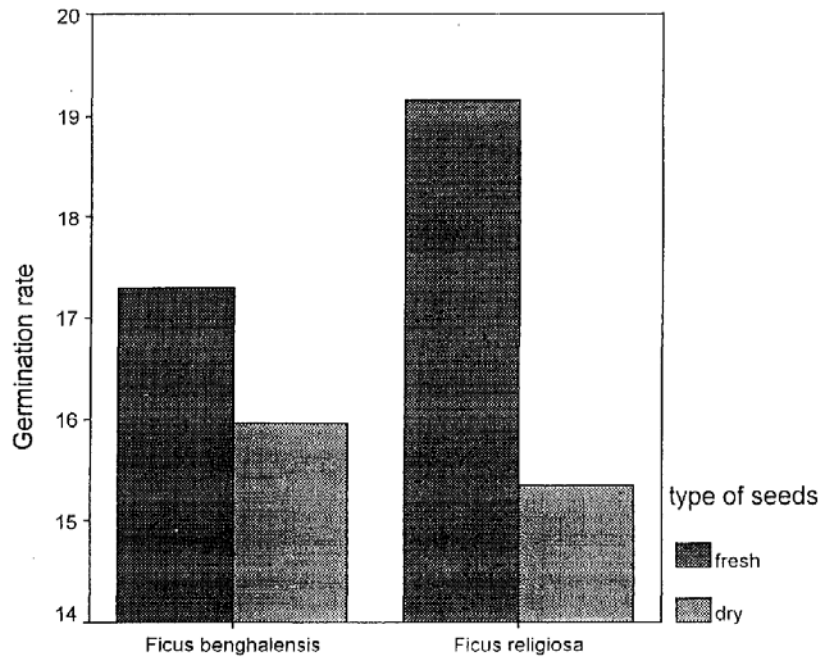
Hot water (H.W) at 60°C may soften the seed coat of some *Ficus* species enabling water imbibitions to take place, thus seed could start germination processes. This effect could be determined as physical scarification, as only the seed coat was affected by this treatment. This result was confirmed by [9], 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 hot water could be of negative effect as reported by [11], 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. [9] Reported that a concentration of (0.3%) of HCL reduced seed germination when applied to *Ficus 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.



Fig. 4



Exp. I Effect of pre-germination treatments on germination rate of Fresh and Dry seeds

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 [12], who reported that Abscisic acid (ABA) fell about 10-fold during fermentation to remove mucilaginous tissues.

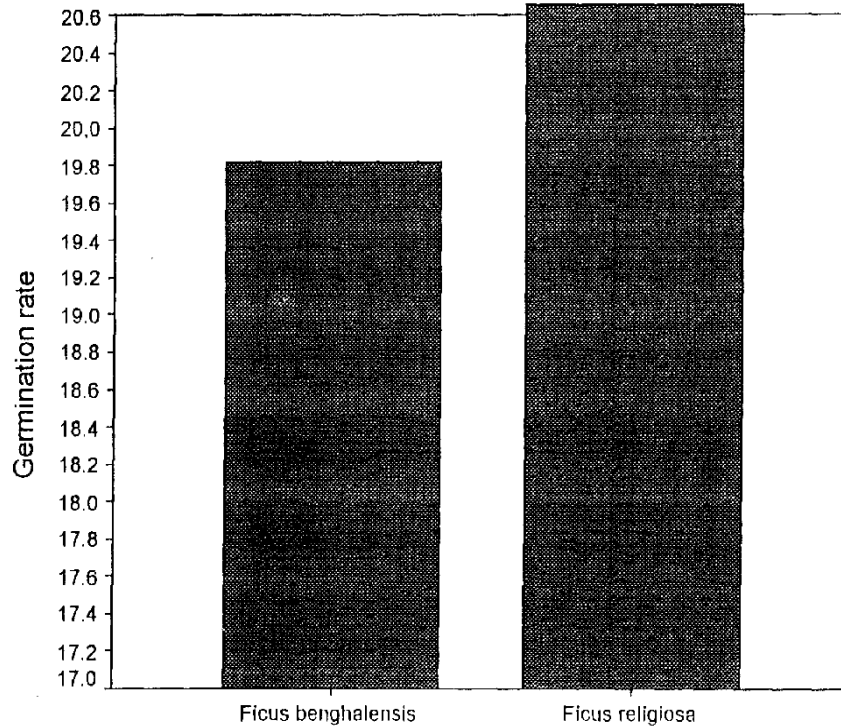
#### Effect of pre germination treatments on germination rate:

##### Experiment One:

Germination rate of both fresh and dried seeds was significantly affected by Pre-germination soaking of Ficus benghalensis.

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). 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 [13,14], but the exact temperature varies with different species and different stages of after ripening [15].

Fig 5



Exp II Effect of pre-germination treatments on germination rate of Fresh seeds

### Experiment Two

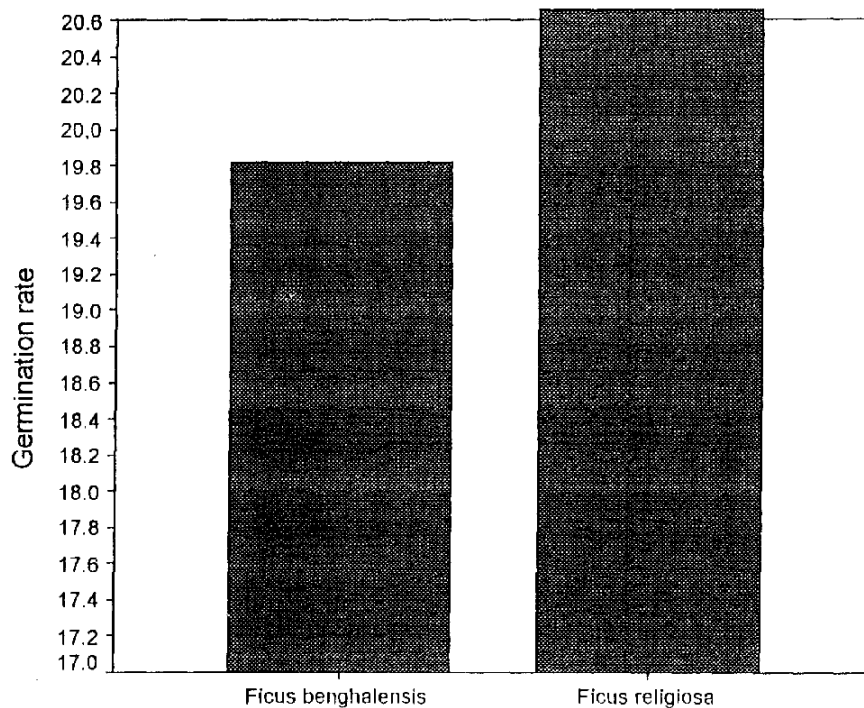
There was no significant effect of peregrinations soaking on germination rate of fresh seeds of the two Ficus species.

This experiment was carried out under stable temperature (20-25°C). This range of temperature may not be optimum for germination of both Ficus benghalensis 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. The temperature of 25-30°C appeared to be more suitable for optimum germination of the two

different Ficus species [14, 15], reported that temperature is the most important factor affecting both initiation and rate of germination.

Fig 5



Exp II Effect of pre-germination treatments on germination rate of Fresh seeds

#### 4. Conclusions

The results of the first experiment showed that there were significant differences in seed germination between the two types of seeds of Ficus reilgiosa only. Best results were obtained for fresh seeds. No significant differences were registered for all pre-germination treatments that were used for both fresh and dried seeds of Ficus benghalensis and Ficus religiosa. In the second experiment, the result showed no significant difference between the pre-germination treatments used for fresh seeds of both Ficus religiosa and Ficus benghalensis. Best results were registered for gibberellic acid (28%) for Ficus religiosa and (23.6%) for Ficus benghalensis.

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