

# Effects of Storage and Exogenous $GA_3$ on Lychee Seed Germination

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## ABSTRACT

The effects of storage time and exogenous gibberellic acid on lychee seeds germination were studied. The seeds were removed from ripe fruits, washed, dried, stored at 8°C for 0, 15 and 30 days, and soaked during 24 hours in water and  $GA_3$  at 50, 100 and 200 mg.L<sup>-1</sup> solutions. As the storage period increased, the germination capacity was lost, and the seeds had a short germinability after 30-day storage period. Gibberellic acid had not significant effect on enhancing both the germination percentage and rate.

**Key words:** Gibberellic acid, gibberellins, deterioration, viability, recalcitrant seed

## INTRODUCTION

The demand on fruits considered “special” has gradually increased over the last few years due to their highly profitable commercialization both on the internal market and for export. As an exotic fruit of high economic potential, the lychee nuts definitely belong to this type of fruits (Saúco & Menini, 1987). However, despite this great interest, few products of lychee nuts exist in Brazil, mainly due to difficulties in reproduction.

Lychee plants have been commercially propagated by layering (Cull & Paxton, 1983; Menzel, 1985; Saúco & Menini, 1987). However, this method has many disadvantages especially in terms of the high need for manpower and the high cost of cutting production (Pinheiro *et al.*, 1984; Xia *et al.*, 1992; Prasad *et al.*, 1996), and interest has arisen in alternative methods of propagation.

The use of seeds for lychee reproduction is a technique extensively used for the production of new varieties and also for the production of graft holders when grafting is used as a multiplication technique. However, many investigators have cited the rapid loss of seed germination capacity, with no tolerance of storage, as one of the great problems in the reproduction of this plant (Cull & Paxton, 1983; Pinheiro *et al.*, 1984; Menzel, 1985;

Saúco & Menini, 1987; Xia *et al.*, 1992; Prasad *et al.*, 1996).

The use of gibberellic acid has been studied in fruit culture as a way to increase seed germination and therefore to obtain a uniform seedling size in the seedbed (Hore & Sen, 1993). The objective of the present study was to determine the effects of the storage time and gibberellic acid treatments on the lychee (*Litchi chinensis* Sonn.) seed germination.

## MATERIALS AND METHODS

The experiment was performed in a FANEN type germinator model 347-G at the Department of Botany, Biosciences Institute, Botucatu Campus – UNESP. Temperature in the germinator was kept constant at 25°C (Xia *et al.*, 1992) and constant white light was provided through of fluorescent lamp.

Seeds were removed on December 13, 1997 from ripe fruits of plants belonging to the orchard of the Lageado Experimental Farm, Botucatu Campus - UNESP. The seeds were submitted to several washes in running water to remove mucilage and dried in the shade for two days (Saúco & Menini, 1987). The dried seeds were either set to germinate immediately after application of gibberellic acid

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(time 1) or stored in plastic bags in a refrigerator at 8° C for 15 (time 2) and 30 days (time 3).

Gibberellic acid was obtained from Pro-Gibb, Abbott Laboratórios do Brasil Ltda., showing GA<sub>3</sub> at 10%. The concentrations of gibberellic acid used were: 0 (water - control); 50 mg.L<sup>-1</sup>, 100 mg.L<sup>-1</sup> and 200 mg.L<sup>-1</sup>; applied over a period of 24 hours in all treatments by soaking the seeds with sprayed solution. The seeds were then treated with the fungicide Captan (orthocide) at 1% in order to prevent contamination with pathogens (Saucó and Menini, 1987). The germinating medium used was filter paper moistened with distilled water. Ten seeds were placed in a gerbox (11 x 11 x 3.5 cm) lined with filter paper.

The experimental design was a complete randomized block with four treatments and eight replications, with 10 seeds per plot and three times. Germination counts were made from the third day after sowing and 3 day intervals up to the 30<sup>th</sup> day. Seeds presenting a radicle five mm long were considered as germinated (Hadas, 1976).

Data concerning to percentage and mean time of germination were submitted to factor analysis of variance (F test) with two factors, treatments and times, and the means were compared by the Tukey test at P > 0.01 (Pimentel-Gomes, 1990). Percentage germination data were previously transformed to arcsin before analysis. The results obtained in the time 3 (30 days of storage), which presented many zero values, were not included in the statistical analysis, and are only discussed on the basis of the figure in terms of biological tendency.

Mean germination time was calculated as follows, according to Labouriau (1983):

$$t = \frac{\sum ni.ti}{\sum n} \quad (\text{days})$$

where:

t = mean germination time

ni = number of germinated seeds during a given time interval

n = total number of germinated seeds

## RESULTS AND DISCUSSION

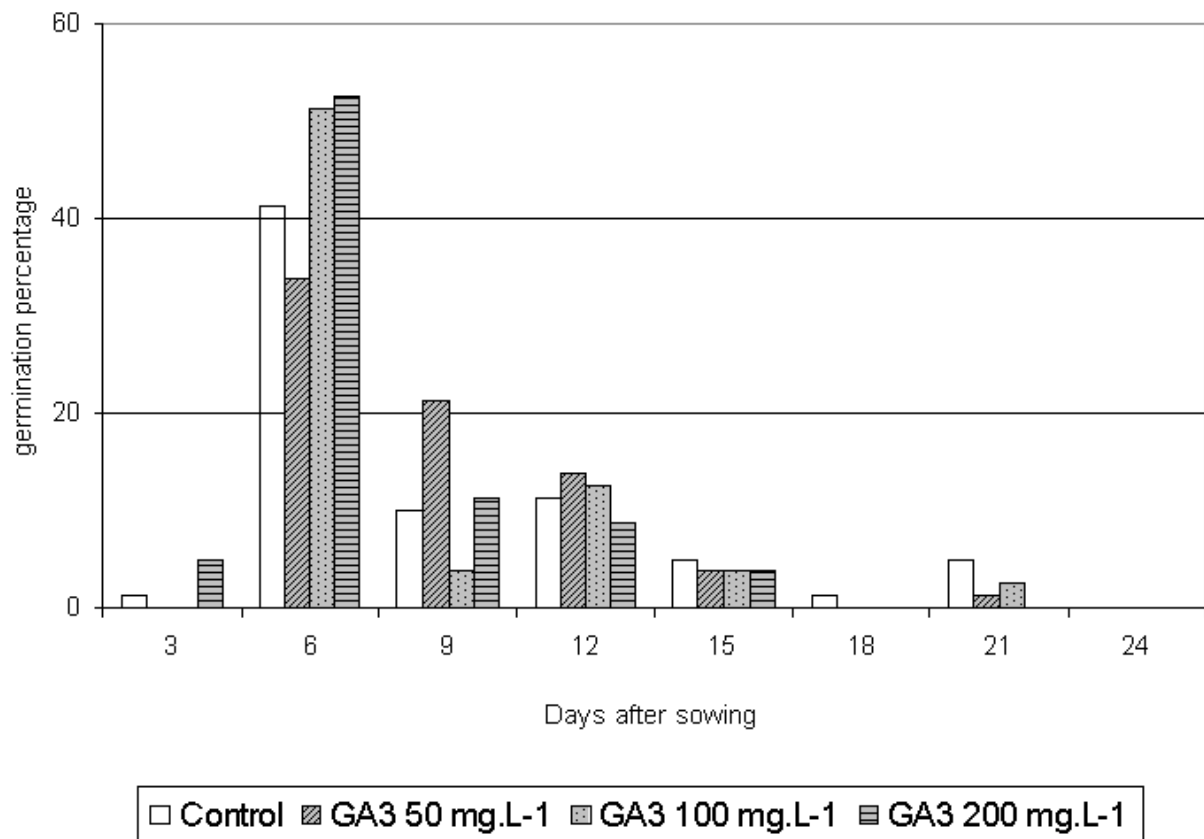
Results presented in Table 1, showed that the mean percentage rate of seeds at time 1 was significantly higher than at time 2. At time 1, in which the seeds were removed from the fruits and allowed to immediately germinate, without storage, mean germination was 74.69% over an interval of 7.8 days (Table 2). At time 2, with a storage time of 15 days, mean germination was significantly reduced by 20.63% to 54.06%. However, there was also a significant decrease in the mean time required for seed germination, which was only four days (Table 2). Thus, the results showed that the lychee seeds lost germination capacity with increasing time of storage (Figures 1, 2 and 3).

**Table 1** - Comparison of the mean germination rates of lychee seeds.

Treatments	Time 1	Time 2
Control	75.00	61.25
GA <sub>3</sub> 50 mg.L <sup>-1</sup>	75.00	60.00
GA <sub>3</sub> 100 mg.L <sup>-1</sup>	73.75	38.75
GA <sub>3</sub> 200 mg.L <sup>-1</sup>	75.00	56.25
Means	74.69 A	54.06 B
F treatments (tr)	0.6	
F times (t)	14.2*	
F tr. x t	0.5	
C.V. (%)	32.5	

\* significant at P ≤ 0.01

Means followed by the same letter do not differ statistically at P ≤ 0.01 (Tukey test).



**Figure 1** - Mean germination rate of lychee seeds in each avaluation interval – without storage.

At time 3, with a storage time of 30 days, germination was drastically reduced to mean values of 7%, with the highest germination rate (11.25%) being obtained by GA<sub>3</sub>, 50 mg.L<sup>-1</sup> as shown in Figure 3.

**Table 2** - Comparison of the mean germination time of lychee seeds (in days).

Treatments	Time 1	Time 2
Control	8.4	4.0
GA <sub>3</sub> 50 mg.L <sup>-1</sup>	8.1	4.2
GA <sub>3</sub> 100 mg.L <sup>-1</sup>	7.5	4.1
GA <sub>3</sub> 200 mg.L <sup>-1</sup>	7.2	3.6
Means	7.8 A	4.0 B
F <sub>treatments (tr.)</sub>	1.16	
F <sub>times (t)</sub>	183.1*	
F <sub>tr. x t</sub>	0.8	
C.V. (%)	20.2	

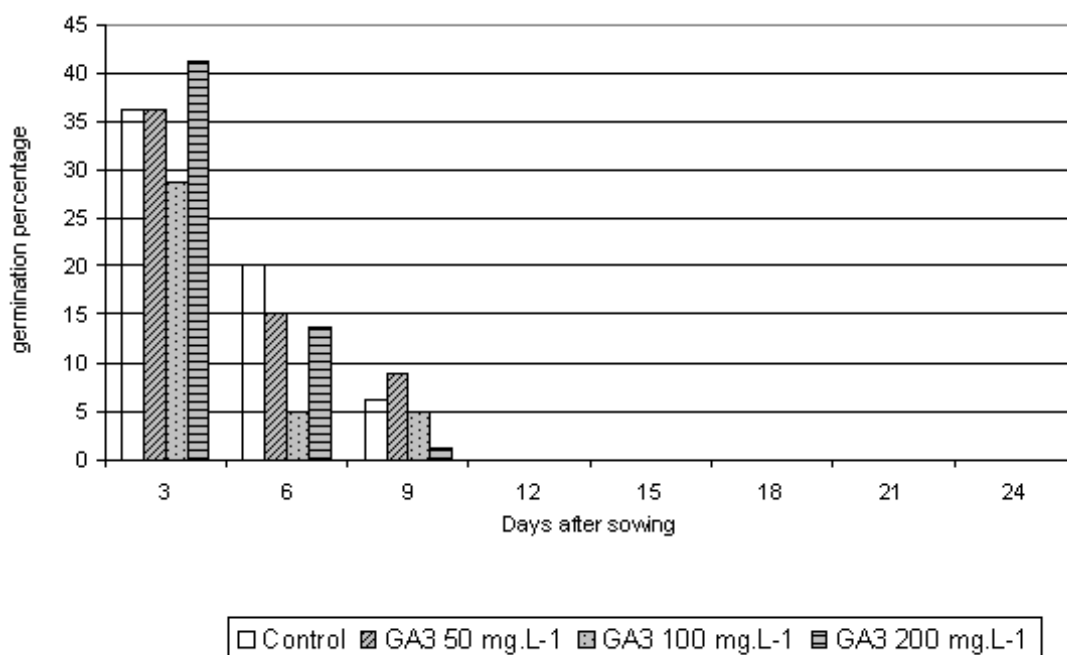
\* significant at P ≤ 0.01

Means followed by the same letter do not differ statistically at P ≤ 0.01 (Tukey test)

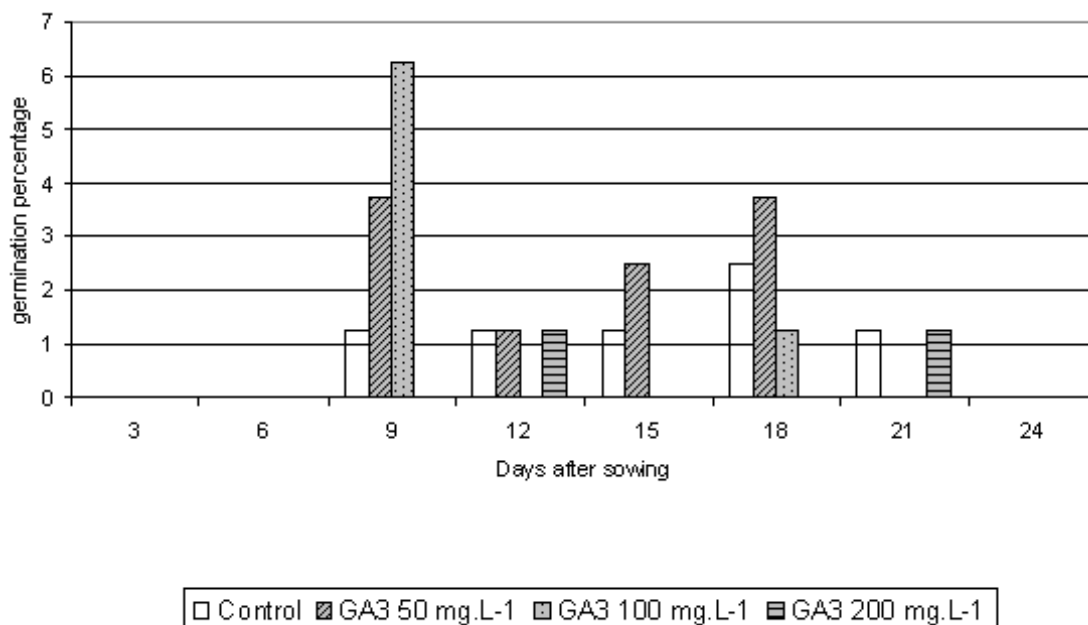
According to Cull & Paxton (1983) and Saúco & Menini (1987) lychee seeds have very short

viability with a total loss of germinative capacity by five days after removal of the fruits. It was recommend the storage in a refrigerator a way to reduce the speed of loss of viability. Ray & Sharma (1985), Menzel (1985) and Chen & Fu (1989) reported that lychee seeds were viable for only 4 – 5 days.

In the present study, just half the seeds stored at a low temperature of approximately 8°C (54.06%) remained viable at 15 days of storage. This result permitted an extension of the period of storage of about 10 days compared to literature data (Figure 2). Therefore, for obtaining a high germination rate of lychee seeds, it could be recommended to sow them soon after the harvest of the fruits. The commercial production of lychee plants requests the sowed of great number of seeds and the obtained of those seeds is a delayed process. Thus, until the time of the sowed it can be necessary the storage of those seeds for a time short, like this, could store them for a smaller period than 15 days. Even so, with reduction in the germination rate.



**Figure 2** - Mean germination rate of Lychee seeds in each avaluation interval – 15 days storage.



**Figure 3** - Mean germination rate of lychee seeds in each avaluation interval – 30 days storage

Prasad *et al.* (1996) found that the use of GA<sub>3</sub> at 100 mg.L<sup>-1</sup> increased the germination rate of lychee seeds in all varieties studied, suggesting

that gibberellic acid played an important role in the germination process of these seeds. Sharma & Dhillon (1986) observed a decline in the

endogenous levels of gibberellins in lychee seeds and suggested that this decline was the limiting factor for the maintenance of viability and/or germination of these seeds.

Metivier (1986) emphasized the key role of gibberellins in germination, which are involved both in the break of dormancy and in the control of reserve hydrolysis on which the growing embryo depends. According to Salisbury & Ross (1992), gibberellic acid is the growth regulator that truly acts on seed germination, showing a favorable action on the break of dormancy.

In the present study, gibberellic acid had no significant effect on the increase in germination rate or in the maintenance of the seeds viability. However, the growth regulator had a beneficial effect on the reduction of the mean time need for seed germination, an effect that was more marked when the 200 mg.L<sup>-1</sup> dose of the growth regulator was used in the time 1 and 2 (Table 2). These results permitted to conclude that the seeds lost their germination capacity with increasing storage time with a very low germination rate (7%) after 30 days of storage. When seeds were stored in a well-sealed plastic bag at 8°C for 15 days, up to 54.06% seed germination was obtained. There was no effect of the different levels of gibberellic acid employed on germination rate or mean time.

## RESUMO

O trabalho teve como objetivo estudar os efeitos do tempo de armazenamento e de tratamentos com ácido giberélico, no processo germinativo de sementes de lichieira (*Litchi chinensis* Sonn.). As sementes foram retiradas de frutos maduros, lavadas, secas à sombra e colocadas para germinar imediatamente ou então, armazenadas em geladeira (8°C) por 15 e 30 dias. Os tratamentos corresponderam à imersão das sementes por 24 horas nas seguintes soluções com aeração: água, GA<sub>3</sub> a 50, 100 e 200 mg.L<sup>-1</sup>. Através dos resultados obtidos, observou-se que as sementes perderam o poder germinativo, à medida que aumentou-se o tempo de armazenamento, sendo a porcentagem de germinação muito baixa (7%) aos 30 dias de armazenamento. O tempo médio de germinação foi menor após 15 dias de armazenamento.

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