# EFFECT OF HOT WATER PRE-TREATMENT, LIGHT AND STORAGE ON GERMINATION OF *SCHLEINITZIA NOVOGUINENSIS* VERD SEEDS

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## ABSTRACT

*S. novoguinensis is a multi – purpose legume tree that is indigenous to the Melanesian group of islands in the pacific region. Though commonly used locally in these islands, there has been very little study regarding its use, management and seed germination. This study assesses the germination rate of two seed types (stored and fresh) treated with hot water under different immersion times and germinated under three shade levels. Stored seeds immersed between 30 to 40 seconds and germinated in 100% sunlight achieved the highest germination as compared to other treatments. Most viable seeds germinated between 3 – 9 days and gradually declined after 18 days.*

**Keywords**: *Schleinitzia novoguinensis, Papua New Guinea, germination, shade level, boiling water immersion.*

## INTRODUCTION

Multi purpose tree legumes (MPTL) have been widely used to improve farming systems as land becomes scarce in many parts of Papua New Guinea (ACIAR 2004). MPTL increase productivity when integrated into cropping systems, and are very useful in managing composition of fallow vegetations (Bourke 1997). Species such as *Casurina oligodon* and *Leuceana* have been widely used to sustain and provide soil nutrient as well as cover crops and forage for livestock.

*Schleinitzia novoguinensis* is commonly used in the coastal communities of New Guinea (Hoft 1992). Local subsistence farmers grow the species in newly cleared gardens by transplanting wild saplings and rarely from seeds due to the hard seed coat dormancy. Verdcourt (1979) describes the botanical attributes of the species, however there is little information published regarding its indigenous use, and seed germination potential (Bourke 1997). Like other legumes, Schleinitzia *novoguinensis* has a hard seed coat that causes dormancy in normal environmental conditions (Krugman *et al.* 1974).

Many studies have used mechanical scarification, acid treatment and hot water at controlled lower temperatures to break dormancy in legume seeds (Bonner et al. 1974, Emery 1987). This study however opted to use boiling water at reduced immersion times as the findings will be greatly adopted in rural areas where highly automatic temperature control devices are rarely available. The main objective of the study is to assess the potential to improve seed germination by this simple seed pretreatment technology; which will in turn increase its ecological and social benefit to the subsistent farming environment and communities in PNG coastal areas.

## MATERIALS AND METHODS

Seeds of *S. novoguinensis* were collected from Milne Bay Province of Papua New Guinea. First collection was done in November 2006, while second collection was in July 2007. Seed trees were located on fallow secondary forests along the coasts of the mainland and atoll Islands of the Province. The earlier collected seeds were stored at room temperature for the period of nine (9) months. Germination assessment was undertaken at the PNG University of Technology's Forestry Nursery in

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Morobe Province. The two seed groups were treated through immersion in 100 °C (boiling water) for 0, 10, 20, 30, 40 and 60 seconds then sowed under 0, 50 and 80 percent (%) shade levels.

A factorial arrangement of treatment was applied consisting of 2 seed groups, 6 immersion times, 3 shade levels and 3 replications consequently 108 experimental units in a randomized complete block design. Each experimental unit (seed tray) contains 100 seeds sowed on treated soil with an average of 65% seed viability for the stored seeds and 60% for the fresh seeds. Germination counts were undertaken in 3 days interval for a period of 30 days. Non immersed seeds sown in 100% sunlight (0% shade level) were used as controls. Average number of germination of the 3 replications were taken for the 10 counts and entered into SPSS for mean differences and ANOVA analysis at 95% CI.

## RESULTS AND DISCUSSIONS

### Seed germination performance between seed groups and shade levels

During the germination period, the following results were obtained. Stored seeds' germination differ significantly compared to fresh seeds, indicated by mean differences and ANOVA (Table 1 and Figure 1).

### Assessment of Germination by immersion time and germination period

General trend of germination (Figure 2), indicates that seeds immersed at shorter times germinate better in lower shade levels. Seeds immersed for longer times on the other hand performed better in higher shade levels. There is high significance of variance (P > 0.05) in germination between shade levels and between the 6 immersion times. Least Significant Difference (LSD) analysis showed that germination performance of seeds in 0% shade level were significantly higher to those in 50% and 80% shade levels. Similarly, LSD analysis for immersion times indicates that immersed seeds perform significantly better than the untreated seeds (control).

Treated seeds immersed between 10 - 40 seconds germinated with less significant difference at lower shade levels however as shade level increases, 30 – 40 seconds immersed seed displayed a significant germination performance from the other treatments. An average combine regression analysis is made to identify the best germination performance of the immersion times (Figure 3). The analysis confirms that on average, immersion times between 10 – 40 seconds achieved better germination than the other lower and upper immersion times. The $R^2$ values for linear (0.073) and quadratic (0.216) are very low and can not be used to make precise germination prediction using the immersion time however, it shows a general trend of germination with increasing immersion times.

Table 1: ANOVA between Seed type and Shade levels

| | Sum of Square | df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| Between Seed Groups | 1198.84 | 1 | 1198.84 | 43.44 | .000 |
| Between Shade Levels | 518.75 | 2 | 259.38 | 8.77 | .000 |

Table 1 indicates that there is a significant difference in germination performance of the two seed groups and shade levels. Stored seeds performed better than fresh seeds at significance level of 0.00 (F value of 43.44). There is also significant germination performance between the 3 shade levels. Seeds germinated under 0% shade level (exposed to 100% sunlight) performed better followed by 50% and 80% shade levels (Figure 1), where averages of 14%, 10% and 6% of the total stored seeds sown germinated under 0%, 50% and 80% shade levels respectively. Fresh seeds germination performance indicates a significant difference between 0% shade level and an insignificance difference between 50% and 80% shade levels with germination percentages of about 7% and 8 % respectively.

Most seeds germinated between 3 -10 days then progressively subsided after 10 days (Figure 4). There was no germination in all the samples after 20 days. The $R^2$ values ($R^2 < 0.5$) show that germination projection on daily basis can not be made using the regressions (linear and quadratic) in Figure 4. This may be factored by the obvious germination differences between the treatments and their replications, though general trends are indicated.

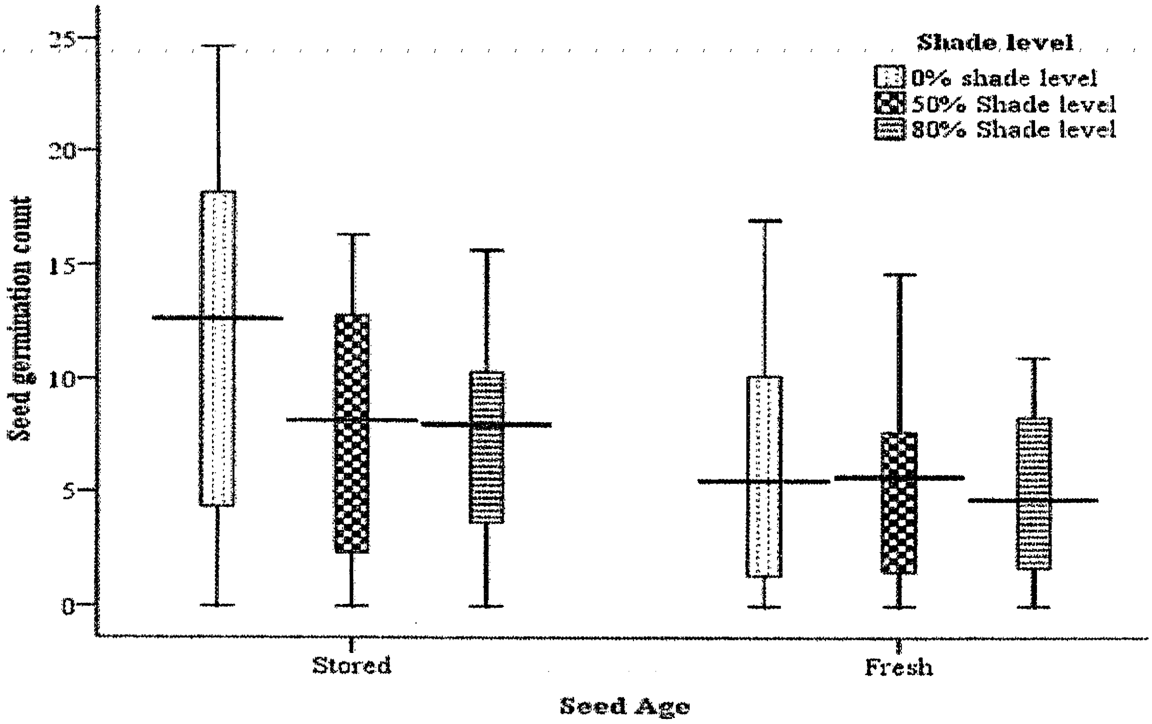


Figure 1: Germination performance of stored and fresh seed groups under different shade levels

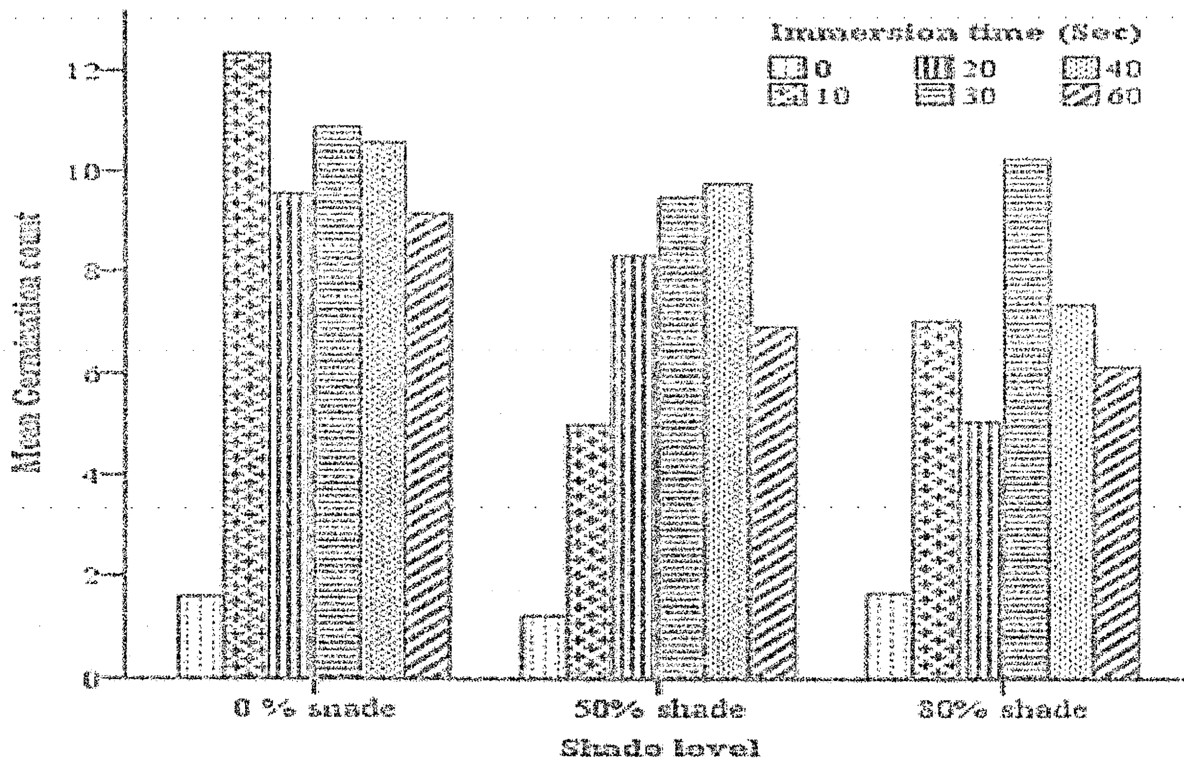


Figure 2: Germination performance of the immersed seeds under different shade levels

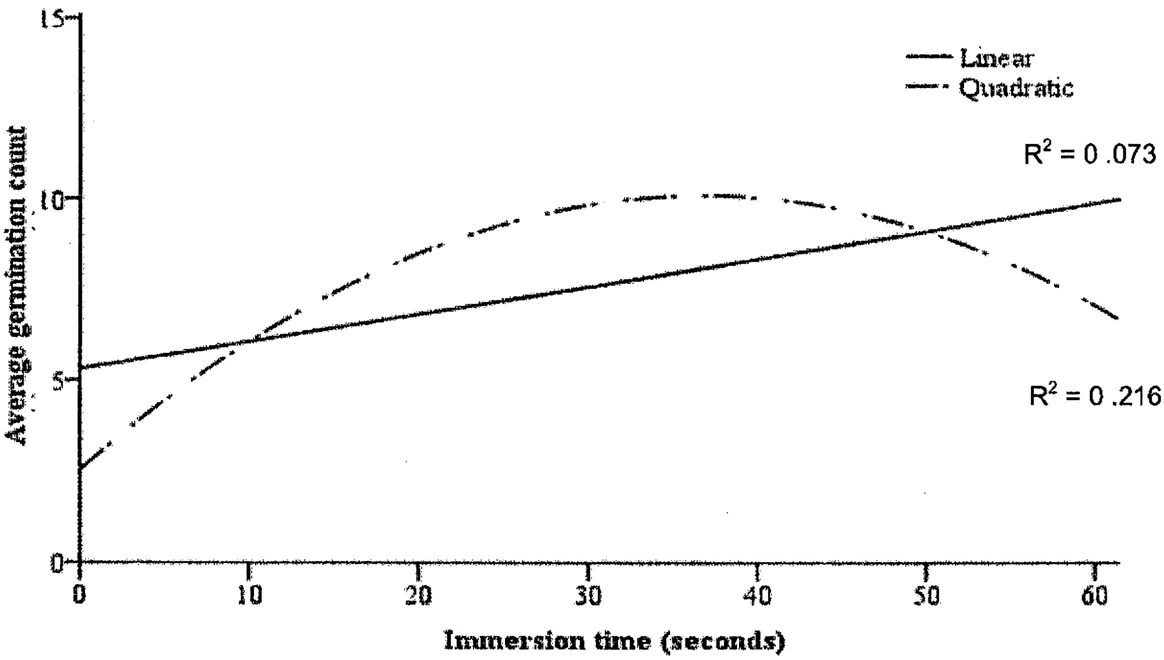


Figure 3: Germination performance of seeds under different immersion times

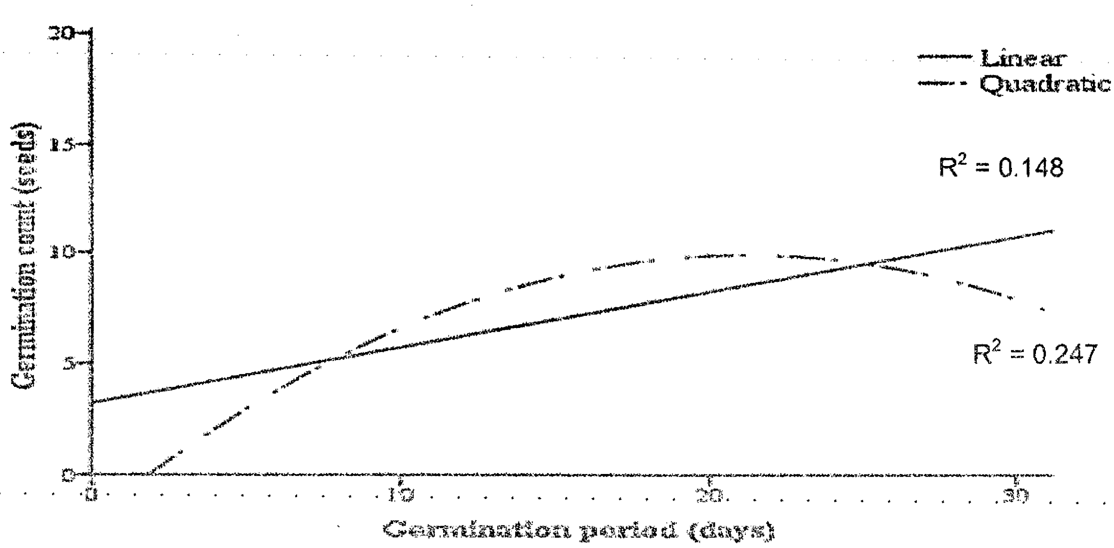


Figure 4: Overall average germination rate over the 30 days

**CONCLUSIONS AND FURTHER RESEARCH**

Stored seeds germinate better than freshly collected seeds. Shading of seeds from sunlight during germination does not improve germination performance. In addition, germination improved significantly in treated seeds as compared to non treated seeds (0 seconds). General average trend indicated the best germination at 20 – 40 seconds immersion times for the three shade levels however, there was no significant variance to 10 and 60 immersion times. These results also reconfirmed Oomen and Koppe (1969) findings that most tropical and sub tropical hard coated seeds germinate well between temperature ranges of 10$^0$C – 35$^0$C. Basra (1995) approves this theory by the development of automatic cabinet incubator for seed germination with standard temperature range of 10$^0$C – 35$^0$C. Most germination occurred within the first two weeks and no seeds germinated after the third week.

General germination trends indicated in this study can be utilized by the practicing farmers who mostly grow the tree by transplanting naturally germinated seedlings. Seeds picked from matured trees can be stored for months until the next cropping season. This seed can then be immersed in boiling water for half a minute and germinated on a prepared open seed bed for transplanting in due time.

This is a preliminary study into the seed germination of the species using boiling water. Results from this study indicated a very low ratio of actual seeds germinated to the quantity of viable seeds. Thus, there is a need for more research into other germination inducement techniques to improve germination quantities and rates. Lower shade levels should be trialed to increase sunlight and reduce shifting erosion in seed trays from direct raindrops as experienced in this study.

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