



## Assessment of physiological performance of greengram seeds treated with botanicals during accelerated ageing

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### Abstract

Ageing is a universal physiological process that occurs in all living organisms and its impact on modern agricultural practice has become a major concern. Seed viability and seed storability are well predicted by accelerated ageing. The current research looks at how the different plant products influence the storability of greengram seeds through an artificially accelerated ageing test. Seed quality parameters *viz.*, rate of germination, germination percent, root length, shoot length, dry matter production and vigor index were assessed in the laboratory for treated and control seeds. The germination percent of greengram seeds was decreased from 98 to 60 as the ageing progresses from 0 to 10 days in case of neem oil treated seed and to 46 percent in untreated seed. Neem oil treated greengram seeds deteriorated slowly and also decreased in values of other seed quality parameters of aged seeds such as root length from 9.8 cm to 7.16 cm, shoot length from 19.2 to 17.40 cm, Dry matter production from 444.02 mg to 195.66 mg and vigour index from 2842 to 1009. As a result, Neem oil treated seeds degraded relatively slowly than other seeds, demonstrating that it is effective in reducing the negative effects of ageing while maintaining vigour and viability.

**Keywords:** greengram, accelerated ageing, botanicals, seed quality, germination percent

### Introduction

Greengram (*Vigna radiata* (L.) Wilzeck  $2n=22$ ) popularly known as mungbean (or) golden bean, is one of the major pulse crop widely consumed next to blackgram. In India, greengram is the most commonly cultivated in the states of Maharashtra, Karnataka, Bihar, Punjab, Andhra Pradesh, Tamilnadu, Uttar Pradesh and Rajasthan. It is an important short duration, multi-season and multipurpose legume crop extensively cultivated in the tropics and subtropics regions of the world. Greengram is a rich source of protein (24%), carbohydrates (60%), fat (1.5%), amino acids, vitamins and minerals.

Good quality seeds are basic for the establishment of healthy and pure crop. Seed storage is an important aspect of post-harvest technology because the viability of seeds has to be maintained throughout the year. Numerous factors directly affect the seed physiological quality including storage condition, which is important for preserving germinability and vigour stamina of seeds and deteriorative process once started, it cannot be reversed back to the original quality as it is an irreversible change. The physiological storability of seeds was significantly affected by initial seed quality, seed moisture content, relative humidity, temperature, storage pathogen and storage duration of seeds. Seed treatment was one of the measures to protect the seeds from deterioration during storage. Seed deterioration during storage is a complex physiological and biochemical process leading to loss of vigour and germination ability. Ageing is a universal physiological phenomenon occurring in living organisms and its effect becomes a problem in modern agricultural practice (Nutille, 1964) [7]. Accelerated ageing is an excellent forecaster of seed viability and seed storability. Accelerated ageing

of seeds by providing favorable condition for seed deterioration such as temperature (40 - 45°C) and high relative humidity (100 percent) and assessing the subsequent performance of seed have been considered to be an easy and reliable method to study the storage behavior of seed in a relatively short time (Abdul-Baki and Anderson, 1973) [1]. According to Mali *et al.* (2014) [6], this method would serve as a tool to predict the storability of crop seeds within short span of time. Since most agricultural seeds should be stored for one or more planting seasons, agriculturists and horticulturists are frequently challenged when it comes to maintaining standard seed vigour in ambient storage. Increased seed deterioration is connected with decreased DNA synthesis, increased DNA degradation, and increased membrane permeability as a result of ageing. Hence, this study focuses on effect of diverse plant products as seed protectants on the storability of greengram seed during an accelerated ageing process by analyzing the seed quality under the laboratory condition.

### Materials and Methods

Genetically pure, freshly harvested breeder seeds of greengram (*Vigna radiata* (L.) Wilzeck) cv. ADT3 obtained from Tamil Nadu Rice Research Station, Aduthurai served as the base materials for the study. Fresh seeds of greengram were subjected to various treatments using botanicals and plant oils to extend the storability and viability of the seed. Treated seeds (Castor oil @ 10 ml/kg (T<sub>1</sub>), Coconut oil @ 10 ml/kg (T<sub>2</sub>), Neem oil @ 3 ml/kg (T<sub>3</sub>), Lemon grass oil @ 10 ml/kg (T<sub>4</sub>), Vasambu leaf powder @ 25 gm/kg (T<sub>5</sub>), Arappu leaf powder @ 25 gm/kg (T<sub>6</sub>), Turmeric powder @ 25 gm/kg (T<sub>7</sub>) and control (untreated seeds) were subjected to accelerated ageing by keeping the

seeds in accelerated ageing chamber, maintained at  $95\pm 2\%$  relative humidity with a constant temperature of  $45\pm 2^\circ\text{C}$  (De douche and Baskin, 1973) <sup>[2]</sup> for a period of 10 days. The experiment was conducted at room temperature  $26\pm 1^\circ\text{C}$  in the seed technology laboratory of the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University. The accelerated aged seeds of different treatment were taken on 11<sup>th</sup> day of ageing and were evaluated for the seed quality parameters with two replications for each treatment. Seed quality could be evaluated by testing the seed quality parameters like rate of germination, germination percent, root length, shoot length, dry matter production and vigor index. Data were statistically analyzed using ANOVA by adopting the procedure recommended by Panse and Sukumathe (1985) <sup>[8]</sup>.

### Results and Discussion

An accelerated ageing experiment was conducted in greengram to study the effect of various plant products as seed protectants to extend the storability of greengram seeds using accelerated ageing test. In the southern part of India, high relative humidity and temperature that prevail during rabi season accelerated the ageing process particularly when seeds are stored in the moisture pervious container like cloth bags, which causes concern for vigour and viability maintenance that ultimately has a bearing on the viability and field performance. Seed germination and other seed quality metrics decreased during storage as the time of ageing increased, which had an impact on vigour, viability, and production. This can be mitigated to some degree or for a period of time by seed protective materials, which slows the decay of seeds by pre-conditioning them.

The degradation of lipoprotein cell membranes by free radical induced lipid per-oxidation has been suggested to be the basic reaction for senescence and ageing. Seed germination capacity may also be affected by the macro molecular level involving qualitative and quantitative changes in protein, nucleic acid lipids and hormones. Near parallelism in deterioration process of the accelerated aged and naturally aged seeds was observed by Delouche and Baskin (1973) <sup>[2]</sup> and Delouche *et al.* (1976) <sup>[3]</sup> with several species.

Seed deterioration during storage could be determined by changes in seed quality parameters. The results revealed that the initial germination of greengram seeds before accelerated ageing was 98%. As the duration of aging increases, there was a decrease in seed germination percent to 60% in case of neem oil treated seeds and 46% in case of untreated seeds. This decrease in germination as well as other seed quality parameters can be reduced to some extent or through some period by the activity of seed protecting material, which restricted the seed deterioration process by seed treatment. According to Ranganathan (2015) <sup>[10]</sup>, Ageing induced stress on seed may cause damage in the seed's germination mechanism, as well as enzyme degradation, which is responsible for converting food reserves to energy products, resulting in delayed germination, which was also similar in the case of greengram seeds after 10 days of accelerated aging and also reported a gradual decrease in germination, and seedling length with an increase in the aging period (Patole and Mahajan, 2008) <sup>[9]</sup>.

The germination percent was decreased from 98 to 60 as the ageing progresses from 0 to 10 days of ageing in case of neem oil treated seed and to 46 per cent in case of untreated seeds. The botanicals triggered a halt in the rate of decrease of seed germination capacity, indicating that the experimental seed material's seed viability was preserved when compared to untreated seeds. There was a decrease of vigour from 2842 to 1009 in case of neem oil treated seed than that of control (805). Neem oil treated seed deteriorated slowly. This may be due to the presence of *Azadirachtin* in neem oil that counteract the production of free radical enzyme, thereby reduces the membrane degradation which maintain the viability of the seed (Mahendran and Mohan, 2002) <sup>[5]</sup>.

Evaluation of seedling vigour parameter revealed that among the seed treatment, neem oil recorded the longest root (7.16 cm) and shoot length (17.40 cm) after 10 days of aging when compared to control and other treatment. This may be due to reduction of free radical enzyme production. This was reported by Vanniarajan *et al.* (2004) <sup>[13]</sup> in blackgram and Gokulakrishnan and Sundramoorthy (2012) <sup>[4]</sup> in greengram. Neem product acts as the best seed protectant throughout the seed storage (Patok and Mahayan, 2008).

Seed deterioration results in delayed germination, slower seedling growth rates, abnormal growth, decreased tolerances to adverse condition and finally loss of germination ability (Shivasharanappa *et al.*, 2018) <sup>[11]</sup>. This slow reduction in germination rate of neem oil treated seed may be due to the impairment of metabolic processes caused by membrane aberrations and the need for the repair mechanisms to take place in order to compensate for the accumulated damages, however, after 10 days of ageing seeds, cells cannot tolerate the severe biochemical changes resulted in decreased seed germination decrease from 98% to 60% in case of treated seeds (neem oil treated seed). At this point, the repair mechanism in the cell has low ability to recover any biochemical changes in the cells of untreated seeds of greengram.

In agricultural crops, nummular decrease in germination and seedling quality characters with advance in days of accelerated aging was observed by numerous scientists. A similar reduction in seed and seedling quality characters were also absorbed with natural ageing which is the characteristics feature of ageing. The decline in seed and seedling vigour was attributable to irreversible causes of ageing (Siadat *et al.*, 2012) <sup>[12]</sup>. So, based on the current observations, pretreated greengram seeds having a higher metabolic status, it appears that the seed pre-treating agents had a significant effect at the metabolic level, resulting in seed vigour retention and consequent extension of seed viability with concomitant enhancement of physiological performance of treated seeds under accelerated ageing.

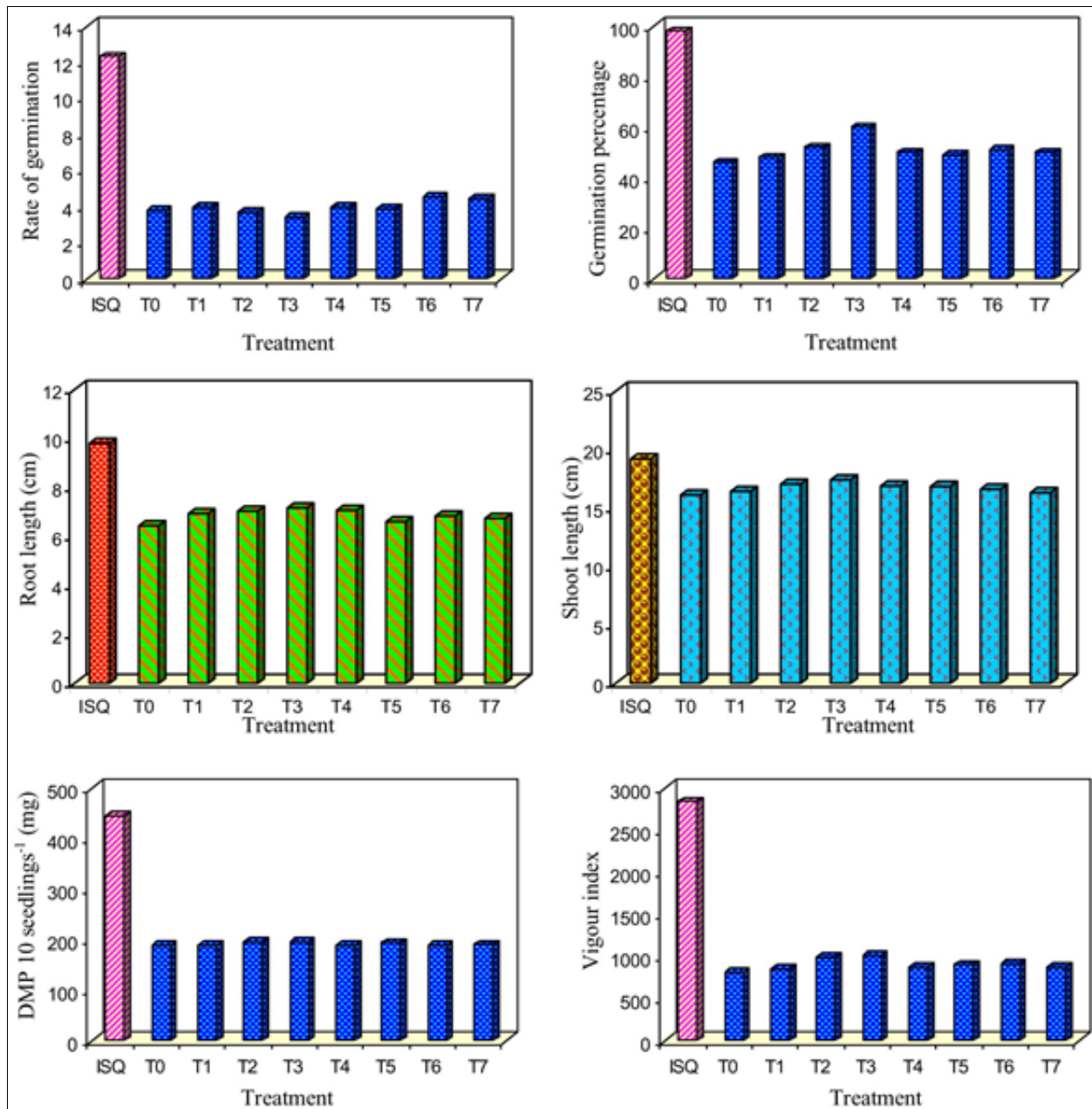
Physiological performance of untreated seed was affected by the accelerated ageing treatment, as evidenced by decreased germination percent, low rate of germination, decreased root and shoot lengths, dry weight, and vigour index.

The neem product reduced the negative effects of ageing on physiological potential of the experimental seed, indicating that the seeds' physiological state was maintained by neem oil treatment during ageing.

## Conclusion

The present study revealed that neem treated seeds can be stored for a longer duration and maintained vigour and viability when compared to untreated seeds. *Azadirachtin*

found in neem, has a wide range of effects, notably acting as a feeding deterrent, insect growth regulator, repellent, and sterilitant, as well as inhibiting oviposition.



ISQ – Initial Seed Quality; T<sub>0</sub> – Control; T<sub>1</sub> – Castor oil @ 10 ml/kg; T<sub>2</sub> – Coconut oil @ 10 ml/kg, T<sub>3</sub> – Neem oil @ 3 ml/kg, T<sub>4</sub> – Lemon grass oil @ 10 ml/kg, T<sub>5</sub> – Vasambu leaf powder @ 25 gm/kg, T<sub>6</sub> – Arappu leaf powder @ 25 gm/kg (T<sub>6</sub>), T<sub>7</sub> – Turmeric powder @ 25 gm/kg.

**Fig 1:** Efficacy of accelerated aging on seed and seedling quality characteristics of greengram cv. ADT3

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