*International Journal of Plant & Soil Science*

*20(2): 1-6, 2017; Article no.IJPSS.37332*
*ISSN: 2320-7035*

# Standardization of Seed Coating Polymer in Pigeonpea (*Cajanus cajan* L.)

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Author MGH performed the study, carried statistical analysis of the study and wrote the first draft of the manuscript. Authors SBP and SNV designed and monitored the study, managed the analysis of the study. Author MGH managed the literature searches. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/IJPSS/2017/37332
Editor(s):
(1) Marko Petek, Professor, University of Zagreb, Faculty of Agriculture, Department of Plant Nutrition, Europe.
(2) Marco Aurelio Cristancho, National Center for Coffee Research, Chinchiná, Caldas, Colombia.
Reviewers:
(1) Leif Marvin R. Gonzales, Capiz State University, Philippines.
(2) Muskhazli Mustafa, Universiti Putra Malaysia, Malaysia.
Complete Peer review History: http://www.sciencedomain.org/review-history/21954

***Original Research Article***

***Received 11th October 2017***
***Accepted 12th November 2017***
***Published 17th November 2017***

## ABSTRACT

Laboratory experiment was conducted with the objective to standardize the seed coating polymer in Pigeonpea (*Cajanus cajan* L.). The experiment consisted of five different dosages of polymer (P) along with a control *viz.,* $P_1$: Control, $P_2$: polymer @ 2 ml per kg of seed, $P_3$: polymer @ 4 ml per kg of seed, $P_4$: polymer @ 6 ml per kg of seed, $P_5$: polymer @ 8 ml per kg of seed, $P_6$: polymer @ 10 ml per kg of seed. Among the treatments imposed, seed coating polymer @ 8 ml/kg of pigeonpea seeds recorded significantly higher germination, speed of germination, shoot length (cm), root length (cm), seedling dry weight (mg/seedling) and seedling vigour index (SVI) as compared to control. However, seed coating polymer @ 8 ml/kg of seed was significantly not different with the results obtained by seed coating polymer (@ 10 ml/kg and @ 6 ml/kg respectively) of seed. Therefore, the polymer @ 6 ml/kg of seed was found to be economically feasible over all the treatments.

*Keywords: Pigeonpea; polymer dosage; seed coating polymer; seed quality; standardization.*

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## 1. INTRODUCTION

Pigeonpea (*Cajanus cajan* L.) is an important pulse crop in India. It is also known as Red gram, Arhar and Tur. Pigeonpea is mainly cultivated and consumed in developing countries of the world. This crop is widely grown in India. India is the largest producer and consumer of pigeonpea in the world, accounting for about 19.07 percent of the total production of pulses in the country during the year 2011-2012 [1].

Pigeonpea is a protein rich staple food. It contains about 22 percent of protein, which is almost three times that of cereals. It supplies a major share of protein requirement of vegetarian population of the country and is mainly consumed in the form of split pulse as Dal, which is an essential supplement of cereal based diet [2]. The combinations of Dal-Chawal (pulse-rice) or Dal-Roti (pulse-wheat bread) are the main ingredients in the average Indian diet. The biological value improves greatly, when wheat or rice is combined with pigeonpea because of the complementary relationship of the essential amino acids. It is particularly rich in lysine, riboflavin, thiamine, niacin and iron [1]. In addition to being an important source of human food and animal feed, pigeonpea also plays an important role in sustaining soil fertility by improving physical properties of soil and fixing atmospheric nitrogen [1]. Being a drought resistant crop, it is suitable for dryland farming and predominantly used as an intercrop with other crops [1].

In order to increase the productivity, good quality seeds need to be made available to the farmers in time at an affordable price through different seed quality enhancement techniques *viz.,* re-sowing hydration treatment, coating techniques and seed pelleting. Seed quality enhancement through seed polymerization is the application of physical, physiological, biological and chemical agents to the seed in order to enhance the physical, physiological, biochemical and health qualities of seed. At present, in Indian agriculture, different seed treatments are imposed on crop seeds for improvement of field stand and productivity [3]. Seed polymerization is a physiological method of seed invigouration that enriches the endogenous level of newly bioactive substances, there by better establishment and improved crop productivity can be achieved. Seed polymer coating is the sophisticated process of applying precise amount of active ingredients along with a liquid polymer directly on to the seed surface without obscuring its shape, seed size and weight [3]. Thus polymer forms a flexible film that adheres and protects the active ingredients, preventing the dusting off and loss of active ingredients during handling. This technology helps in precise and uniform application of fungicides, insecticides, bioagents, micronutrients, colours and other additives [3].

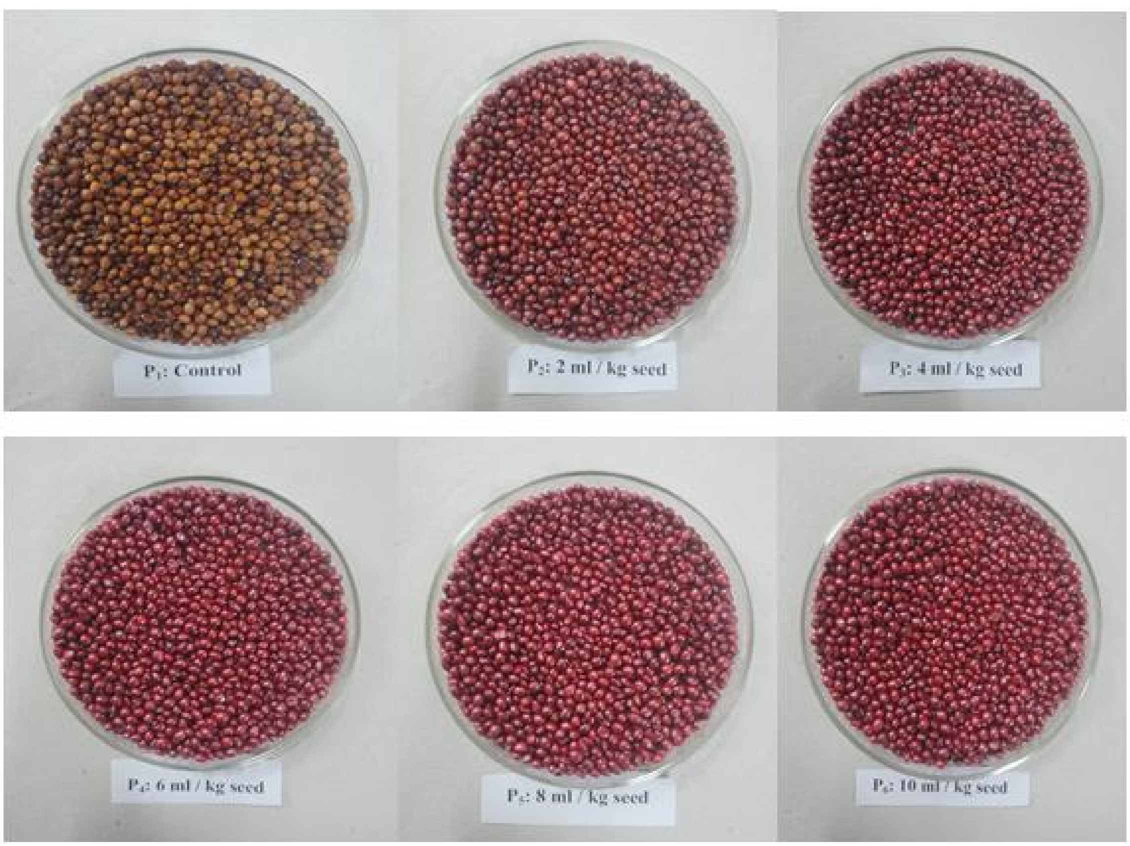
Seed coating (polymerization) is a technique wherein any substance applied to the seed does not obscure or change its shape. The film is readily water soluble (hydrophilic) so as not to impede seed germination [4]. In this method small quantity of chemicals or micronutrients are needed as compared to soil application or foliar spray. Seed polymerization is one of the most economical approaches for improving seed performance. Film coating helps to smoothen the seed surface which improves ability of flow and helps in mechanized planting [4]. The improvements in crop establishment, growth and yield due to coating or pelleting have been reported in several agricultural, horticultural and tree crops [4-5].

With this background, an experiment was carried out in the Department of Seed Science and Technology, University of Agricultural Sciences, Raichur with the main objective of standardization of seed coating polymer in pigeonpea (*Cajanus cajan* L.) for ascertaining seed quality parameters.

## 2. MATERIALS AND METHODS

The Laboratory experiment was conducted during 2014-2015 in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur to standardize the seed coating polymer in pigeonpea seeds (variety TS-3R). The polymer used in the present study was Disco Agro DC Red L-603 procured from the Incotec Pvt. Ltd. Ahmedabad, Gujarat. The experiment was laid out in the Completely Randomized Block Design (CRD) with four replications and it consisted of five different dosages of polymer (P) along with a control *viz.,* $P_1$: Control, $P_2$: polymer @ 2 ml per kg of seed, $P_3$: polymer @ 4 ml per kg of seed, $P_4$: polymer @ 6 ml per kg of seed, $P_5$: polymer @ 8 ml per kg of seed, $P_6$: polymer @ 10 ml per kg of seed. Fresh and untreated seeds of pigeonpea variety TS-3R were obtained from Seed Unit, University of Agricultural Sciences, Raichur. The cleaned and graded seeds were coated with polymer as per treatment after diluting the polymer with 45 ml distilled water in a rotary seed coating machine (Picture 1). Subsequently the seeds were air dried to 24 hours to bring back to original moisture content and then used for germination test and recording of other observations. The statistical analysis of the data was done as per the procedure described by [6].

Germination test was conducted using four replicates of 100 seeds each by adopting 'between paper method' and incubated in the 'walk in seed germination chamber' maintained at 25 ± 1°C temperature and 90 ± 2 percent Relative humidity (RH). The number of normal seedlings in each replication was counted on the final day of count ($6^{th}$ day). For speed of germination, the average germination was worked out by adopting ISTA procedure [7]. The number of seeds germinated was recorded daily up to the day of final count ($6^{th}$ day). The shoot length was measured by randomly selected 10 seedlings from each treatment, replication wise on the day of final count ($6^{th}$ day) of germination test and was measured from the base of the primary leaf to the base of hypocotyl. After that, the mean shoot length was expressed in centimetres. Similarly, the normal seedlings used for shoot length measurement were (10 in number) also used for the measurement of root length. It was measured from the tip of primary root to the base of hypocotyl and mean root length was expressed in centimeters. The same ten normal seedlings after measuring the shoot and root length were put in butter paper bag and kept in a hot air oven maintained at 70 ± 1°C for 24 hours. After drying, the seedlings were placed in a desiccator for cooling. The weight of dried seedlings was recorded and means weight was calculated per seedling and expressed in milligrams. Thereafter, Seedling vigour index was computed by adopting the formula suggested by [8]. i.e., Vigour index = Germination (%) x [Shoot length (cm) + root length (cm)] and expressed as number.




**Picture 1. Pigeonpea seeds coated with different dosage of polymer**

## 3. RESULTS AND DISCUSSION

The data on seed quality parameters *viz.,* germination (%), speed of germination, seedling dry weight (mg), shoot length (cm), root length (cm) and seedling vigour index are presented in Table 1 and Table 2.

From the laboratory experiment, it was ascertained that germination percentage (94.60%) was significantly higher in the seeds coated with 8 ml polymer per kg seed ($P_5$) as compared to all other treatments and control ($P_1$ - 91%). However, from the statistical data it was ascertained that, 8 ml polymer per kg seed ($P_5$) was not significantly different from 10 ml polymer per kg seed ($P_6$ - 94.38%) and 6 ml polymer per kg seed ($P_4$ - 94.10%). Such beneficial effects of germination due to polymer coating were reported by [9,10,11]. The increase in germination might be attributed to the increase in the rate of moisture imbibition where the fine particles in the coating act as a 'wick' or moisture attracting material or perhaps to improve seed soil contact. Coating with hydrophilic polymer regulates the rate of water uptake, reduce imbibition damage and improve the emergence [12], similar findings were also reported by [13].

Significantly higher speed of germination (30.55) was recorded in $P_5$ (8 ml per kg of seed) as compared to control i.e. $P_1$ (27.00).The treatment $P_5$ (8 ml per kg of seed) was on par with $P_6$ at the rate of 10 ml per kg of seed and $P_4$ at the rate of 6 ml per kg of seed which recorded 29.74 and 29.50 speed of germination, respectively. The increase in speed of germination of polymer coated seeds is attributed to its hydrophilic nature, leading to higher water uptake, which resulted in quicker radical emergence [14]. These findings were in agreement with the findings of [11].

Seeds coated with polymer at the rate of 8 ml per kg of seed ($P_5$) recorded significantly higher seedling dry weight (84.62 mg) as compared to control (79.83 mg) and all other treatments. Whereas, $P_5$ (8 ml per kg of seed) was statistically not significant with 10 ml per kg seed ($P_6$ - 84.36 mg) and 6 ml per kg seed ($P_4$ - 84.20 mg). The increase in seedling dry weight might be due to the greater vigour reflected in early stage and higher percentage of germination of seeds that had reached autotrophic stage well in advance than others [13,14,15]. Increase in dry weight might further be enhanced due to enhanced lipid utilisation through glyoxalate cycle, a primitive metabolic pathway thereby, facilitating the conversion of acetate into nucleic acid [11,13,15].

In the present investigation, the results of shoot and root length differed significantly due to seed polymer coating. Significantly maximum shoot and root length (11.50 and 15.63 cm, respectively) were recorded in the seeds treated with polymer at the rate of 8 ml per kg of seed ($P_5$). However, $P_5$ (8 ml per kg of seed) was on par with 10 ml polymer per kg seed ($P_6$ - 11.28 cm, 14.83 cm) and 6 ml per kg of seed ($P_4$ -11.10 cm and 14.78 cm) (Picture 2) respectively. The minimum shoot and root length were recorded in the untreated seeds ($P_1$-9.15 cm, 12.10 cm) respectively. The improvement in shoot and root length might be due to enhanced metabolic activity resulted in early germination as reported by [11,12,14,15]. Other studies in relevance to these results were also reported by [13,15,16].

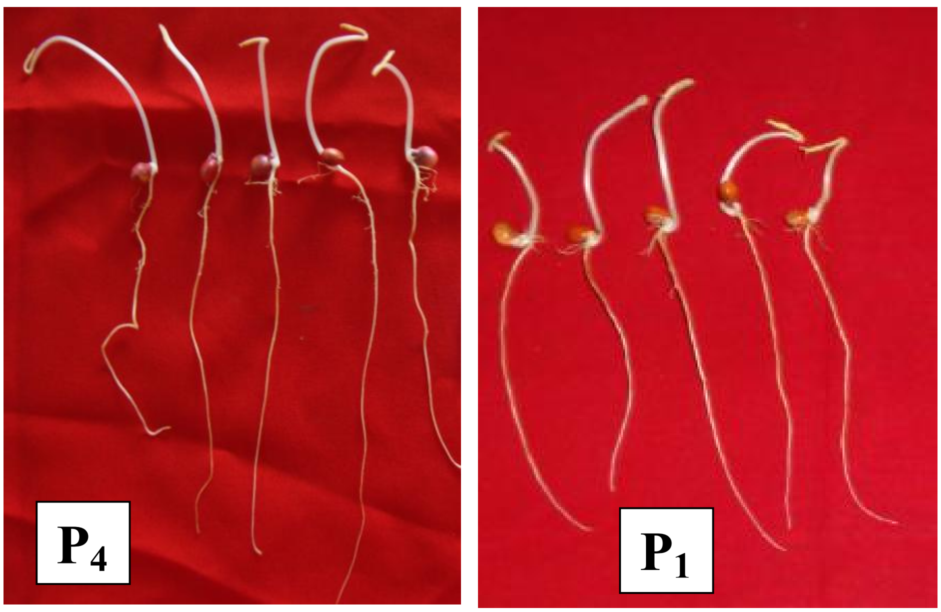
**Table 1. Influence of seed coating polymer on germination percentage, speed of germination and seedling dry weight of pigeonpea**

| Treatment | Germination (%) | Speed of germination | Seedling dry weight (mg) |
|---|---|---|---|
| $P_1$: control | 91.00 (72.55) | 27.00 | 79.83 |
| $P_2$: 2 ml per kg of seed | 92.08 (73.68) | 27.45 | 80.40 |
| $P_3$: 4 ml per kg of seed | 92.25 (73.85) | 28.10 | 81.37 |
| $P_4$: 6 ml per kg of seed | 94.10 (75.98) | 29.50 | 84.20 |
| $P_5$: 8 ml per kg of seed | 94.60 (76.63) | 30.55 | 84.62 |
| $P_6$: 10 ml per kg of seed | 94.38 (76.31) | 29.74 | 84.36 |
| **Mean** | **93.07** | **28.72** | **82.46** |
| S.Em.± | 0.50 | 0.51 | 0.31 |
| *CD (P = 0.01)* | 1.48 | 1.53 | 0.92 |

**Figures in the parenthesis indicate arcsine transformed values*

**Table 2. Influence of seed coating polymer on shoot length (cm), root length (cm) and seedling vigour index**

| Treatment | Shoot length (cm) | Root length (cm) | Seedling vigour index |
|---|---|---|---|
| $P_1$: control | 9.15 | 12.10 | 1934 |
| $P_2$: 2 ml per kg of seed | 9.25 | 12.62 | 2013 |
| $P_3$: 4 ml per kg of seed | 9.35 | 13.20 | 2080 |
| $P_4$: 6 ml per kg of seed | 11.10 | 14.78 | 2435 |
| $P_5$: 8 ml per kg of seed | 11.50 | 15.63 | 2567 |
| $P_6$: 10 ml per kg of seed | 11.28 | 14.83 | 2464 |
| **Mean** | **10.27** | **13.86** | **2249** |
| S.Em.± | 0.21 | 0.33 | 43 |
| *CD (P = 0.01)* | 0.64 | 0.99 | 128 |




**Picture 2. Influence of seed coating polymer on seedling growth of pigeonpea**

Among the different dosage of polymer, the seedling vigour index was significantly higher in 8 ml per kg seed ($P_5$ - 2567) as compared to control ($P_1$ - 1934) and all other treatment. The reason for improvement in vigour might be due to the enhanced metabolic activity resulted in early germination as reported by [11] and might also be due to the increased dry matter accumulation in seedling and increase in seedling dry weight as reported by [14,17].

## 4. CONCLUSION

From the above results of the present investigation as there was no significant differences for all the seed quality parameters studied between 6 to 10 ml polymer per kg seed. It can be concluded that for bulk treatment of pigeonpea seeds, polymer coating with 6 ml per kg of seed found more effective and economical as it recorded increased germination and seedling vigour.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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