Influence of seed pelleting on seed quality improvement in redgram (Cajanus cajan L.)

R. Anbarasan*, P. Srimathi and A. Vijayakumar

Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore - 641 003, India.

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ABSTRACT

Redgram is a protein rich staple food and contains about 22 per cent protein, which is almost three times that of cereals. Pelleting is a presowing physical seed management technique, in which growth promotive substances with protective, nutritive and invigourative function are applied on the seed to enhance the seed-soil relationship. To evaluate the efficacy of herbal powders for seed pelleting, studies were initiated with redgram cv. CO 7 with Carboxy methyl cellulose adhesive @ 200 ml per kilogram of seed and were coated with the herbal powders viz., noni (Morinda citrifolia), tulasi (Ocimum sanctum) and gallnut (Terminalia chebula) @ 200 g kg⁻¹ of seed. The pelleted seed evaluated for the effect of seed invigouration, nursery emergence and storability along with unpelleted reviled that tulasi leaf powder followed by noni improved the seedling vigour and field emergence. At field pelleted seed has enhanced chlorophyll index highlighting the efficacy of the treatment. The treated seed also stored well upto one month with restoration of all evaluated seed quality characters.

Key words: Field emergence, Gallnut, Noni, Redgram, Seed pelleting, Seedling quality, Storability, Tulasi.

INTRODUCTION

Pulses are the second most important group of crops, worldwide. India ranks first in terms of pulses production, consumption and acreage. World Health Organization actually recommends 80 grams of pulses per person per day (ASSOCHAM, 2012). The major constraint in pulse production is the lower productivity per unit area, which expose the importance in adoption of effective seed crop management technique. Among the pulses redgram is a protein rich staple food and contains about 22 per cent protein, which is almost three times that of cereals. The biological value improves greatly, when wheat or rice is combined with redgram because of the complementary relationship of the essential amino acids. It is particularly rich in lysine, riboflavin, thiamine, niacin and iron.

Seed quality is the prerequisite for improving germination and yield of crop plants, which can be improved through seed management techniques (Khatun et al., 2011). Seed management techniques not only invigorate the seed but also modify the physical and biochemical characteristics of seed and aid in improving its productivity. Pelleting is a presowing physical seed management technique, in which growth promotive substances or any needy substance with protective, nutritive and invigourative function are applied on the seed to enhance the seed-soil interface (Scott, 1989) at the rhizosphere region. Some of the common benefits of pelleting are uniformity in size, easier planting, uniform stands, reduced seed rate, more resistance to insect and disease, stress tolerance and nourishment to the seedlings (Balaji, 1990; Angamuthu, 1991; Nargis, 1995; Peterhalmer, 2003). Pelleting is also expressed as the process of enclosing seed into a small quantity of filler material for singling the seeds, the most essential phases of precision planting in modern agriculture (Vanangamudi et al., 2010). In general, seed pelleting provides a package of effective quantities of growth stimulating substances in such a way that they can influence the micro-environment of each seed and avoids the wastage of materials on broadcasting or soil application (Scott, 1989). In addition pelleting with organic leaf powders said to improve the water holding capacity of soil at the region of root formation and improve the supply of nutrients to the germinating seed (Muruganantham, 1996). Thus through pelleting the inputs can be saved compared to broad casting and the associated costs of applying them.

In promotion of organic farming, development of the ecofriendly production techniques using natural product is much warranted in pulses, which has economic value as food product. Among the various seed production technique, pre sowing seed invigoration one of seed management techniques widely adopted with plant products. Leaf and fruit powders of herbal plants are widely used for seed pelleting (Bashyam, 1999). Noni (Morinda citrifolia), tulsi (Ocimum sanctum) and gallnut (Terminalia chebula) are some of the medicinal plants, widely used ayurveda medicines.

*Corresponding author’s e-mail: anbu107@yahoo.com.
Researches revealed these plants possess various nutrients and antioxidant compounds as follows.

<table>
<thead>
<tr>
<th>Plants</th>
<th>Chemical compounds</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noni</td>
<td>Scopoletin, Octanoic acid, Potassium, Vitamin C, Terpenoids, Alkaloids, Anthraquinones and Xerone</td>
<td>Wang et al., 2002</td>
</tr>
<tr>
<td>Tulasi</td>
<td>Eugenol, Urosolic acid, Carvacrol, Linalool, Caryophylline and Estragol</td>
<td>Pattanayak et al., 2010</td>
</tr>
<tr>
<td>Gallnut</td>
<td>Tannins, Chebulinic acid, Ellagic acid, Gallic acid, Punicalagin</td>
<td>Suryaprakash et al., 2012</td>
</tr>
</tbody>
</table>

Hence an attempt was made to evaluate the suitability of the leaf powders of tulasi, noni and fruit powder of gallnut as filler material for seed pelleting in red gram cv. CO 7 at Dept. of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore (11°12’63 N, 76°58’213 E).

**MATERIALS AND METHODS**

Genetically pure seeds of red gram cv. CO 7 obtained from Dept. of Pulses, Tamil Nadu Agricultural University, Coimbatore, were graded with BSS 5 x 5, sieves for obtaining homogeneity of seed lot based on size. Fresh matured leaves of noni and tulasi from middle portion of plant and dried fruits of gallnut were collected. The leaves were dried under sun for a week, powdered in a mixer grinder and sieved through 0.250 mm sieve to obtain fine herbal powder. Similarly gallnut fruit was separated as nut and mesocarp and the mesocarp alone were finely powdered in a mixer grinder and sieved through 0.250 mm sieve to obtain fine herbal powder. Carboxy methyl cellulose is an organic adhesive and was prepared as five per cent concentration by dissolving 5 g of the adhesive in 100 ml of luck warm water.

The graded seeds of each of the redgram were divided into four sub samples and one sample was considered as unpelleted and other samples were individually coated with the adhesive @ 200 ml per kilogram of seed and were individually coated with the herbal powders viz., noni (Morinda citrifolia), tulasi (Ocimum sanctum) and gallnut (Terminalia chebula) by sprinkling the powders @ 200 g kg⁻¹ of seed as filler material and rolled on a flat surface for obtaining uniformity in size and coating. The pelleted seeds were dried under shade for two days and were evaluated for seed quality characters under the germination room condition (25°C and 95 ± 2% RH). The seeds as 4 x 100 were germinated in sand media as per the recommendations of ISTA (2010). Daily counts were taken on each of the species, treatment and replication up to the germination period of 6 days (ISTA, 2010) and speed of germination was calculated as per Maguire (1962) using the following formula.

\[
\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \ldots + \frac{X_n - X_{n-1}}{Y_n}
\]

\(X_1\) - Percentage of seeds germinated at first day; \(X_n\) - Percentage of seeds germinated at second day; \(Y_n\) - Number of days from sowing to first count; \(Y_n\) - Number of days from sowing to second count; \(Y_n\) - Number of days from sowing to nth count

At the end of the germination period, the germination test was evaluated as normal seedlings, abnormal seedlings and dead seed and the germination was reported in percentage adopting the following formula as per the standard procedure (ISTA, 2010).

\[
\text{Germination (\%) =} \frac{\text{Number of normal seedlings}}{\text{Total number of seeds placed for germination}} \times 100
\]

Among the normal seedlings of each of the crop/treatment/replication ten seedlings were selected at random and measured using measuring scale for root length (the length between the collar region to the tip of primary root in centimeter), shoot length (the shoot length from the collar region to the tip of the true leaves in centimeter) and dry matter production of 10 seedlings (ten normal seedlings were dried at first in shade and then in a hot air oven at 85 ± 2°C for 48 h then cooled in desiccators containing calcium carbonate and weighed in milligram). Based on the results obtained, the vigour index values were computed adopting the following formula Abdul-Baki and Anderson (1973) and the values were reported as whole number without unit.

\[
\text{vigour index} = \frac{\text{Germination (\%) x total seedling length (cm)}}{\text{Field emergence (\%) =} \frac{\text{Number of normal seedlings}}{\text{Total number of seeds placed for emergence}} \times 100
\]

Immediately after treatment the seeds were evaluated for hardiness using hardiness tester as a measure of compactness that would interfere with speed of emergence. Ten days after treatment the seeds were washed with water including control and were evaluated for electrical conductivity adopting the procedure formulated by Presley, (1958). The pelleted seeds were also sown in field as single seeds using 4 x 100 seeds in each of the treatment for observed for speed of emergence as per Maguire, (1962). The seedlings emergence up to 10 days were counted, adopting the following formula the field emergence was calculated in percentage.

\[
\text{Field emergence (\%) =} \frac{\text{Number of normal seedlings}}{\text{Total number of seeds placed for emergence}} \times 100
\]

After ten days the seedlings measured for root length, shoot length, dry matter production and vigour index as indicated above were thinned @ 20 seedlings per replication and grown up to 30 days with regular watering. At 30 days the leaves were measured for chlorophyll index using SPAD meter and the values were recorded. The seedlings were uprooted and washed with running and the roots were counted for formation of nodules in number. The pelleted seeds were also stored under ambient condition and were evaluated for seed and seedling quality characters (speed of germination, germination, root length, shoot length, dry matter production and vigour index) as mentioned above. The data collected were statistically scrutinized as per Panse and Sukhatme,
(1985) for understanding the significance at 0.5 per cent. The percentage values were converted to arcsine values, while non significant results were indicated as NS.

RESULTS AND DISCUSSION

In pelleting process, the seeds are stamped using an adhesive and are filled with filler material by sprinkling and are rolled for uniformity. The success of pelleting depends on the selection of filler material. Researchers expressed the beneficiary influence of different filler material such as leaf powder (Khatun et al., 2011), biofertilizer (Selvakumar et al., 2012), biocontrol agents (Nargis, 1995) inorganic nutrients (Lu et al., 1983), vermicompost (Mathivanan et al., 2012) and combination of all these for obtaining improved planting value. In the present investigation, the redgram seeds were pelleted with organic powders of noni, tulasi and gallnut (Table 1) recorded highly significant difference among the seed pelleting treatment at initial laboratory evaluation.

All the seed quality characters were highly influenced by the pelleting treatment and the seeds pelleted with tulasi recorded 10, 22, 11, 6 and 31 per cent higher values than unpelleted seed respectively for germination, root length, shoot length, dry matter production and vigour index and second best influencive effect was observed with noni leaf powder, which had improved germination by 5 per cent compared to unpelleted seed, however seed pelleted with gall nut recorded 22 per cent lesser values for seed germination than unpelleted. The influencive effect of tulasi leaf powders might be due to the nutrient value of the leaf powders as indicated vitamin C and A and minerals like calcium, zinc and iron, as well as chlorophyll and many other phytonutrients (Anbarasu and Vijayalakshmi, 2007).

Prasad (1994) opined that in botanical pelleting, the leaf powder acted as wick by absorbing/regulating the soil moisture availability and thus enhanced better seed soil relationships, as indicated through higher seed and seedling quality characters of the pelleted seeds. Malarakodi (2003) opined that the macro and micro nutrients present in the leaf powder also as the cause for invigourative effect of botanicals treatments. In addition the leaf powder contains the gibberellins like substance in addition to the saponins, nutrients, especially the micronutrient that might have synergistically interact with amino acid, tryptophane to form the Indole Acetic Acid (IAA) (Lu et al., 1983). However the present results revealed that because the reason dealt above the seed pelleted with tulasi performed better than unpelleting and were followed by noni leaf powder but the seed pelleted with gallnut powder had negative influence on seed quality characteristics might be due to the lethality of its chemical compound on seed quality characters. The speed of germination was late in all the pelleting treatments due to physical hardiness of the seed, restricting the radical emergence from the seed compared to unpelleted seed causing hindrance for the emergence of seedlings that persist with pelleted seed while enclosing the seed in filler materials compared to control. The hardiness of the seed tested through hardiness tester also expressed 14, 13 and 9 percent higher value for gallnut, noni and tulasi pelleted seed than unpelleted seed (Fig 1) Similar late emergence was also expressed by several researchers Barua (1994) in Acacia nilotica, Sumathi (2010) in Psoralea corylifolia and Parameswari et al. (2001) in Tamarind) in different crops.

![Fig 1: Influence of seed pelleting with herbal powders on hardiness of seed (Kg/cm²)](image)

At field, evaluation of field emergence along with seed quality characters as highlighted in Fig. 2, seed pelleting with tulasi excelled other herbal powders and unpelleted seed, which might be due to the reason spelt earlier. In

| Table 1: Influence on seed pelleting with herbal powders on seed quality characters |
|-----------------------------------------------|------------------|------------------|------------------|------------------|------------------|
| Seed and Seedling parameters                  | Pelleted seed    | Unpelleted seed  | SEd              | CD (P=0.05)      |
|                                               | Noni             | Tulasi           | Gallnut          |                  |
| Speed of germination                          | 13.1             | 13.7             | 11.1             | 14.9             |
| Germination (%)                               | 81               | 86               | 54               | 76               |
|                                               | (64.15)          | (68.02)          | (47.29)          | (60.66)          |
| Root length (cm)                              | 12.4             | 13.8             | 5.9              | 11.3             |
| Shoot length (cm)                             | 16.3             | 16.9             | 7.6              | 15.1             |
| Dry matter production 10 seedling (mg)        | 199              | 203              | 175              | 192              |
| Vigour index                                  | 2325             | 2640             | 729              | 2006             |

(Figures in parentheses indicates are sine values)
accordance with result of laboratory test it was followed by noni leaf powder while the performance of gallnut fruit powder was lesser than unpelleted seeds. In addition, they have permitted an improvement in germination, emergence and improved the growth of plant which is favored in further stages too by way of height and better development of root system. Similar results were reported by Lu et al. (1983), Renugadevi (1992) and Prasad (1994).

The data observed on chlorophyll index was supportive of the above results highlighting causes for the improved vigour of the seedling. The chlorophyll index was highest with tulasi leaf powder pelleting and was followed by noni leaf powder, gallnut fruit powder and unpelleted seed. The nodulation capacity of the filler material measured through the number of nodules (Fig. 3) indicated the nodule number recorded by tulasi and noni were 39 and 19 per cent higher than unpelleted seed, however seed pelleted with gallnut recorded 13 per cent lesser values for nodule number than unpelleted. On storage, the seed pelleted with tulasi recorded 10, 15, 13, 6 and 29 per cent higher values than unpelleted (Table 2) seed.

The performance noni leaf powder after storage was also higher than unpelleted seed while that of gallnut fruit powder was lesser than unpelleted seed as expressed with earlier results. Umarani (1998) expressed that on leaf powder treatment, the enzymatic activity responsible for maintenance of seed quality (amylase, catalase, peroxidase, superoxide dismutase and dehydrogenase) and the ascorbic acid (antioxidant) content were maintained at higher order during storage and protected the seed from deterioration on further handling. The presence of higher antioxidant activity in tulasi and noni was also reported by several researchers (Kelm et al., 2000; Wang et al., 2002 and Pattanayak et al., 2010). The storability of pelleted seed with sustained invigourative influence and the extended protectiveness was reported by Hossain et al. (1999) in soybean, Arati (2000) in bengal gram and Maraddi (2002) in cowpea.

**Table 2:** Influence on seed pelleting with herbal powders on storage seed quality characters

<table>
<thead>
<tr>
<th>Seed and Seedling parameters</th>
<th>Pelleted seed</th>
<th>Unpelleted seed</th>
<th>SEd</th>
<th>CD (P=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed of germination</td>
<td>Noni</td>
<td>Tulasi</td>
<td>Gallnut</td>
<td></td>
</tr>
<tr>
<td>(cm/minute)</td>
<td>13.3</td>
<td>13.6</td>
<td>10.2</td>
<td>14.5</td>
</tr>
<tr>
<td>Germination (%)</td>
<td>79</td>
<td>85</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>(62.72)</td>
<td>(67.21)</td>
<td>(45.00)</td>
<td>(60.00)</td>
<td></td>
</tr>
<tr>
<td>Root length(cm)</td>
<td>12.5</td>
<td>13.8</td>
<td>5.4</td>
<td>12.0</td>
</tr>
<tr>
<td>Shoot length(cm)</td>
<td>16.8</td>
<td>16.9</td>
<td>7.0</td>
<td>14.9</td>
</tr>
<tr>
<td>Dry matter production 10 seedling (mg)</td>
<td>194</td>
<td>197</td>
<td>141</td>
<td>190</td>
</tr>
<tr>
<td>Vigour index</td>
<td>2315</td>
<td>2610</td>
<td>620</td>
<td>2018</td>
</tr>
</tbody>
</table>

(Figures in parentheses indicates arc sine values)
The results on measurement of electrical conductivity also support the above results on seedling vigour indicating the lesser biochemical degradation of pelleted seed compare to unpelleted which was also support by Malarkodi, 2003 and Kokila, 2012 in the research on storability on pelleted seed. (Fig. 4)

CONCLUSION

Thus the study indicated that tulasi and noni leaf powder are highly suitable for seed pelleting as filler material in organic pelleting and has proved to have invigourative influence on seed quality characters that was sustained both at field and storage. The pelleted seeds had improved photosynthetic efficiency of the plant and also improved the nodulation which are essential for enhanced productivity. However the study also indicated unsuitability gallnut fruit powder for pelleting indicating further studies on the causes for negative influence.

Reference


