Effect of different botanicals on the seed quality of lentils during storage

A. Khatun\textsuperscript{1)}, M. A. H. Bhuiyan\textsuperscript{2)*}, G. Kabir\textsuperscript{3)} and A. K. M. M. Haque\textsuperscript{4)}

Abstract

A laboratory experiment was carried out in the Seed Technology Laboratory, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur from August-September in 2004 and 2005 to study the effects of different botanicals on the seed quality of lentils during storage. After processing and drying, seeds were preserved with different botanicals and stored in earthen pots. The seeds were divided into four parts including a part considered as a control. For botanical treatments, three botanicals of whole leaf powders of neem, dholkalmi and bishkatali were used at the doses of 5\% w/w \textit{i.e.}, 25 g/500 g of lentil grains. The lentil seeds were stored till the next planting time and the seed quality data on moisture (%), germination (%), dry weight of seedlings and vigor index were observed during the storage period. Germination percentage of the initial seed lot was on average 90\%, and average moisture content of the seeds before storage was 9\%. Significant influences of the botanicals were observed in germination percentage, dry weight and vigor of the lentils. The highest values for almost all of these characteristics were observed for the seeds preserved with neem leaf powder. Bishkatali showed the same performance as neem. Among the three botanicals, dholkalmi showed the least effect. Neem treated seeds were found to have the highest germination percentage (86.0\% in 2004 and 87.2\% in 2005), dry weight (0.72 g in 2004 and 0.78 g in 2005) and vigor (62.3 in 2004 and 68.0 in 2005), which were somewhat similar to bishkatali but significantly higher than the control. No significant difference among the seeds with botanicals on moisture percentage was observed.

Keywords: Lentil, Botanicals, Storage, Seed quality

Introduction

Pulses play an important role in fulfilling the protein deficiency in the daily diet of the people of Bangladesh. The major pulses grown in the country are khesari (\textit{Lathyus sativus} \textit{L.}), lentil (\textit{Lens culinaris} \textit{L.}), chickpea (\textit{Cicer arietinum} \textit{L.}), mungbean (\textit{Vigna radiata} \textit{L.}) and blackgram (\textit{Vigna mungo} \textit{L.}). These are considered as the most nutritious pulses and occupy a very significant position in Bangladesh agriculture as a source of minerals, protein nutritious fodder and soil enriching green fodder (Saraf and Bhoi, 1989). Lentils are an important pulse crop grown in Bangladesh to meet the domestic needs. Ban-
Bhadesh ranks 3rd among the lentil growing countries of the Asia Pacific region (FAO, 2004). Lentils are the second most important pulse crop in the area and production, but stands first in the consumer’s preference in the country (Afzal, 2003). It is grown over about 134,818 ha, producing 115,000 tones of grain, with an average yield of 853 kg ha\(^{-1}\), and contributes about 40% of the total pulse production in Bangladesh (BBS, 2006).

Seed quality is the pre-requisite condition that affects the germination and yield of any crop plant. This condition is directly related to the factors of moisture content, seed drying temperature and relative humidity around seed storage, types of storage container and storage period.

Recently, the use of different plant parts and their derivatives has appeared as an effective alternative to the use of poisonous chemical insecticides or the cumbersome traditional methods for controlling various insect pests of crops and storage. In the world, as many as 2,400 plant species have been recorded that have potential pesticidal properties and biological activity against a wide range of pests (Grainge and Ahmed, 1988). Being situated in the tropical region, Bangladesh has a rich botanical biodiversity, which contains innumerable plant species having medicinal and pesticidal properties (Karim, 1994).

Before the advent of the synthetic pesticides, local pesticidal plants were a major source of controlling agents against pests of field crops as well as stored grains. In recent years, the use of local botanicals has gained much importance, mainly among researchers, because of its high bio-efficacy against a wide range of pests and relatively safe residual toxicity to the environment as compared to pesticides.

Powder from drupes of *Thevetia nerifolia*, rhizomes of *Acorus calamus*, leaves of *Adhatoda vasica* and *Ipomea cornea* and petroleum ether extracts from bulbs of garlic, *Allium sativum*, and onions, *A. cepa* and neem, *Azadirachta indica* were tested by Pandey et al. (1976) for their repellent properties against *C. chinensis* infesting grain seed, and they found that 1 to 2 parts of *T. nerifolia* drupes, and rhizomes of *A. calamus*, 8 parts of *T. cornea* and 1 to 3 parts of petroleum ether extract of garlic and neem oil per 100 parts of seed gave effective protection for at least 135 days. *Adhatoda* leaf powder and onion extracts were ineffective. No adverse effects of treatments were observed on the germination of the seeds. Yadav (1983) assessed the efficacy of 6 plant products at 3 doses against the bruchid, *C. chinensis* on stored seeds of cowpea (*V. unguiculata*). The plant products tested were leaf powders of neem (*A. indica*), dhatura (*Datura metel*) and akanda (*Calotropis procea*), garlic powder, and shell and seed powder of soapnut (*Spindus trifoliatus*). Mortality was low initially, but increased with time after 1 week; all treatments were significantly superior to the untreated variant. After a period of 5 months, the mean percentage of damage to the seeds were 6.9, 7.6, 7.6 and 8.2 for treatments with soapnut shell powder, akanda leaf powder, soapnut seed powder and garlic powder, respectively, compared to 2.2% for malathion at 15 ppm. Leaf powders of neem and dhatura were slightly less effective. None of the treatments had adverse effects on germination of the seeds. Rahman et al. (1992) mixed dried and ground leaves of *R. communis* with stored cowpeas (1-5 g leaf powder with 300 seeds) in a laboratory setting and reported 100% mortality of *C. maculates* in 7 days. After 48 hours, only 20% mortality was recorded with 5 g. The grains were protected from damage for more than 3 months. In Senegal, powders and aqueous solutions of an ecotype *A. indica* were tested by Seck et al. (1991) against *C. chinensis* in stored cowpeas in a laboratory setting. Both neem leaves and neem seed powders, mixed with cowpeas at 3% w/w, caused 85-90% mortality to adult bruchids in 72 hours. Seed powders were more effective than the leaf powders.

In storage, lentil seeds deteriorate in quality due to fungal, insect and other pest infestations. Different
botanicals can be used for the protection of the seeds. Uses of different chemicals are costly and may cause natural dangers, whereas botanicals are less costly, easily available to farmers and safe to handle. Comparative studies of botanicals help to choose suitable ones for storing the lentil seeds. Therefore, this experiment was carried out to determine the effects of the three botanicals of neem leaf powder, bishkatali and dholkalmi on the seed quality of lentils.

**Materials and Methods**

The experiments were carried out during the two seasons of 2004 and 2005 at the Laboratory of Seed Technology Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh. The experiment used different botanicals and was conducted on lentils. Lentil (BARI Masur-2) seeds were collected from Pulses Research Centre experimental field, BARI, Gazipur during the *rabi* seasons of 2003-04 and kept in earthen pots with the three botanicals viz. neem leaf powder, bishkatali or dholkalmi and were stored under normal conditions.

The seed protecting materials (botanicals) used in this experiment were as follows:
1. Neem (*Azadirachta indica*) leaf powder
2. Dholkalmi (*Ipomoea sepiara*) leaf powder
3. Bishkatali (*Polygonum hydropiper*) leaf powder

**Preparation of the botanicals**

The leaves of the test botanicals were collected from different villages of Gazipur, Bangladesh. The leaves were used as a dried powder. The collected leaves were dried under ambient room temperature (27˚C to 34˚C), ground separately by a hand grinder and passed through a 60-mesh sieve to get fine leaf powder form.

**Preparation of pulse grains for treatment**

Clean and fresh lentil (BARI Masur-2) seeds were taken from the seed lot and sun dried to maintain a 9-10% moisture content. Before setting up the experiments, the grains were placed in earthen pots (1 kg size) and placed in a refrigerator at 5˚C for seven days to free them from any infesting insect pests. Later, the pulse grains were stored at room temperature for the conducting of the experiment.

**Experimental procedures in the laboratory**

Laboratory experiments were carried out in the Laboratory of Seed Technology Division, BARI following a Completely Randomized Design (CRD). The prepared seeds were then divided into four parts. One part without any botanical treatment was considered as the control (*T*$_0$). The other three parts were treated with three different botanicals.

The botanicals included whole leaf powder of neem, dholkalmi and bishkatali used at the doses of 5% w/w *i.e.*, 25 g/500 g of lentil grains (Bhuiyah, 2001).

Experiments were performed with six replications. Before storage, the seeds were analyzed for germination, moisture content and vigor index. The seeds were stored in March until the next planting time.
and the seed quality was observed from August to September in 2004 and 2005. Data on moisture (%), germination (%), dry weight of seedlings and vigor were recorded. The average germination percentage of the seed lots before storage was 90% and average moisture content of the seed before storage was 9%.

**Procedure of data collection**

**Moisture content**

The moisture content of seed samples were determined following ISTA rules (ISTA, 1976). Ground seed samples of lentils (10 g) were taken into a moisture cup and put into a pre-heated oven at a temperature of 103 ± 2°C for one hour. After cooling, the weight of the container with its cover and contents were taken. The samples were cooled in desiccators and weighed to find out the percent moisture content of the grains. The seed moisture content (SMC) was determined by dry weight basis and was calculated by the following formula:

\[
SMC = \frac{M_2 - M_1}{M_3 - M_1} \times 100
\]

where \( M_1 \) is the weight of the container and its cover in grams, \( M_2 \) is the weight of the container, its cover and its contents before drying in grams, and \( M_3 \) is the weight of the container, its cover and contents after drying in grams.

**Germination test**

The germination test was carried out according to ISTA rules (ISTA, 1976). For each treatment, 100-seeds were put into petri dishes. The petri dishes were put on a laboratory table at room temperature (25 ± 2°C). After eight days, normal, abnormal and diseased seeds were counted.

**Dry weight of seedlings**

After measuring moisture content and germination percentage as described above, the fresh weight of seedlings was recorded. Then, the root and shoot were put into separate paper packets and placed into a preheated oven (70°C) for 48 hours. After cooling in desiccators, the dry weight was measured.

**Seed vigor**

Seed vigor was calculated based on the following formula (Reddy and Khan, 2001):

\[
\text{Vigor index} = \text{Percent germination} \times \text{Total dry weight of seedlings}
\]

**Statistical analysis**

The data for different characters were compiled and tabulated in proper form and then subjected to statistical analysis following a computer IRRISTAT and MSTAT package program (Freed, 1992) to adjust the means. A correlation coefficient and regression analysis were done for different variables wherever needed using Microsoft Excel Programme 1997.
Results and Discussion

Moisture percentage

There was no significant effect on moisture percentage among the different botanicals including the control both in 2004 and 2005 (Table 1). This indicates that the botanicals had no effect on seed moisture percentage. The highest moisture percentages (9.46% in 2004 and 9.40% in 2005) were observed in the lentil seeds stored under the control condition. The lowest percentages (8.44% in 2004 and 8.87% in 2005) were observed in lentil seeds preserved with neem leaf powder. Shahjahan (2003) observed that lentil seeds contain 8.57-11.45% moisture content after nine months of storage in six types of containers. Khatun et al. (2008) found that moisture content of lentil seeds ranges from 8.19 to 10.36.

Germination percentage

There was a significant effect on germination percentage using different botanicals (Table 1). The highest germinations (86.0% in 2004 and 87.2% in 2005) were recorded in the seeds preserved with neem leaf powder. Seeds preserved in neem leaf powder recorded an identical result for germination percentage when preserved with bishkatali. The lowest germination percentages (72.8% in 2004 and 71.6% in 2005) were recorded when the seeds were preserved under the control condition. Seeds preserved with dholkalmi had no effect on the germination percentage. Shahjahan (2003) found that lentil seeds give 87.8-92.9% germination after nine months of storage in different containers. Morshed et al. (2003) reported that khesari seeds give 85.0-95.0% germination while mungbean seeds give 85.0-95.0% germination percent after six months of storage. Grasspea seeds also give 80.4-89.8% germination after nine months of storage in different containers (Shahjahan, 2003). Sabitri et al. (1994) found that neem leaf powder gives a higher germination percentage (65.7%) while the control treatment gives a lower germination percentage (61.3%). Bhuiyah (2001) observed that there is no significant difference in the germination of lentil seeds among the treatments of leaf powders of neem, bankalmi or biskhatali. They also reported that the leaf powder of bishkatali has no advance effect on the germination of lentils while their viability is retained for a storage period of 4 months. Khatun et al. (2008) reported 84.3 to 94.2%

<table>
<thead>
<tr>
<th>Botanicals</th>
<th>Moisture (%)</th>
<th>Germination (%)</th>
<th>Dry weight (g)</th>
<th>Vigor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neem</td>
<td>8.44 8.87</td>
<td>86.0a 87.2a</td>
<td>0.72a 0.78a</td>
<td>62.3a 68.0a</td>
</tr>
<tr>
<td>Bishkatali</td>
<td>8.91 8.93</td>
<td>85.5a 86.7a</td>
<td>0.65a 0.69ab</td>
<td>55.8ab 60.0a</td>
</tr>
<tr>
<td>Dholkalmi</td>
<td>8.98 9.11</td>
<td>74.2b 73.4b</td>
<td>0.65a 0.63b</td>
<td>48.1bc 46.0b</td>
</tr>
<tr>
<td>Control</td>
<td>9.46 9.40</td>
<td>72.8b 71.6b</td>
<td>0.56b 0.58b</td>
<td>40.8c 41.6b</td>
</tr>
<tr>
<td>SE(±)</td>
<td>–</td>
<td>4.76 4.02</td>
<td>0.04 0.05</td>
<td>5.83 5.01</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>–</td>
<td>10.14 11.85</td>
<td>0.11 0.15</td>
<td>12.42 14.77</td>
</tr>
<tr>
<td>Sig.</td>
<td>NS</td>
<td>*</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>CV (%)</td>
<td>5.3</td>
<td>8.7</td>
<td>10.4</td>
<td>19.5</td>
</tr>
</tbody>
</table>

In a column, those having common letters do not differ significantly at a 5% level of DMRT
NS: Not significant
germination in lentils when the seeds are stored.

**Dry weight of seedlings**

The highest dry weights of 0.72 g in 2004 and 0.78 g in 2005 were observed when the seeds were stored with neem leaf powder (Table 1). Dry weight was highly significant. This might be due to better keeping quality of neem leaf powder which gave higher germination as well as dry weight. Seeds preserved with neem leaf powder recorded an identical result with bishkatali and dholkalmi in 2004 and only with bishkatali in 2005. The lowest dry weights (0.56 g in 2004 and 0.58 g in 2005) were recorded under the control condition. Khatun et al. (2009a) noted that dry weight of seedlings of lentils is found between 0.75 to 1.21 g.

**Vigor**

Botanicals also had a significant effect on vigor. The highest vigors (62.3 in 2004 and 68.0 in 2005) were recorded in the seeds preserved with neem leaf powder (Table 1). Neem leaf powder gave an identical result with bishkatali. Higher vigor recorded by neem powder might be due to higher germination percentage and dry weight. The lowest vigors (40.8 in 2004 and 41.6 in 2005) were recorded for the seed preserved under the control condition. It gave an identical result with dholkalmi. Khatun et al. (2009a) observed 70.3 to 120.2 vigor in lentils. In another study, Khatun et al. (2009b) also found 71.2 to 97.1 vigor in lentils.

**Correlation**

Correlation matrix among the plant characters of lentils is shown in Table 2. In the present study, germination percentage had a positive and significant correlation with dry weight and vigor, and dry weight also had a positive and significant correlation with vigor. A positive and linear correlation was observed between germination percentage and dry weight (Fig. 2), germination percentage and vigor (Fig. 3), and dry weight and vigor (Fig. 4). However, a negative and linear correlation was observed between moisture percentage and germination percentage (Fig. 1). Reddy and Khan (2001) found a positive and significant correlation of germination with seedling dry weight and vigor index. Results reported by Baburatan et al. (1993) and Ponnuswamy et al. (1991) were found to be in close agreement with the present findings. Khatun et al. (2009a and 2009b) also found a positive and significant correlation of germination with dry weight and vigor, and dry weight with vigor.

From the results, it was observed that seeds preserved in neem leaf powder had higher germination percentage, dry weight and vigor both in 2004 and 2005, and there was no significant difference among the seeds preserved with any of the botanicals for moisture percentage.
Effect of different botanicals on the lentils seed quality

Table 2. Correlation matrix among different parameters of lentils

<table>
<thead>
<tr>
<th>Characters</th>
<th>Germination (%)</th>
<th>Dry weight</th>
<th>Vigor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>–0.227*</td>
<td>–0.057*</td>
<td>–0.331**</td>
</tr>
<tr>
<td>Germination (%)</td>
<td>–</td>
<td>–</td>
<td>0.488*</td>
</tr>
<tr>
<td>Dry weight</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

* Significant at 5% level, ** Significant at 1% level, NS: Not significant

Fig. 1. Relationship between moisture content and germination (%) of lentils (based on average values of 2 years data)

Fig. 2. Relationship between germination (%) and dry weight of lentils (based on average values of 2 years data)

Fig. 3. Relationship between germination (%) and vigor of lentils (based on average values of 2 years data)

Fig. 4. Relationship between dry weight and vigor of lentils (based on average values of 2 years data)
References


Freed, R.D. (1992) MSTAT-C. Crop and Soil Science Department, Michigan State University, USA.


