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Original article

Seed quality, germination, and vigor of soybean (*Glycine max* L.) seeds as influenced by moisture content and containers

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ABSTRACT

Moisture content and types of containers used to store seeds are the most critical factors influencing the rate of deterioration in seeds. This study aimed to evaluate the seed quality, germination, and vigor of soybean seeds using different containers under two moisture contents upon storage. The experiment was arranged in CRD with a 2 x 3 factorial experiment with three replications. Levels of % MC (10% and 13%) served as the main plot, and different containers (plastic bag, paper bag, and bottle) served as the sub-subplots. Four months after storage, comparing the two moisture levels of the seeds, data showed increasing values of moisture contents regardless of the container used in the study. Moreover, using the paper bag as a container showed a significant increase in moisture content (MC) under 13 %. Initial % germination in a composite sample of soybean seeds was high (81% under 10 %MC and 83% in 13% MC) before the seed germination test. Four (4) months after storage, the quality and % germination were significantly decreased to 32% and 60% seed germination under 13 % MC and 10%MC, respectively. Moreover, % seed germination was only 35% and 30% in plastic and paper bag containers. However, it showed a 70% germination when the seeds were stored in closed bottles. Moreover, the seed vigor of soybean seeds was 3.43% only after the seeds were planted in the field and exposed to open field conditions regardless of moisture and containers used for storage.

KEYWORDS: *soybean, containers, seed quality, germination and vigor*

1 INTRODUCTION

Soybean or soya bean (*Glycine max* L.) is a species of legume native to East Asia, widely grown for its edible bean, which has numerous uses. The plant is classed as an oilseed rather than a pulse by the U.N. Food and Agricultural Organization (FAO, 2018). Fat-free soybean meal is a significant and cheap source of protein for animal feeds and many prepackaged meals; soy vegetable oil is another product of processing the soybean crop. For example, soybean products such as textured vegetable protein (TVP) are ingredients in many types of meat and dairy analogs. Soybeans produce significantly more protein per hectare than most other uses of land. Traditional non-fermented food uses of soybeans include soy milk and from the latter tofu and tofu skin. Because of its many uses for industrial products, soybean gains high demand for the production of grains. However, low production is still a problem due to the low viability of the seeds for planting. Thus, farmers find ways to store their seeds for planting materials for the next cropping season. Soybean seeds are susceptible to agro-ecological conditions. The research findings of Shellar (2008) found that no significant changes occurred for the soybeans stored at 4 degrees C, the soybeans stored at high temperatures (30 to 50 degrees C) exhibited significant quality loss. Several combinations of storage conditions at temperatures exceeding 30 degrees C produced a drastic loss in tofu yield. Storage also affected the tofu-making process by reducing the optimum mixing time to produce the highest tofu yield.

The varietal difference in soybean storability was observed. The results provided helpful information for the soybean processing industry to store soybeans using the optimal storage conditions and estimate soybean quality after storage. Depending upon the duration and conditions of storage, physical, chemical, and biochemical alterations can occur in the soybeans (Narayan et al., 1988; Hou & Chang, 2002; Hou & Chang, 2005; Kong et al., 2008; Shelar et al., 2008), and such qualitative changes contribute to reducing oil, meal quality and tofu (Liu, 1997; Hou & Chang, 1998; Chang, 2005). According to (Kong & Chang 2009), the significant factors affecting the storability of soybeans include ambient relative humidity, type of containers and storage, seed initial moisture content, temperature, and time duration of storage. Storing soybeans with inadequate moisture content leads to crude, refined, bleached, and deodorized oil.

Moreover, Zucareli, et al. (2014) discovered that seeds with intermediate thickness, for both cultivars, generally presented greater vigor. Concerning width, larger seeds, for the BR-401 cultivar, and intermediate seeds, for the BR-402 cultivar, showed better physiologic

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quality. They found out that these genetic characteristics of seeds will result in yield advantage over the low quality and low percent vigor seeds. Likewise, Dias et. al. (2011) they concluded in their soybean study that an increased percentage of soybean seeds with high vigor results in the greater initial growth of the crop until the phenological stage of eight leaves and resulted in high grain yield. Likewise, there are many studies on the storage and the correct moisture content of soybean seeds for storage, but there are limited recommendations on the type of containers to be used and the specific moisture contents needed in storing the soybean seeds as well as the time and duration of storing soybean seeds for planting materials. Hence, this study.

2 MATERIALS AND METHODS

Collection of Seeds and Setting up the Experiment

Four (4) kilograms of soybean seeds (NSIC Sb9) were procured at Philippine Mechanization in Central Luzon State University, City of Munoz, Nueva Ecija. While, polyethylene plastic bags (12cmx14cm) and the paper brown bags were bought at San Jose City, Munoz, Nueva Ecija. Six (6) bottles and rubber bonds were borrowed from the storage office at PhilMech in Central Luzon State University, City of Munoz, Nueva Ecija. The experiment was conducted and arranged in CRD with a 2 x 3 factorial experiment. The treatments designated were as follows; Factor A-Levels of moisture contents; M1- 10% and M2- 13%. Factor B- different containers; C1- polyethylene plastic bag (tied with rubber bond), C2- paper brown bag (tied with a rubber band), and C3- closed bottles. A one-half kilogram of soybean seeds was placed in each container. Two different moisture levels were adopted (10% and 13 %). Moisture contents of the soybean seeds were set using the moisture meter.

Data on seed quality was based on the rating of 1-5 where 1 is the lowest and 5 is the highest. The seed with physical quality should have uniform size, weight, form and color. It also should be devoid of shriveled, diseased mottled, molded, discolored, damaged and empty seeds.

While, percent (%) seed vigor was gathered by recording the number of seeds that fully emerged from the soil surface 5 days after planting (DAP). This was done using the formula below:

$$\text{Percent (\%) Seed Vigor} = \frac{\text{Number of seeds emerged from the soil surface 5 DAP}}{\text{Total number of seeds planted}} \times 100$$

Data Gathered and Statistical Analysis

The following parameters evaluated were percent (%) seed moisture content, seed quality, percent (%) seed germination, and seed vigor. These were gathered four four (4) months after storage of the seeds. All the data were analyzed using the Statistical Tool for Agricultural Research (STAR). The mean comparison was done using the Honestly Significant Difference (HSD) test at 0.05 level of significance.

3 RESULTS AND DISCUSSION

Figure 1 presents the result of the moisture content of soybeans seeds after four months of storage. Results revealed that soybean seeds exposed to 10% MC after four (4) months of storage were significantly lower (10.98 %MC) than the seeds exposed to 13% MC. Seeds stored in conditions of low moisture content and temperature will retain their viability for longer periods. Seeds are hygroscopic in nature.

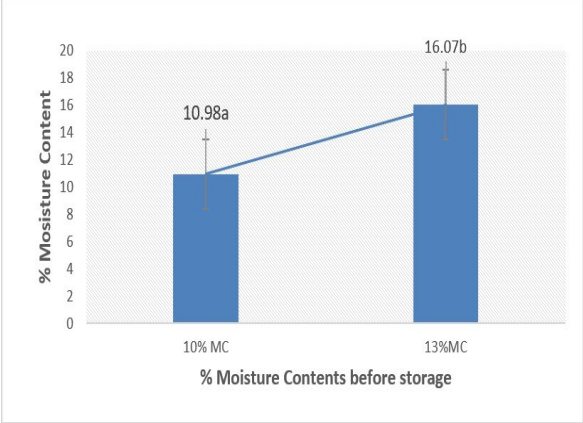

Figure 1. The percent moisture content of soybean seeds four months after storage as influenced by the moisture content of the seeds upon storage

This means that a seed loses moisture to the atmosphere at a given temperature or absorbs moisture from it until the vapor pressures of seed moisture and atmospheric moisture (relative humidity) reach equilibrium. When seed moisture and the relative humidity of the air are in equilibrium, there is no net moisture movement as in the case of the seeds stored under low moisture content as observed in the treatment (M1-10%MC).

However, any changes in the seed moisture, the relative humidity of the air surrounding the seed, or the temperature, upsets this equilibrium, and a net movement of water occurs (Islam, 2007). This process is virtually continuous under ambient conditions, but is not instantaneous, often requiring several days and sometimes several months before equilibrium is established. On the other hand, soybean seeds stored in closed bottles, paper bags, and plastic bags show no significant differences among the treatments (Figure 2). According to (Mathur and Kongdal, 2003), they found that any containers can be recommended for use such as paper bags, plastic bags or air-tight containers depending

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on the duration and the storage conditions. Moreover, in this study, there were no significant differences among the different containers used.

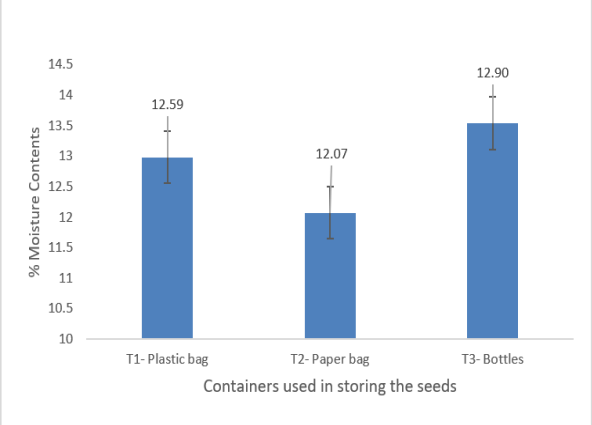

Figure 2. The percent moisture content of soybean seeds four months after storage as influenced by containers upon storage

This result suggested that these three containers can be used to store the soybean seeds provided they should have a 10-13% MC. On the other hand, the seed quality did not differ significantly regardless of the moisture contents of 10 and 13% (Figure 3). However, there was a significant difference observed among the different containers used in this study, (Figure 4). Soybean seeds stored in the closed bottles as containers had a significantly higher quality than the seeds stored in the plastic bag and paper bags. The seeds placed in closed bottles cannot absorb moisture from the outside environment. According to (Cormack, 2004) closed bottles can be a good source of containers for storing seeds especially in smaller and less quantities as they will not absorb moisture from the outside atmosphere. Schuch et al. (2009) noted that high-quality soybean seeds had better performance in the field and produced a high grain yield.

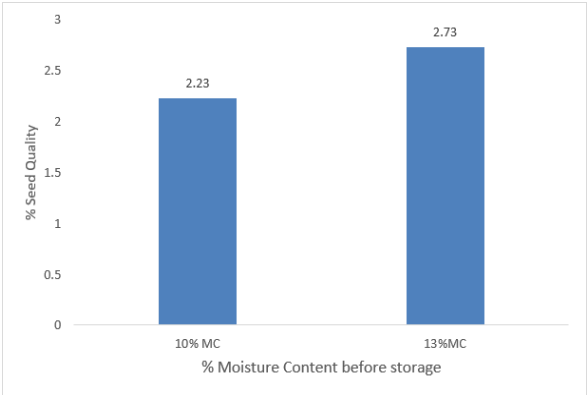

Figure 3. Seed quality rating of soybean seeds four months after storage as influenced by moisture content

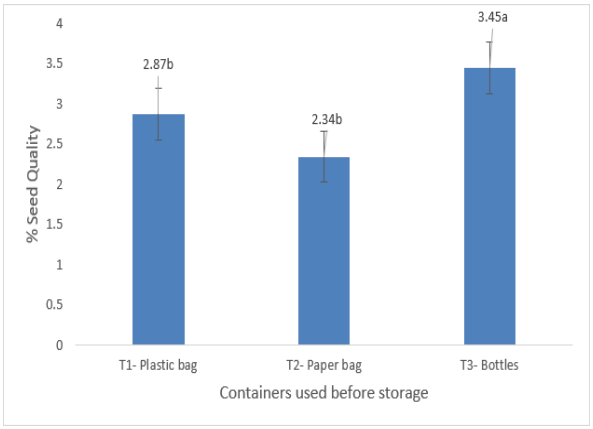

Figure 4. Seed quality of soybean seed four months after storage as influenced by containers used for storage

Figure 5 presents the data on percent seed germination after four (4) months of storage. Looking at the data, the initial % germination (composite sample) of the soybean seeds were higher (81% under 10 %MC and 83% under 13% MC) before the seeds were stored. This result can be attributed to the fresh and viable seeds with lower initial moisture content of 10.00%, which gave the enzymes inside the seeds to be more active and the seeds are still viable for germination. It will enhance germination compared to the seeds under old stock and high %MC. Low moisture content (10%) is suitable for storing the seeds because it gives a 60% germination than the seeds stored at 13 %MC. The % germination of the seeds declined after four months of storage regardless of the containers used. The results show that seeds under 13 % MC, regardless of storage conditions, only germinated up to 32%. These results suggested that soybean seeds are not safe for storage if the MC is 13% and beyond regardless of storage condition and containers. As observed, the seeds under these treatments showed some molds and another fungus even in hermetic containers (Haque et al. 2014). This suggests that seeds with 10% MC can be stored in closed bottles and will still germinate up to 60% only.

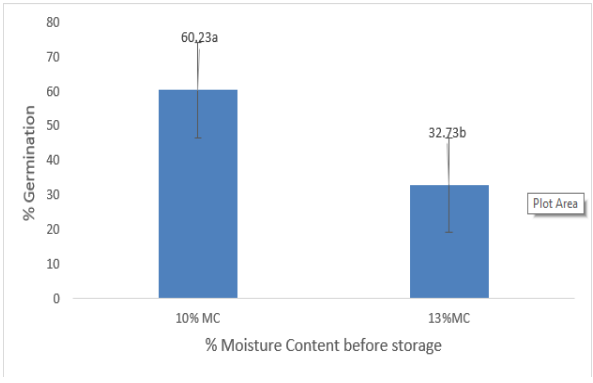

Figure 5. Percent seed germination of soybean seeds four months after storage as influenced by moisture content

On the other hand, for seeds stored in closed bottles,

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the percent germination ends up to 70% even after four months of storage. This result suggested that closed bottles can be used for soybean seed as containers for seed storage.

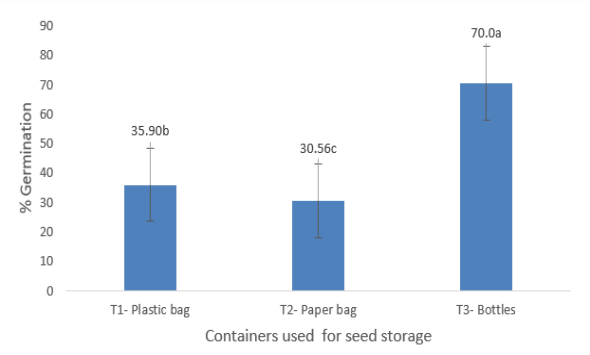

Figure 6. Percent seed germination of soybean seed four months after storage as influenced by containers used for storage

Figures 7 and 8 show the data on percent seed vigor four months after storage as affected by the type of containers used in storing the seeds and the levels of moisture contents. Percent seed vigor, the soybean seeds four (4) months after storage were planted in the pots and exposed to the outside condition. Data showed a very low % seed vigor even on the seeds that germinated high. Only 3.45 % seed vigor was noted at 10-13% MC regardless of containers after seven days of observation. This result suggested that four months of seed storage for soybean is not anymore viable regardless of the type of containers used. According to Shellar et al. (2008), seeds that are low in vigor generally produce weak seedlings that are susceptible to environmental stresses. Whereas, a high level of vigor in seeds can be expected to provide for early and uniform stands, which give the growing seedlings a competitive advantage against various environmental stresses. Moreover, Dias, et. al. (2011) concluded that an increased percentage of soybean seeds with high vigor results in the greater initial growth of the crop until the phenological stage of eight leaves and resulted in high grain yield.

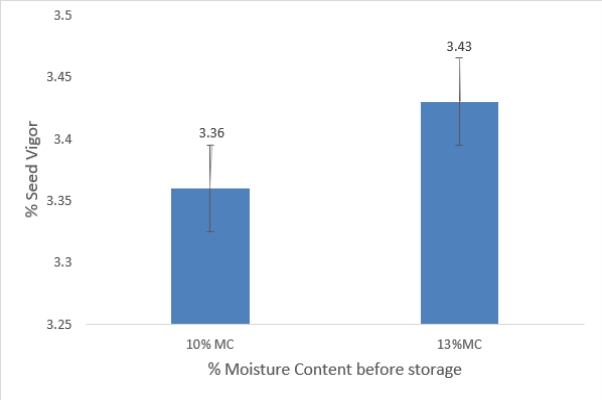

Figure 8. Seed vigor of soybean seeds four months after storage as influenced by moisture content

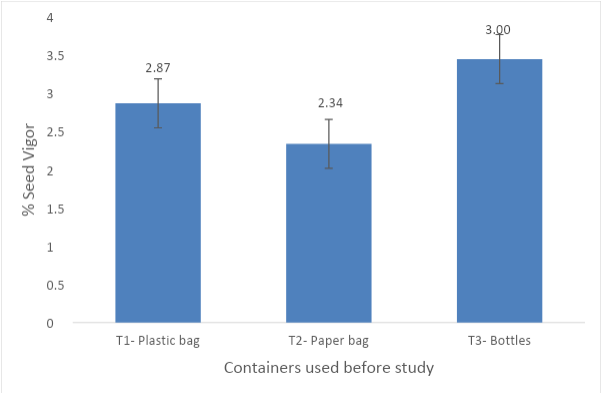

Figure 8. Seed vigor of soybean seeds four months after storage as influenced by containers used for storage

4 CONCLUSIONS AND RECOMMENDATION

Based on the result of the study, the quality of soybean seeds was reduced to 2.48 rating (means low to moderate seed quality and form) after four months of storage even exposed to 10-13% MC. On the other hand, soybean seeds showed a 3.00 rating (means low to moderate quality) when stored in closed bottles and had 70% germination after four months of storage. However, the percent (%) seed vigor of soybean seeds showed a very low 3.45% only after five days of observation in the field for both seeds exposed to 10 and 13 %MC stored in plastic bottles. Therefore, it was concluded that soybean seeds are very sensitive and not anymore recommended for planting after four (4) months of storage.

REFERENCES

Dias, M. A. N., Pinto, T. L. F., Mondo, V. H. V., Cicero, S. M., & Pedrini, L. G. (2011). Direct effects of soybean seed vigor on weed competition. *Revista Brasileira de Sementes, 33*, 346-351.

Haque, S. M. A., Hossain, I., & Rahman, M. A. (2014). Effect of different storage containers used for storing seeds and management practices on seed quality and seed health in CVL-1 variety. *International Journal of Plant Pathology, 5*(2), 28-53.

Islam, M.M., (2007). *About jute seed research*. R.S. Printing Press, Kalwalapara, Dhaka, Bangladesh.

Mathur, S.B. and O. Kongdal, (2003). Common laboratory seed health testing methods for detecting fungi. *International Seed Testing Association,* Zurich, Switzerland, ISBN-13: 9783906549354, Pages: 425.

McCormack, J. H. (2004). Seed processing and storage: principles and practices of seed harvesting, processing, and storage: an organic seed production

p-ISSN: 2599-4875 e-ISSN: 2599-4980

manual for seed growers in the Mid-Atlantic and Southern US (p. 28). McCormack.

Hou, H. J., & Chang, K. C. (2005). Storage affects color and chemical composition and tofu making quality. *J Food Proc Pres, 28*, 473-88.

Iwuoha, C. I., & Umunnakwe, K. E. (1997). Chemical, physical and sensory characteristics of soymilk as affected by processing method, temperature and duration of storage. *Food Chemistry, 59*(3), 373-379.

Kamata, Y., Umeya, J.I., Kimura, M., Tanii, S. and Yamauchi, F. (1990). Effects of heating rate and high-temperature holding on soy protein gel viscosity. *Nippon Shokuhin Kogyo Gakkaishi, 37*(3), 184-190.

Khatib, K. A., Aramouni, F. M., Herald, T. J., & Boyer, J. E. (2002). Physicochemical characteristics of soft tofu formulated from selected soybean varieties 1.. *Journal of Food Quality, 25*(4), 289-303.

Schuch, L. O. B., Kolchinski, E. M., & Finatto, J. A. (2009). Seed physiological quality and individual plants performance in soybean. *Revista Brasileira de Sementes, 31,* 144-149.

Shelar, V. R., Shaikh, R. S., & Nikam, A. S. (2008). Soybean seed quality during storage: A review. *Agric. Rev, 29*(2), 125-131.

Zucareli, C., Brzezinski, CR, Guiscem, JM, Henning, FA, & Nakagawa, J. (2014). Physiological quality of sweet corn seeds classified by thickness and width. *Tropical Agricultural Research, 44*, 71-78.

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