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A review: Loss of pulses seed during storage

Vijay Dugesar, AK Chaurasia and Sachchida Nand Mishra

Abstract
After-harvest storage loss of pulses seeds is a major issue, and it is one of the main causes of food insecurity for farmers in developing countries. As a result, the goal of this study is emphasis on the aspects and postharvest techniques that are used to maintain seed quality. Healthy seeds and grains have become a high-demanding enterprise in recent years in order to produce good yields in the coming season to maintain a high-yielding crop, the seeds must be stored. Seed is an important input in agriculture that impacts not only production but also productivity, therefore maintaining seed quality and vigour during storage is crucial. Storage is a basic technique in the control of the physiological quality of the seed, and it is a way for preserving the viability of the seeds and maintaining their vigour during the time between planting and harvesting. Farmers store seeds in traditional storage containers for their own use. These storage structures are relatively inexpensive, ecofriendly and give stored goods a long shelf life, with minimum modifications, these old storage systems could be used in modern storage rooms to safeguard food items that would otherwise be harmed by insects. Such a good storage system will help reduce seed storage losses, maintain grain quality and contribute to reducing food insecurity. Seed treatments play a significant role in improving the establishment of healthy crops as well as reduce losses of seed during storage. Chemical pesticides and insecticides used during seed storage have harmed the quality of food grains, which is why conventional, organic, and indigenous pesticides and insecticides are increasingly favored to safeguard the grain and seeds to make it safe for production and consumption.

Keywords: Pulses seeds, moisture content, storage factors, post-harvest losses, storage structure and seed treatments

Introduction
Pulses are an important part of many people's diets and can help to provide balanced nutrition. They can also be grown as a nutritious and delicious animal feed, a green manure crop, a fuel source, or even for medicinal purposes. Pulses are efficient protein producers which require few resources (Havlin *et al*., 2014) [33]. Pulses are an integral part of Indian culture. It's a common offering in many temples. Green gramme powder as prasada in Mookambika Temple, boiled cowpea in Parassini Muthappan Temple and 'Chana Sundal' a special preparation during Ganesh Puja, to name a few. Pulses are a good source of protein. It also has a low glycemic index (FAO, 2016) [27], is gluten free, and can be used as a functional food (Rao, 2002) [68]. Pulses are also important for soil and water conservation. They are essential crops for ensuring food security, combating malnutrition and alleviating poverty, improving human health, and enhancing agricultural sustainability (Garg and Geetanjali, 2007) [29].
Storage is a fundamental practice in the control of the physiological quality of the seed, and it is a method for preserving the viability of the seeds and keeping their vigour at a reasonable level between planting and harvesting (Azevedo *et al*., 2003) [9]. Seed storage is the practice of storing seeds in storehouses, heaps, bulks, and bags in such a way that seeds retain both food and seedling value, assuming certain conditions such as ventilation, fumigation, and optimal temperature and humidity are met (Raoudha *et al.*, 2013) [69]. Seed viability may be affected by seed storage period because seed viability decreases directly proportionally to time (Bortey *et al.*, 2016) [20]. This is due to the fact that it allows for the storage of ripening embryos and the accumulation of food that lasts for storage before germinating; these activities resulted in an increase in the metabolic processes in the seed. Seed viability was influenced by seed storage environments such as temperature and relative humidity in addition to seed storage period (Sisman, 2005) [81].
Storage good effective in preserving the initial quality of a seed lot after it has been harvested and processed if the water content is significantly reduced during the drying phase (Abdellaoui *et al.*, 2013) [1]. The high water content in the seeds increases the breathing process, such as reserve metabolism, in special proteins, in addition to favoring microorganism attacks during

storage, particularly pathogens (fungi). The appropriate values for water content in seeds for storage range from 7% to 12%, depending on the type of reserve stored: for amylaceous seeds, it is 12%, while for oil and amyl-protein seeds, including pigeonpea, it is 10%. This content can be much lower, around 7%, for vegetable seeds stored in an airtight environment (Marcos Filho, 2015) [47]. As a consequence, it is critical to search for this information in order to create a better data base for technicians and producers regarding aspects related to this fabaceae, particularly those concerning appropriate procedures for seed conservation of superior physiological quality (Zonta *et al,* 2014) [89]. Furthermore, it can be stated that storage is a fundamental practice for controlling the physiological quality of the seeds, being a method by which it may be possible to preserve seed viability and keep vigour at a reasonable level in the period between sowing and harvest, the latter being entirely dependent on the amount of water present due to storage (Swinnen and Maertens, 2007). The following factors are highlighted as influencing seed viability and vigour conservation: initial physiological quality of the seed, seed vigour, climatic conditions during maturity, mechanical damages during and after harvest, action of microorganisms and insects, drying conditions, proper water content, relative humidity, storage temperature, types of packaging, and storage length (Pandey *et al.,* 2012) [60].

Purpose of seed storage

For a long time, post-harvest facilities or appropriate storage technology for pulse crops have been a major issue in India and other developing countries. This has resulted in significant waste of agricultural output and, as a result, significant economic loss. In indigenous storage structures, the average proportion of pulse grains retained by farmers for their own use (rather than for sale) is usually assumed to be 60-70 percent (Kanwar and Sharma, 2003) [40]. The goal of seed storage is to keep planting stocks from one season to the next or to keep harvested produce quality but not necessarily to improve it (Sisman and Delibas, 2004) [82]. Seeds must be of good storage quality to ensure that they remain in good condition until they are used for sowing (Pratt *et al.,* 2009) [63]. Furthermore, seed storage allows for the preservation of seeds over time in order to improve plant breeding programmes. When the seed reaches physiological maturity, it should be harvested, dried to safe moisture content, cleaned and stored under favorable conditions, and protected from damage and pests until planted. The type of seed crop, moisture content, storage conditions (temperature, relative humidity) and storage pests are the most important factors influencing storability (Babiker, 2015) [10].

Food grain storage plays a crucial role in the economies of both developed and developing countries. Quality food grains must be supplied to consumers for the production of various products and marketing, as well as to farmers for the sowing and cultivation of healthy pulse grains. This necessitated the regular availability of agricultural outputs, which will stabilize any country's economy. To meet the demand for a plentiful supply, grains must be stored all year and gradually released to the market during off-season periods, which also helps to stabilize seasonal prices (Adejumo and Raji, 2007) [3]. Traditional methods of grain storage and preservation have been developed in communities and passed down from generation to generation since time immemorial (Natarajan and Santha, 2006) [58]. Farmers in one-fourth of developing countries keep their products at the village level. The traditional storage system is thought to be effective or to provide satisfaction and they continue to improve in order to protect seeds from damage.

The percentage of total food crop yield retained at the farm level, as well as the period of storage, are largely determined by farm size and yield per acre, marketing pattern, consumption pattern, labor payment method, credit availability and future crop expectations (Channal *et al.,* 2004) [23]. Pulse seeds can be stored indoors, outdoors, or underground in structures ranging from mud berms to modern bins. The storage containers are made of locally available materials and vary in design, shape, size, and function (Kanwar and Sharma, 2003) [40].

Losses during storage

Storage losses can be classified in two categories: direct losses, due to physical loss of commodities; and indirect losses, due to loss in quality and nutrition. It is important to consider both damage and losses by the insects during storage instead of just weight loss (Deepak Kumar and Prasanta Kalita, 2017) [25]. "Damage" can refer to physical evidence of deterioration, for example, holes in the grains. It mainly affects the quality of grains. "Loss", on the other side, is the total disappearance of the food, which can be measured quantitatively (Boxall, 2002) [21].

Loss in weight: Moisture changes can cause weight gain, and in some situations, the weight loss can be partially countered by the creation of water caused by insect infestation. Weight loss is caused by the feeding of insects, rats and birds, as well as spills, incorrect handling, and pest activity (Lale and Vidal, 2000) [45]. Because the trader sells by volume, weight loss may go undetected in many cases. Weight is an essential component in commercial storage, which can lead to malpractices such as adulteration with water, stones or earth to make up for a shortfall (Gan *et al.,* 2008) [28].

Loss in seed quality: Generally quality is assessed and products graded on the basis of appearance, shape, size, etc., but smell and flavour are sometimes included. Contaminants and foreign matter content are factors in quality degradation (Simic *et al.,* 2007) [79]. Insect pieces, grass, rat hairs, and excrement; weed seeds, plant parts, dirt, stones, glass, and so on are examples of foreign matter. Pest excretions, oils, pesticides, pathogenic organisms transferred by rodents, and toxins resulting from fungal infections are examples of contaminants that are difficult to remove (Walters *et al.,* 2010) [85].

Loss in biochemical content: The loss in nutritional quality is the product of both the quantitative and qualitative losses. Food loss is measured by weight loss during storage (not moisture loss), however the latter may be proportionately larger due to selective insect feeding (Singh and Sharma, 2003) [80]. Rodents and moth larvae may preferentially target the grain's germ, reducing a significant portion of the protein and vitamin content, whereas weevils feeding mostly on the endosperm lower carbohydrate and protein levels. Other storage conditions, such as moisture and fungal infection, cause changes in vitamin content and enzyme activity, according to Wilson and McDonald (1986) [87]. In beans in particular, loss of protein is very important where there is infestation, as up to 25% of the dry matter may be crude protein (Bhanuprakash *et al.,* 2005) [17].

Loss of seed viability: This has to do with seed germination failure. Because of its higher potential value, seed grain is normally stored with additional precautions (Cartelazzo *et al.*, 2005) [22]. Changes in light, temperature, moisture, excessive respiration, infestation, and, in rare situations, the methods used to control infestation can all contribute to loss. Insects that attack the germ preferentially will reduce germination more than others (Balesevic-Tubic *et al.*, 2011) [13].

Understanding the physiological and molecular mechanisms by which seeds held for longer periods of time, as a result of seed ageing, might delay and fail to germinate is crucial. Natural seed ageing processes and physiological changes can occur as seed is stored for longer periods of time (Sisman and Delibas, 2004; Morad Shaba, 2013) [82, 55]. As a result, there would be a drop in viability, as well as anomalous and poor seedling establishment. Seed ageing has been shown in studies to impair germination and emergence (Rice and Dyre, 2001) [71]. Increased seed storage was followed by an increase in mean germination time, which reduced seed germination, emergence rate and seedling establishment (Verma and Tomer, 2003; Basra *et al*., 2003) [84, 16]. After one year storage, seed germination declined significantly (Mrda *et al.*, 2010) [56].

The term 'storage period' suggests that natural seed aging events take place over prolonged period. If the storage period is extended, the natural seed ageing process is accelerated, and chemical changes occur, resulting in seed degeneration. Seed degeneration is the loss of viability, quality and vitality as a result of natural ageing or adverse environmental variables such as high temperature, high humidity and wetness, among others (Sisman and Delibas, 2004; Azadi and Younesi, 2013) [82, 8]. Storing seed for longer than the recommended time might impair germination potential, seedling establishment, and final seed yield (Sisman, 2005) [81].

Factors affecting seed storage

Several factors, such as insect pests, microorganisms, rodents, and birds, are responsible for the quantitative and qualitative degradation of seeds during storage, reducing the seeds shelf life. At the same time, we must pay attention to various factors, such as the nature of the storage structure, the type of commodity stored, the duration of storage, and the quantity of stored seeds, as well as climatic factors, in able to preserve the seeds safe during storage (Said and Pradhan, 2014) [74].

Many factors affect seed storage, according to Justice and Bass (1978) [39], including pre-harvest field conditions (e.g. high temperature, high humidity and high moisture), harvest maturity, mechanical injury, high temperature, high moisture, fungi, insects, pests such as rats, mice and birds, and seed treatment (fumigation). Seeds that have been mechanically damaged have a lower storability. They not only disintegrate more quickly, but they're also more prone to fungus in storage and treatment harm.

Seeds' storage life greatly reduces when storage temperature and moisture content rise. According to Harrington and Douglas (1970), from 0 to 50 °C, each 5 °C rise in storage temperature halves the seed's life span, while for seed with moisture content of 5-14 percent; each 1 percent decrease in moisture content nearly doubles seed storage life.

Fungi behaved like parasites within the stored grain, causing serious disease in the consumers. As a result of the fungi's growth, the respiration rate of food grain within storage grew gradually, creating a hotspot that affected the stored grains' milling properties. Different mycotoxins have also been formed as a result of the expansion of fungi that are considered highly harmful to users (Minjinyawa, 2010) [54]. Mold can grow in a humid and hot environment, but it can also thrive in a cold and humid environment with a high relative humidity. Dry weather slows fungal growth but does not kill spores due to their great resistance capability in dry environments (Edwards, 2013) [26].

Storage fungus, especially Aspergillus and Penicillium species, are found practically everywhere and can destroy seed stored at 65-100 percent relative humidity (Justice and Bass, 1978) [39]. Storage fungi can grow quickly when seed moisture content and/or ambient relative humidity are both high. Insects attack endosperm and/or embryos in seed stored at 9 percent moisture content or above, causing substantial harm (Justice and Bass, 1978) [39]. Pests such as rats, mice, and birds devour seeds, cause sacks to be damaged, and disperse, mix, and contaminate seeds.

Insect growth in various storage structures is influenced by favorable conditions such as moisture, temperature, and air. Beetles and moths are two major insects that wreak havoc on grains and pulses that have been kept (Groot, 2004) [30]. If storage systems in which food grain is stored are unable to destroy the insect-pest impact, insect-pests can multiply very quickly. Insect infestation occurred during storage due to insufficient storage facilities. Weevils, according to Jakob *et al.*, (2006) [37], are the most harmful grain bug, causing food grains to degrade by damaging the outer layer and obstructing the inside edible sections of the grain.

Certain seed treatment chemicals can have an unfavorable effect on seeds that are rich in moisture, have mechanical damage or have been stored for a long time. Treatments that are healthy for some crop seeds may be harmful to others; a high rate of treatment also impacts storability. Under some situations, some fumigants have a negative impact on seed viability. Increases in seed moisture, temperature, fumigant dosage, and exposure time all raised the chance of damage (Justice and Bass, 1978) [39].

Seed moisture

The amount of water in a seed is measured as seed moisture content (SMC). Water is found in cells both free and bound to chemical compounds such as carbohydrates and protein. It is expressed in terms of the weight of water contained in a seed as a percentage of the total weight of the seed before drying, known as the wet-weight (ww) or fresh-weight basis (ISTA, 2005) [36]. SMC (% ww) = wet weight-dry weight over wet weight x 100 Moisture content can also be expressed on a dry weight basis (db)-that is, the loss in weight as a percentage of the dry weight of the seeds. SMC (% db) = wet weight-dry weight over dry weight x 100 (Rao *et al.*, 2006).

Impact of storage duration on seed quality

Another thing that impacts seed quality is storage time. Seed moisture content rises progressively during storage, lowering seed quality as germination % falls. Seed viability may be affected by seed storage time, as seed vitality decreases in direct proportion to the length of time (Bortey *et al.*, 2016) [20] Bortey. This is due to the fact that it allows for the preservation of ripening embryos and the accumulation of food that lasts for storage before germination; these activities resulted in an increase in the metabolic processes in the seed. Farmers in developing countries continue to keep their goods, including seed, in the open air for longer periods of time, which has been shown to impair seed quality and germination in particular (Isaac *et al.*, 2016) [35]. As a result of the metabolic process, the seed's viability has decreased and it is unable to germinate optimally (Badawi *et al*., 2017) [11]. Seed quality decline is caused by prolonged seed storage periods, which are linked to biochemical changes in seed physiology, such as lipid autoxidation and an increase in the concentration of free fatty acids, which cause rapid deterioration (Ramya *et al.*, 2018) [66]. According to the report, as storage durations were extended, final germination percentages, germination index percentages, energy of germination percentages and emergence rate percentages fell (Sheteiwy *et al*., 2013) [78]. The results demonstrated that in terms of final germination percentage, germination index percentage, energy of germination percentage and emergence rate percentage, before storage treatments greatly outperformed the other storage periods after 3 months. After a year in storage, the final germination %, germination index percentage, energy of germination percentage and emerging rate percentage were all the lowest. Birhanu Gebeyehu (2020) [19] concluded that increasing storage period from 3, 6, 9 and 12 months decreased final germination percentage by 3.11, 9.91, 18.87 and 25.80%, respectively compared with final germination percentage of pre storage treatment. Increasing storage periods from 6, 9 and 12 months decreased germination index percentage by 6.51, 15.34 and 26.40%, respectively, compared with germination index percentage after 3 months. In addition to a storage period of seed, seed viability was also influenced by seed storage environments such as temperature and relative humidity (Sisman, 2005) [81]. Throughout the storage period, seeds stored at low temperatures germinated faster than those stored at high temperatures (Mbofung, 2012) [50]. Because the seeds are stored at high temperatures, the respiration rate and enzyme activity rise, causing the food reserves to be depleted before the seeds germinate, the seeds vigour and physical quality suffer.

Among the pulses, pigeonpea seed contains a considerably amount of starch (<50%) and protein (>22%), being classified as protein from the medium to long run, due to the concentration of protein as compared to storing starchy seeds-corn, rice, wheat, etc. A clear example of this affirmative was obtained by Martins Filho *et al.*, (2001) [48] by evaluating the physiological quality of soybean seeds whose protein levels are greater than those in the pigeon pea-around 45% when it was observed that there had been a decrease in vigor and viability starting at the 120th day of storage and after 210 days which presented a void effect. This behavior can be attributed as shown by Peske *et al.*, (2006) [61], a deviation in the chemical composition of the seed, hence the metabolism of proteins promotes partial breaking of these same amino acids presenting within this process, changes in chemical composition during the deterioration generating difficulties in obtaining seeds with high capacity growth and vigor.

Storage structures

Losses of the seeds have been taken place due several reasons which interferes and degraded the food grain qualities in the absence of advance storage structures (Rezende, 2002) [70]. To feed the world's rising population, storage containers play an important role in preventing losses and keeping seeds safe during storage by minimizing the effects of rodents, microorganisms and environmental conditions (Jakob *et al.*, 2006) [37].

On farm storage

The process of farm storage is used by various countries to store major part of seeds (Semple, 1992) [75]. The capacity of the storage structure varies from 100 kg to a few metric tons. Depending on the weather, changes to the locally prepared storage structure could be made. There is a traditional storage system in place (McFarlane, 1988) [51]. Plywood, aluminum, and high-density, high-molecular-weight polyethylene are common materials for bins. Plywood is the best material for storage buildings and underground structures of all shapes and sizes that work on the hermetic storage principle. This results in a higher amount of carbon dioxide and a lower level of oxygen, both of which are fatal to insect and microbial attack during seed storage New Challenges in Seed Biology-Basic and Translational Research Driving Seed Technology (Shejbal and Bioslambert, 1988) [77].

Bag storage

The majority of commodities are kept in gunnies (gunny bags). Although bag storage necessitates a significant amount of labour, a small investment in permanent structures and equipment is sufficient. The advantage of bag storage is that it is short-term storage and there is a higher risk of seed spillage and biological losses. Water seepage and humidity issues may arise as a result of warehouse flooring that isn't up to code (Kennedy and Devereau, 1994) [41]. Bags don't require any fumigation or aeration systems. The approach will be uneconomical in underdeveloped countries due to tiny farm sizes and cheaper manual labor (McFarlane, 1988) [51].

Bulk storage

According to Multon (1989) [57], there are two methods of bulk seed storage: vertical (silos or bins) and horizontal (on floor stores). Horizontal stores are warehouse floors that have been properly built with sufficient ventilation and walls that are strong enough to handle the weight of the seeds (Bailey, 1992) [12]. The procedure is suitable for handling or storing seeds in bulk. Bulk storage of food grain is supervised with the assistance of several government authorities in order to minimize various losses throughout the storage period, as stored grains are frequently impacted by insect pests, reducing nutritional and other qualities (Mehrotra *et al.*, 1987) [52].

Hermetic storage

Hermetic storage protected the stored seeds from rodents, insect-pest, and moisture migration by creating suitable storing atmosphere within the storage structure with the help of modified atmosphere (less oxygen and high carbon-dioxide availability) (Sabio *et al.*, 2006) [72]. Traditional seed preservation methods use a natural build of oxygen and a lower oxygen level to preserve the seeds from biological damage. For seeds with lower moisture content, this traditional storage method is ineffective, and infestation is less than insects per kilogramme of seeds. In hermetic storage, the controlled atmosphere treatment and fumigation must be augmented (Alvindia *et al.*, 1994) [5].

Air tight Storage

Air tight storage systems used for storing the seeds in absence of oxygen because of insects-pests cannot survive in the storage structure without oxygen. Containers with a tight fitting lid (like bamboo baskets layered with clay, plastic, metals, etc.) or underground storage structures have been used to store the grains because the lack of air completely inhibits the growth of microorganisms, insects and pests, extending the storage life of the food grains (Groot, 2004) [30].

Bin storage

1. **PAU bin:** Punjab agricultural university has been designed a storage structure called as PAU bin, constructed with galvanized iron sheet. Capacity varies between 1.5 to 15 quintals depends upon the size of designed PAU bin (Acharya and Agrawaal, 2009) [2].
2. **PUSA bin:** Pusa bin is considered as modern small-scale storage structure designed by constructed with the help of mud or bricks and polythene sheets used for providing proper sealing within the wall of the structure. Pusa bin was constructed on the mud bricks platform which covered with plastic sheet of 700 gauges for protecting the stored grain properly that is why it is also known as “low density polyethylene” storage structure (Sahay and Singh, 2009: Said and Pradhan, 2014) [73, 74].

Seed treatments

Low germination rate, low vigour, poor development, and a high incidence of seed-borne diseases are all symptoms of poor seed quality, which appear to be managerial rather than technological issues. Chemical pesticides and insecticides used during grain storage have harmed the quality of food grains, which is why conventional, organic and indigenous pesticides and insecticides are increasingly favored to safeguard the grain and make it safe for consumption (Phillips and Throne, 2010) [62]. Routine inspection, fumigation, and plant-based natural additives were employed to ensure quality and hygiene throughout storage (Kiruba *et al.*, 2006) [44].

Chemical seed treatment has been shown to be particularly successful in preserving seed quality by inhibiting the activity of storage pests and fungus (Gupta *et al.*, 1989) [31]. According to Bhattacharya and Basu (1990) [18], dry dressing of pea seeds with CaOCl2 at 3g/kg of seeds for nine months resulted in increased vigour and viability than control. Controlling pests and diseases in storage can help to improve seed quality; fungicidal treatment of seeds is also used to keep seeds viable in storage (Khatun *et al.*, 2010; Khatun *et al.*, 2011) [43, 42]. Uses of some insecticides, such as such as Dimethoate, Permethrin, Carbosulfan and Malathion in stored products are facing restriction as some strains of C. maculatus have exhibited higher tolerance than normal to some insecticides (Mbata and Payton 2013) [49]. This has again raised the issue of biosafety for the use of these chemicals in higher doses in food commodities. Sulphuryl fluoride is evolving as a new age fumigant, which may be accepted worldwide for disinfesting different grains. There are reports of success of this fumigant in warehouses, flour mills and storage structures (Chayaprasert *et al.*, 2009; Baltaci *et al.*, 2009; Tsai *et al.*, 2011) [24, 14, 83]. This chemical has a good potential to act as potent fumigant in stored pulses, however air-tightness should be maintained for the fumigant to be effective. This should be followed by aeration to eliminate the residual effect of the chemical. On the other hand, advanced technologies such as irradiation and dielectric heating could be adopted commercially as alternate methods to chemical disinfestations (Wang *et al.*, 2010; Baoua *et al.*, 2012; Hallman, 2013) [86, 15, 32].

For effective decrease in % seed damage during storage, Sharma (1995) [76] advocated treating chickpea seeds with neem leaf powder (100g/kg) and ash (10g/kg). Cowpea seeds treated with neem leaf powder (3g/kg) demonstrated reduced bruchid infestation after five months of storage, according to Ogunwolu and Odunlani (1996) [59]. Anil *et al.*, (1998) [6] found no significant differences in germination between soybean seeds treated with neem products and untreated seeds. Seed treatment, on the other hand, prevented mycoflora association for up to 120 days of storage. Hossain *et al.*, (1999) [34] found that soybean seeds covered with moringa leaf powder had excellent control of colletotrichum dematium seed borne disease and had higher seed health during storage. Bengal Gram seedlings treated with arappu leaf powder had increased germination and vigour index at the end of a 10-month storage period, according to Arati (2000) [7]. Cowpea seeds treated with neem leaf powder (5g/kg) had higher germination and vigour index at the conclusion of a 10-month storage period, according to Maraddi (2002) [46].

Benefits of seed treatment

- Prevents spread of plant diseases.
- Protects seed from seed rot and seedling blights.
- Improves germination.
- Provides protection from storage insects.
- Controls soil insects.

Problems of seed storage

The food crisis in India is primarily the result of an inability to preserve food surpluses during short harvest periods, rather than a lack of production. Seed production has a minor impact on the economies of developed and developing countries because agricultural production is seasonal, whereas agricultural commodity demand is more evenly distributed throughout the year (Rajashekar *et al.*, 2014; Swinnen and Maertens, 2007) [65]. In this case, excess supply must be stored during the harvesting season for gradual release to the market during the off-season period in order to meet average demand. Quality food grains must be supplied to consumers for making various products and marketing, as well as to farmers for sowing and growing healthy grains, in order to ensure regular availability of agricultural outputs or to stabilize the economy of any country (Wright and Cafiero, 2011) [88]. To meet demand, a plentiful supply of legume seeds must be stored throughout the year. These traditional food grain storage and preservation practices can be improved or modified as needed to ensure effective grain storage and the full realization of agricultural potential to meet the world's increasing food and energy needs. Postharvest losses are a major cause of concern worldwide where below 5% research funding has been allocated (Rajashekar *et al.*, 2012) [64].

Conclusion

Storage is a fundamental practice in the control of the physiological quality of the seed. Farmers may store pulse seeds in bulk or in bags for a month or two after harvesting before transferring them to a structure. It has been observed that different localities in India have unique storage methods based on the types of agricultural crops, and farmers have varying levels of success in applying the basic principles involved in the safe storage of food grains. Thus, several methods are being used to prevent quantitative and qualitative losses due to various biotic and abiotic factors during storage, such as seed treatment with appropriate chemicals or plant products, as well as seed storage in a safe environment. So, it is more important to use seed treatment on time rather than store seeds for a longer period of time and to control the seed storage environment.

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