International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 08-08-2021, Accepted: 23-08-2021, Published: 08-09-2021
Volume 6, Issue 5, 2021, Page No. 331-334

Impact of conventional storage system on germination and storage fungi of paddy in Chikkamagaluru, Karnataka

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Abstract
Practice of suitable method of storage benefited to maintain the highest germination ability even to the duration of six months up to 90%. Paddy stored for a year good in quality for consumption and flour. Conventional structures recorded were constructed with locally available plant wood, bamboo, mud, coconut jute. As insect protector plant leaf, sugarcane, paddy husk was selected which been in use traditionally. Storage fungi infestation rate was fund increased more in 9 to 12 months storage time. Insect's damage was more in Panatha, although this structure had good protection against rodents and cold. SB and sand method test results was calculated and analyzed for samples, stored for three different storage period in three different storage structures.

Keywords: conventional storage, paddy germination, paddy fungi, storage fungi, paddy storage

Introduction

Rice (Oryza sativa L.) the name represent more than twenty species in the grass family. Twenty percent of the world's population consumes rice as food in daily routine in 2012 by Kim *et al.,* (2012) [9] but now in matter of nine years it increased to half of the world population (Kaur and Gill 2020) [7]. Production and consumption happen more in Asia (Cho *et al.,* 2016) [3]. Antioxidants of rice valuable in controlling the threat of diabetes (type2), cardiovascular problem and cancer (Kaur and Gill 2020) [7]. Starch is one of the major component of rice (kalita *et al.,* 2017) [7]. By Starchy endosperm activity paddy can germinate in low oxygen level even when submerged (Lee 2009) [9] this ability promoted for its cultivation globally. Quality and quantity of agriculture produce can be sustained to long period by following suitable storage method. Effectiveness of particular storage practice showed its impact on stored product. Eco-friendly storages were beneficiary to stored seeds, humans and nature. Farmers financial balance depend upon good, low cost and long lasting storages (Hengsadeekul and Nimityongskul 2004) [6]. Evading of chemicals or high-tech storage system and artificial treatment for drying and cooling will decrease the storage cost (Adhikarinayake *et al.,* 2006) [1]. Quality of stored content has to be maintained for complete utilization of total produced. To avoid influence of non chemical storage method, its better switch to conventional structures which build by using plant materials, cement and mud. By following these structures farmer will become self dependent, coast can be minimized and increase farmers earnings during off season also (Wasala *et al.,* 2016) [13]. These conventional structure was found in Chikkamagaluru region are so eco-friendly and very much sustainable for many years even during adverse environment conditions. This study was conducted on paddy samples stored in these structures for deferent time period to know their impact.

Collected paddy samples were analyzed for its viability by using Standard Blotter (SB) method and also observed common storage fungi. It was observed in result paddy stored were viable with good percentage and less affected by storage fungi. Consumption rate of this paddy was up to remarkable level and even for sowing. Chikkamagaluru region is one of the more rain fall region of Karnataka, even with these conditions mentioned conventional storage methods are very effective and safer.

Materials and method

Field work

Personal visit lead us to derive about paddy stored structure in chikkamagaluru region of Karnataka. We were interacted many farmers in many villages across. Found huge number of farmers who following conventional storage from several generations. The technology of construction had been passing from generation to generation some important regularly practicing structures were recorded and collected the seed samples.

Conventional storage structures observed

Sustainable conventional storage structures recorded are

1. 1.circular bamboo chamber named kanaja constructed by bamboo, by preparing small strips of few inches with two to three meters in length were fabricate as wall of the chamber, finally turn into cylinder like structure, required size cylinder can be made normally we observed had the of capacity 5-6 tons.
2. Rectangular storage made by using cement and brick called Panatha was one of the very common systems followed by many farmers. Wall of the chamber constructed by brick and cement and plastered by cement or mud. The size of Panatha generally up to 6-8feat.
3. Jute bag prepared by coconut jute in different sizes -25, 50, 100 & 200kg

Sample collection

Paddy stored by means of conventional storage method was collected and labeled in the field than brought to lab. Samples from regularly followed conventional storage structures which practiced by many farmers they are circular bamboo chamber, concrete chamber and jute bag. Many paddy samples stored for deferent time period was collected. For study we classified collected samples on the basis storage time period, as six month, nine months and twelve months samples. These seed are subjected to two germination tests to analyze its viability, under lab condition. Germination induces important changes in the biochemical, nutritional and sensory characteristics of seeds, including the degradation of starch (Xu *et al*., 2011) [15].

Germination Test

Germination process is affected by external factor such as germination time and absence or presence of light both of which can aid or inhibit germination in relation to the reserve within the seed.

Two types of tests were conducted to know germination capability of the samples they are Standard Blotter (SB) method and Sand Method. These methods are standardized and recommended by ISTA (International Seed Testing Association).

SB Method Test

To conducted SB method plastic Petri dishes was used lower lid is placed by wet blotter sheath using distilled water and twenty five paddy seeds were placed in order with 5-6cm distance, closed by upper lid, four hundred seeds of each sample was conducted for test as standard by ISTA. This setup was placed for observation in incubation chamber for 7 day with interval of observation and distilled water was used.

Sand Method Test

This test was conducted in a plastic tray of which 70cm length, 45cm width and 15cm in height, it was filled by washed sand for about 12cm as sowing bed. Each tray was used to sow twenty five seed each seed was sowed at 5cm deep between every seed 8cm distance was maintained. Distilled water was used for watering. 400 seed used for test from each sample (Devihalli *et al*., 2005) [4] as standard setup, placed in lab condition for fifteen days as observation period. Observation and watering was done in interval of time. Germinated and non germinated seeds were noted for further analysis.

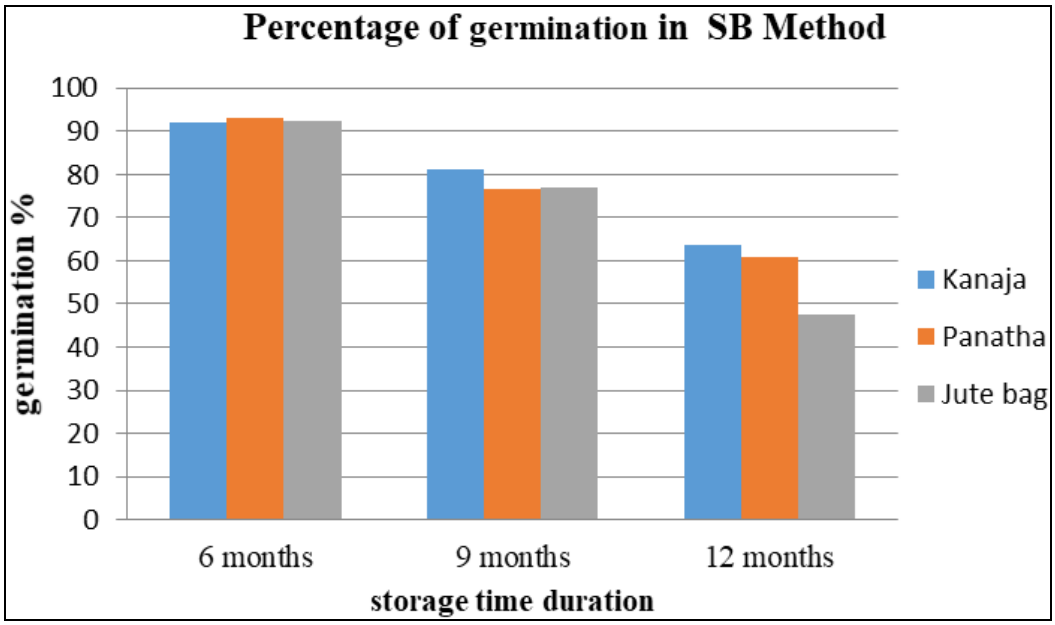
Observation and calculation

SB method gave us fast results compare to sand method to know the germination capacity of the seeds, germination percentage was recorded for four hundred seeds of each storage time period. The ability of germination in percentage was calculated by using following formula.

$$\text{Percentage of Germination} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds plated}} \times 100$$

Table 1: Showing percentage of germination in SB and Sand method

SL No	Types of storage method	Storage duration in months	Percentage of germination in SB method	Percentage of germination in Sand Method
1	Kanaja	6	92	80
		9	81.7	68.5
		12	63.5	45
2	Panatha	6	93	82.5
		9	76.5	70
		12	60.7	43.7
3	Jute bag	6	92.5	73.7
		9	77	60
		12	47.5	35



Graph 1: Showing percentage of germination in SB and Sand method

Table 2: Percentage of different fungi infestation observed in SB and sand method

SL No	Types of storage method	Storage duration in months	percentage of fungi infected		
			Aspegillus flavus	*Rhizopus rocenances*	*Aspegillus niger*
1	Kanaja	6	8	8	-
		9	18	15	2
		12	36.5	30	15
2	Panatha	6	7	7	-
		9	26	25	8
		12	36.75	32	16
3	Jute bag	6	7.5	7	2
		9	23	23	9
		12	52.5	50	25
		Mean %	5.9	5.4	2.2

Result

Germinated seed stored by all three methods was observed under the binocular microscope. Plated seeds observed every day, protruded radical and plumule consider to defining germination (Umnajkitikorn *et al.,* 2013) [12]. Radical and plumule emerged for 1cm and above were considered as germinated other as un-germinated. Storage fungi infestation observed and recorded.

SB method

Kanaja six months seeds had germination of 92%, nine months had 81% and twelve months was 63%. A.flavus, Rhizopus and A.niger are observer storage fungi infestation rate were 40%, 28%, 25% respectively

Panatha six months seeds had germination of 93%, nine months had 70% and twelve months was 60.7%. A.flavus, Rhizopus and A.niger are observer storage fungi infestation rate were 40%, 28%, 25% respectively

Jute bag six months seeds had germination of 92%, nine months had 77% and twelve months was 47.5%. A.flavus, Rhizopus and A.niger are observer storage fungi infestation rate were 40%, 28%, 25% respectively

Sand method

In this method conducted to consider germination percentage only for all above samples.

Kanaja six months seeds had germination of 80%, nine months had 68% and twelve months was 45%.

Panatha six months seeds had germination of 82%, nine months had 70% and twelve months was 43%.

Jute bag six months seeds had germination of 73%, nine months had 60% and twelve months was 35%.

Storage fungi

Germinated seed sample from SB method was observed to calculate percentage of storage fungi infestation. As shown in Table 3 fungi found grown are *Aspegillus flavus*, Rhizopus and *Aspegillus Niger*. In ungerminated seeds 98% of seeds were infected by these fungus. Minimal of 7-8% infestation observed in six months sample of all three storage method. Maximum growth of 52.5% recoded in 12th month sample collected from Jute bag, meanwhile Kanaja and Panatha sample had affected between 36-37%. Seed damage was dominated by *Aspegillus flavus* (5.9% -mean value) to Rhizopus (5.4%) and *Aspegillus Niger* (2.2%)

Conclusion

It was observed that the farmer and storage holders are preferred to use conventional storage structure. Storage structures mentioned are very much maintenance free for years, minimum coast to repair it can be done by their own. Hengsadeekul and Nimityongskul 2004 [6] recommends cylindrical structure for its integrity an load bearing capacity here one we found Kanaja, depending on these structures was high.

Kanaja because of its cylindrical shaped structure was known for its integrity an load bearing capacity, which was also observerd by Hengsadeekul and Nimityongskul 2004 [6]. In all the three structures more care is need to control moisture entry, it had to be consider because Joseph Rickman And Eugene Aquino noted that in open storage system after 12-months of storage moisture level was fluctuated over 2-3% which lead to more fungal activity. It result in the rejection of the stored product for human consumption and cattle feed due to loss in quality. Formers should be aware of these things, but we noted that till 3-4 months period it can be claim that these storage structures are very much safer for paddy. Our result also showed seeds viability up to70% even after 7-9 months of storage period, this percentage is good to consider for consumption.

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