



Assessment of Purdue Improved Crop Storage Bags for Hermetic Storage Technology on Groundnut Pods

Jyothi I¹, K Raghavendra Chowdary² and G S Panduranga³

Krishi Vigyan Kendra, Kalikiri,
Acharya N G Ranga Agriculture University, Lam, Guntur,
Andhra Pradesh-522 034

ABSTRACT

Groundnut seed has the highest quality deterioration due to indigenous techniques and damage due to Bruchid infestation and mold growth. Purdue Improved Crop Storage (PICS) bags (T1) were introduced for hermetic storage of groundnut pods against traditional methods using gunny bags (T2). PICS storage bags were consisting of 80 micron thick high density polyethylene in two inner layers and surrounded by a third layer of woven nylon bag for strength. For the assessment of PICS hermetic storage bags to reduce the pest incidence, Groundnut varieties (Dharani and Kadiri 6) were selected and stored for 6 months period. T1 consisted of Groundnut varieties with good germination percent during the storage study. T2 consisted of Groundnut varieties with a loss in germination per cent of 20 and 26 under the indigenous method of using gunny bags whereas in PICS(T1) negligible loss of 2 and 4% were recorded during 180 days. Grain weight of samples stored in PICS bags (T1) was restored from the beginning to end of the study of 6 months and maintained 'A' grade quality up to the 5th months where in T2, the loss of grain weight was higher and the quality of grain was reached to 'D' grade at the end of the study. Thus, the efficacy of triple-layer PICS bags over gunny bags was protecting seed viability, seed weight and quality content while safeguarding the groundnuts from bruchids and retarding toxic aggregation.

Key Words: Aflatoxin, PICS Bags, Germination, Groundnut, Post-harvest technology.

INTRODUCTION

Storage loss of many kinds of cereal, pulses and oilseeds in developing countries is a major problem at the small and marginal farmer level. Post-harvest losses are a significant concern, insects and pest incidence is the major cause of dry matter loss; the majority of farmers use indigenous methods and application of insecticides to handle and store the grains after harvesting. Storage of the grains in woven gunny bags is inexpensive and need not require any special techniques to use. Most of the farmers are cultivating DHARANI (TCGS-1043(2013) is drought tolerant, water use efficient, tolerant to stem and dry root rots, and yield 16-26 q/ha during *khari*f-rainfed, 37-43q/ha during *rabi*. KADIRI-6 which is tolerant to leaf spots, duration of 105 -110 d and yields 18-24 q/ha. But the farmers are facing problems with the storage of pods after harvesting. Most of the farmers are selling the product immediately to the market without storing

the product for the next crop season of sowing, due to its contamination with aflatoxin which occurs more during post-harvest. At farmer practice for long-term storage, the containers are sealed with mud after the addition of ashes, ground pepper, dried neem leaves or other local herbs to control storage pests. The summer crop of groundnut is harvested from May to June. When this product is stored, the relative humidity increases up to 80 to 90% with the onset of monsoon in June to July. Consequently, the pod moisture also increases to 10 to 15%. Pod moisture percent over 10% will affect seed viability and quality. Reduction in post-harvest losses is one of the keys to improving the economy of the Nation. Moreover, post-harvest losses is vital for increasing food availability without the need for additional resources (Kimatu *et al*, 2012). The Introduction of PICS triple-layer hermetic storage bags is sustainable, cost-effective and user-friendly for the storage of cereals, pulses and oilseeds, to reduce pest

Corresponding Author's Email: Email: isukajothi@angrau.ac.in

1 Subject Matter Specialist, Home Science, KVK, Kalikiri.

2 Scientist (Extension) Regional Agricultural Research Station, Nandyal, (Acharya N G Ranga Agricultural University)

3. Programme Co-ordinator, KVK, Kalikiri

incidence, restoration of grain weight, and quality during storage. The PICS bags usage in grain storage enhances an opportunity to improve food security through the lean season when supply is low; Increases the incomes of millions of small and marginal farmers by providing the flexibility to store grain until to get good supporting prices and improves health by alleviating the impact of aflatoxin while restricting the insecticide use. The present study on Assessment of PICS Hermetic storage bags to reduce pest incidence was aimed to reduce the drudgery of farm women for repeated cleaning of produce and changing bags, evaluation of the performance of seed storage bags through germination, grain weight, and quality. Almeida *et al* (2017) while working on chemical changes in bean grains during storage in controlled conditions concluded that the storage conditions and storage time influenced the quality and nutritive content of pinto group of beans.

MATERIALS AND METHODS

PICS bags were originally developed for cowpeas but were later shown to be effective against pests of several other stored crops including maize, beans, sorghum, pigeon pea, peanuts, and rice (Baributsa *et al*, 2015). PICS storage bags were consisting of 80 micron thick high density polyethylene in two inner layers and surrounded by a third layer of woven nylon bag for strength. These bags are produced in 10, 25, 50 and 100 kg capacity sizes (Sudini *et al*, 2014). 10 kg capacity of Triple-layer hermetic PICS airtight bags were obtained from an authorized dealer from Telangana state served as sample bags and the non-airtight jute bags were procured from the local market and loaded with 10 kg of groundnut seed in both bags. These jute bags served as controls for comparison with triple-layer bags. A total number of 15 locations (15 farm families) in Guttapalem, Yallampalli, and Balamvari Palli villages were selected for the study.

Groundnut varieties DHARANI (TCGS1043(2013) and KADIRI 6 (K6 2005) were

stored in PICS triple layer hermetic bags for assessing the germination percentage, grain weight and quality for 6 months of storage. Groundnut is the major crop in these villages which are adopted by KVK, Kalikiri. Analysis of Groundnut during storage period was done for germination percentage, 1000 seed count and weigh method, visual analysis and organoleptic analysis.

Organoleptic analysis

Sensory or Organoleptic evaluation is an important task to analyze groundnut due to its aflatoxin accumulation and its effect on palatability. Stored grains were arranged for sensory evaluation by using 9 points hedonic scale with the scores on a 9-point hedonic scale, which has 9- Like extremely, 8- Like very much, 7- Like moderately, 6- Like slightly, 5- Neither like nor dislike, 4- Dislikeslightly, 3- Dislike moderately, 2- Dislike very much, 1- Dislike. Using the scale Appearance, Taste, Texture, Colour and Overall acceptability were analyzed by attained panel.

RESULTS AND DISCUSSION

The germination percentage was same in T1 and T2 in two varieties of groundnut Dharani and K6. The data depict the post-test germination of mean values from the sample of T1 (PICS bags) which show 2% reduction in germination percentage in Dharani and 4% in K6 were recorded respectively. Whereas T2 (Gunny bags) showed a 20% of the loss in germination percentage from the 1st month to the 6th month of the storage period was recorded in Dharani and 26% in K6. The seed weight was observed that 1.1g loss in Dharani and 1.2g per 100 grams of seed in K6 in observed in T1, and 7.1g and 7.2g per 100 grams were recorded mean weight loss in T2. According to visual observation of seeds from T1 sample of Dharani and K6 reached B grade which shows that 20% and T2 sample reached the D grade i.e., about 85% seeds were damaged in gunny bags.

Assessment of Purdue Improved Crop Storage Bags for Hermetic Storage Technology

Table1. Initial readings of germination, seed weight, and visual damage of Groundnut.

Germination percentage of seed (Variety)	T1 (PICS Storage Bags) Mean	T2 (Gunny Bags) Mean
Pre-test for Initial sample (1st month)		
Dharani	95	95
K6	95	95
Seed weight		
Dharani	43.09g	42.08g
K6	41.51g	41.58g
Visual damage		
Dharani	A	A
K6	A	A

Table2: Post-test readings of germination, seed weight and visual damage of groundnut

Post-test	2 nd month		3 rd month		4 th month		5 th month		6 th month	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Germination %										
Dharani	95	89	94	86	94	87	94	82	93	75
K6	95	90	95	88	94	87	93	79	91	69
Seed weight per 100 g										
Dharani	42.5	41.3	42.4	39.8	42.1	37.1	41.4	35.4	41.4	34.2
K6	42.8	40.3	42.7	38.7	42.5	36.2	41.9	34.5	41.6	33.1
Visual damage										
Dharani	A	A	A	B	A	C	A	D	B	D
K6	A	A	A	B	A	C	A	D	B	D

Williams *et al* (2017) noticed that overall, germination rates for maize stored in triple bags were almost equal to rates observed in non-infested controls. Maize germination rates ranged between 70 and 95% across eight month study period. After 8 months, germination rates for maize stored in the infested woven bags were statistically lower than rates observed in non-infested woven bags (9% lower) and all triple bags (30% lower). He indicated that the technology may as well be good in nutrient preservation. This is because it was shown that relative humidity in PICS remains constant during the storage of cowpeas, while oxygen concentrations reduced with storage time compared to poly propylene bags, indicating that PICS could retain quality of grains under storage.

Antoine Waongo *et al* (2019) noticed that grain weight loss and damage caused by the insects in

the Poly Propylene bags were significantly higher compared to those stored in PICS bags. Germination rates of sorghum grains stored in Poly Propylene bags decreased significantly while no changes were observed in grains stored in PICS bags when compared to the initial germination. PICS bags preserved the quality and viability of stored sorghum grains and protected it from key insect pests. The PICS technology is effective for long-term sorghum storage but the potential resurgence of insects in low-oxygen environment calls for further research. PICS are superior to PPB bags in nutrient and quality retention of common beans during storage. Beans in PICS bags had optimal starch and protein digestibility and tannin content on day 225 of storage. Nutrient retention in beans was high at lower storage moisture and duration in PICS (Micah Rambeka Momanyi *et al*, 2022).

Vanitha *et al* (2021) observed that there was no decrease in seed moisture content at 2, 4 and 6 months respectively and germination percent in triple-layer PICS bag at 2, 4 and 6 months storage was highest among all bag types. Test weight (g), protein content (%) and carbohydrate content (%) at 2, 4 and 6 m storage respectively were higher in triple layer PICS bag. The mean fat content recorded was highest in jute bag (1.25%) and lowest in triple layer PICS bag

(0.63%). It was concluded that the triple layer PICS bags hermetic technology was efficient in managing maintaining same level of moisture content percent, germination percent and test weight compared to other bags over 3 different periods of storage. The triple layer PICS bags were also highly useful for retaining carbohydrate percent and protein percent at almost the same levels compared to initial values.

Table1. Initial readings of germination, seed weight, and visual damage of Groundnut.

Germination percentage of seed (Variety)	T1 (PICS Storage Bags) Mean	T2 (Gunny Bags) Mean
Pre-test for Initial sample (1stmonth)		
Dharani	95	95
K6	95	95
Seed weight		
Dharani	43.09g	42.08g
K6	41.51g	41.58g
Visual damage		
Dharani	A	A
K6	A	A

Table2: Post-test readings of germination, seed weight and visual damage of groundnut

Post-test	2 nd month		3 rd month		4 th month		5 th month		6 th month	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Dharani	95	89	94	86	94	87	94	82	93	75
K6	95	90	95	88	94	87	93	79	91	69
Seed weight per 100 g										
Dharani	42.5	41.3	42.4	39.8	42.1	37.1	41.4	35.4	41.4	34.2
K6	42.8	40.3	42.7	38.7	42.5	36.2	41.9	34.5	41.6	33.1
Visual damage										
Dharani	A	A	A	B	A	C	A	D	B	D
K6	A	A	A	B	A	C	A	D	B	D

Williams *et al* (2017) noticed that overall, germination rates for maize stored in triple bags were almost equal to rates observed in non-infested controls. Maize germination rates ranged between 70 and 95% across eight month study period. After 8 months, germination rates for maize stored in the infested woven bags were statistically lower than rates observed in non-infested woven bags (9% lower) and all triple

bags (30% lower). He indicated that the technology may as well be good in nutrient preservation. This is because it was shown that relative humidity in PICS remains constant during the storage of cowpeas, while oxygen concentrations reduced with storage time compared to poly propylene bags, indicating that PICS could retain quality of grains under storage.

Assessment of Purdue Improved Crop Storage Bags for Hermetic Storage Technology

Antoine Waongoa *et al* (2019) noticed that grain weight loss and damage caused by the insects in the Poly Propylene bags were significantly higher compared to those stored in PICS bags. Germination rates of sorghum grains stored in Poly Propylene bags decreased significantly while no changes were observed in grains stored in PICS bags when compared to the initial germination. . PICS bags preserved the quality and viability of stored sorghum grains and protected it from key insect pests. The PICS technology is effective for long-term sorghum storage but the potential resurgence of insects in low-oxygen environment calls for further research. PICS are superior to PPB bags in nutrient and quality retention of common beans during storage. Beans in PICS bags had optimal starch and protein digestibility and tannin content on day 225 of storage. Nutrient retention in beans was high at lower storage moisture and duration

in PICS (Micah Rambeka Momanyi *et al*, 2022). Vanitha *et al* (2021) observed that there was no decrease in seed moisture content at 2, 4 and 6 months respectively and germination percent in triple-layer PICS bag at 2, 4 and 6 months storage was highest among all bag types. Test weight (g), protein content (%) and carbohydrate content (%) at 2, 4 and 6 m storage respectively were higher in triple layer PICS bag. The mean fat content recorded was highest in jute bag (1.25%) and lowest in triple layer PICS bag (0.63%). It was concluded that the triple layer PICS bags hermetic technology was efficient in managing maintaining same level of moisture content percent, germination percent and test weight compared to other bags over 3 different periods of storage. The triple layer PICS bags were also highly useful for retaining carbohydrate percent and protein percent at almost the same levels compared to initial values.

Table3. Pre and Post-test sensory evaluation scores of groundnut varieties.

Sensory attribute	Ground Nuts (Pre-test)		Dharani (post -test)						K6 (Post -test)					
	Dharani	K6	60days		120days		180days		60days		120days		180days	
			T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Appearance	9.0	9.0	9.0	7.7	8.0	7.1	8.0	5.2	9.0	7.4	8.0	6.9	8.0	5.1
Taste	9.0	9.0	8.2	7.9	8.1	6.8	7.0	5.1	8.2	7.5	7.5	6.1	7.0	4.9
Texture	9.0	9.0	8.6	7.3	8.1	6.4	7.1	6.1	8.1	7.2	7.9	6.2	7.1	5.1
Colour	9.0	9.0	8.8	6.8	7.9	5.3	7.1	4.3	8.9	6.1	7.9	5.1	7.2	4.9
Flavor	9.0	9.0	8.4	7.9	7.9	6.2	7.1	5.2	8.3	7.2	7.5	6.1	6.9	4.8
Overall acceptance	9.0	9.0	8.2	7.1	7.5	6.2	7.2	6.1	8.7	7.0	7.5	6.1	7.1	5.8

Sensory evaluation was conducted in 3 villages by 60 farmers and staff of KVK at 60 days intervals. A storage period of 180 days showed significant results on the palatability of Groundnut. T1 and T2 both showed declined mean scores from the initial to the end of the study. In samples of T1, Dharani and K6 appearance scored like extremely at 60 days and neither like nor dislike at 180 days. Taste and texture are important factors in sensory evaluation. According scores of T1 in both varieties showed like very much at 60 days and like moderately at 180 days. Colour and flavor improve the appetite of individuals and it plays an important role in recipe preparation. Both color and

flavor of groundnut scored from like very much to like slightly due to its aflatoxin content. Overall acceptance of groundnut from PICS bags showed positive results during the storage period i.e., from like very much to like moderately. Whereas in T2 all parameters showed declined mean scores from like moderately at 60 days and dislike slightly at 180 days.

CONCLUSION

The present study revealed that PICS hermetic bags provide farmers with a safe and convenient method to preserve their agricultural commodities. Applications of hermetic storage systems expanded

throughout the Asian countries at the farmer's level. In India food is distributed through Public Distribution System to every village in collaboration with the Food Corporation of India, it needs proper storage conditions and transport. If the Food Corporation of India and Public Distribution System maintain these hermetic storage systems post-harvest losses, as well as storage loss can be reduced effectively.

REFERENCES

- Antoine Waongoa, Fousseni Traorea, Malick N Bab, Clementine Dabire-Binsoa (2019). Effects of PICS bags on insect pests of sorghum during long-term storage in Burkina Faso. *J Stored Products Res* **83**:261-266.
- Baributsal D, Baoua T, Abdoulaye and Murdock L (2015). The modified count and weight method: An improve procedure for assessing weight loss in stored maize cobs. *J Stored Products Res* **34**(4):277-285.
- De Almeida A J B, Coelho S R M, Schoeninger Vand Christ D(2017). Chemical changes in bean grains during storage in controlled conditions. *J Brazilian Assoc Agri Engineer* **37**(3), 529–540.
- Deivasigamani S and Swaminathan C (2018). Evaluation of Seed Test Weight on Major Field Crops. *Int J Res Stud Agri Sci* **4**(1):8-1.
- Kimatu J N, Mc Conchie R, Xie X and Nguluu, S N (2012). The significant role of post-harvest management in farm management, aflatoxin mitigation and food security in Sub-Saharan Africa. *Greener J Agri Sci* **2**:279-288.
- Micah Rambeka Momanyi, John Masani Nduko and Mary Omwamba(2022). Effect of hermetic Purdue Improved Crop Storage (PICS) bag on chemical and anti-nutritional properties of common Bean (*Phaseolus vulgaris* L.) varieties during storage. *Current Res Food Sci* **5**:107-116.
- Sudini H, Ranga Rao G V, Gowda C L L, Chandrika R, Margam V, Rathore A and Murdock L L (2015). Purdue Improved Crop Storage (PICS) bags for safe storage of groundnuts. *J Stored Products Res* **64**:133-138.
- Vanitha K, Saidaiah P, Harikishan S, Geetha A and Reddy K (2021) Effect of hermetic storage on seed quality maintenance of *Dolichos* bean. *Legume Res – An Int J* **44**(7):803-810.
- Williams S B, Murdock L L and Baributsa D (2017). Storage of Maize in Purdue Improved Crop Storage (PICS) Bags. *PLoS ONE* **12**(1): e0168624.
- Yeole N R and Swain K C (2018). Hermetic storage technology for small holder farmers in India. *Aayushi Int Interdisciplinary Res J* **25**: 91-95

Received on 10/1/2024 Accepted on 24/2/2024