International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(5): 680-684

Received: 09-07-2020
Accepted: 10-08-2020

Basavanjali
Department of Agricultural Entomology, College of Agriculture, Raichur, Karnataka, India

Sushila Nadagouda
Department of Agricultural Entomology, College of Agriculture, Raichur, Karnataka, India

A Prabhuraj
Department of Agricultural Entomology, College of Agriculture, Raichur, Karnataka, India

Basavegowda
Seed Unit, University of Agricultural Sciences, Raichur, Karnataka, India

Shivaleela
Department of Agricultural Entomology, College of Agriculture, Raichur, Karnataka, India

Corresponding Author:
Basavanjali
Department of Agricultural Entomology, College of Agriculture, Raichur, Karnataka, India

Evaluation of different packaging materials for management of angoumois grain moth on paddy

Basavanjali, Sushila Nadagouda, A Prabhuraj, Basavegowda and Shivaleela

DOI: https://doi.org/10.22271/chemi.2020.v8.i5j.10379

Abstract
Evaluation of different packaging materials against angoumois grain moth on paddy was carried out in the Seed unit, UAS, Raichur during 2018-19 with ambient conditions (20.3 ± 2.3 ºC temperature and 50.5 ± 6.3% RH). The seeds packed in PICS bag recorded significantly zero per cent seed damage, lowest adult emergence of angoumois grain moth (1 adults /100 g of seeds), highest germination (89.00%) maintained good seed health throughout the storage period which was on par with grain pro bag compared to gunny bag. The PICS bag recorded highest net returns (1372.50 Rs) compared to gunny bag (1130.50 Rs).

Keywords: PICS bag, grain pro bag, paddy and angoumois grain moth

Introduction
Rice (*Oryza sativa* L.) is an important cereal, staple food and plays an important role in the economic stability of the country. It supplies 50 to 80 per cent calories of energy and hence considered as the "global grain" (Das *et al*., 2018) [4]. India has the world's largest area devoted to rice cultivation, and it is the second largest producer of rice after China. India has the largest area under rice of 43.5 m ha (IRRI STAT, 2018). The production is about 110 million tonnes with productivity of 3.76 t/ha, accounting 40 per cent of the country's total food grain production (ICAR-NRRI Annual Report, 2017-18).

A huge amount of loss occurs during storage due to improper storage were prone to attack of storage insect (beetles and moths) leads to deterioration of stored paddy. Among the moths, the Angoumois grain moth, *Sitotroga cerealella* (Olivier) is one of the principal causes of loss in storage (Hall, 1970) [5]. It is carried over from field to the storage through infested grains. It is cosmopolitan in distribution. Only larvae is able to damage the commodities by boring into the grains and feeds about 30-50 content contents of the grain which ultimately gives unpleasant smell and unhealthy appearance (Bushra *et al*., 2013) [3]. The emerging adults pushes the flap, forms the typical 'circular hole symptom'. The loss due to insect infestation in rice, range from 4.09 to 12.61 per cent (Shafique and Ahmed, 2003) [12]. Misuse or overuse of chemicals have serious repercussions, such as the development of resistance, pollution of the environment, effect on non target organisms and food poisoning (Musa *et al*., 2009).

Hermetic storage such as Purdue Improved Cowpea Storage (PICS), super grain bags, zero fly bag and others, are being promoted as cheap and effective ways to control storage insect pests in Asia (Quezada *et al.*, 2006) [11]. Protects the seeds from contamination and reduce excessive usage of chemical pesticides in storage for maintaining seed quality and lead to a reduction in the economic losses associated with infestation. Paddy seeds stored in packaging material will develop a modified atmosphere of low oxygen and high carbon dioxide content, created by respiration of living organisms such as insects and fungi.

Material and Methods
Freshly harvested paddy seeds of variety Gangavati sona were dried to safe moisture level (10%) and were packed in gunny bag (standard check), polylined gunny bag (V pro bag), HDPE bag with single layer polythene, PICS bag, grain pro bag and zerofly bag for management of angoumois grain moth was stored up to 10 months.

The seed samples were drawn at bimonthly intervals and estimated for seed quality attributes up to 10 months.

Seed damage (%)

Seeds were thoroughly mixed and one hundred seeds were randomly drawn from each treatment and replications, seeds with exit holes were considered as damaged seeds and expressed as per cent seed damage.

$$\text{Seed damage (\%)} = \frac{\text{Number of seeds damaged}}{\text{Total number of seeds in the sample}} \times 100$$

Number of live adult insects per 100 g seeds

Number of live adult insects emerged from 100 g sample seed of each replication of the treatment was counted.

Per cent seed germination

Seed germination was carried out on rolled paper towel test method (ISTA, 2013), which was conducted in four replication of 100 seeds each by following between paper method and the rolled towels were incubated in the walk in seed germination chamber maintained at 25 ± 2 °C temperature and 90 ± 5 per cent RH. The paper towels were opened on 14th day and numbers of germinated and ungerminated seeds were counted and per cent germination was calculated on the basis of following formula:

$$\text{Per cent germination} = \frac{\text{No. of Germinated seeds}}{\text{Total number of seeds taken for germination}} \times 100$$

Cost economics

Cost economics of different packaging materials was worked out by taking into account of cost of bags, cost of seeds and per cent yield loss by angoumois grain moth and net returns was calculated as follows.

$$\text{Net returns} = \text{Total cost} - \text{Loss in yield}$$

Result and Discussion

Seed damage

The PICS bag, grain pro bag, zerofly bag with single layer polythene and polylined gunny bag (V pro bag) proved to be effective and continued to be free from seed damage up to six months of storage. Among all six packaging material, PICS bag showed its superior performance by not recording any damage followed by grain pro bag, zerofly bag with single layer polythene proved significantly superior to other treatments and highest (34.17%) seed damage was observed with seeds packed in gunny bag at the end 10 months of storage period proving its ineffectiveness in protected from seed damage by angoumois grain moth.

The percentage of seed damage increased with the exposure periods after six, eight and ten months of storage it varied from 0.33 to 4.67 per cent in HDPE bag with single layer polythene, 5.68 to 34.17 per cent in gunny bag (standard check). This may be mainly due to the moisture impervious nature of the bags, in PICS bag triple layered protection helps in halting or minimizing the insect damage. First, the plastic lines greatly hinder the transmission of oxygen in and out of the seed stock. When oxygen levels fall rapidly in the bag it creates negative feedback loop on insect growth or habitat. The present findings are in accordance to Martin *et al.* (2015) [8] who reported that wheat grain stored in the PICS (Purdue Improved Crop Storage) bags had much lower levels of insect damage and therefore better protected from germination losses compared to conventional woven storage sacks. According to Baoua *et al*. (2013) [2] PICS and super grain bags suppress bruchid populations equally well.

Adult emergence

Among all packaging material, PICS bag (0.33 adults /100g of seeds) was significantly superior over all the packaging materials and the next best packaging material was grain pro bag (1 adults /100g of seeds) followed by zero fly bag with single layer polythene (1.67 adults /100g of seeds) which was on par with polylined gunny bag (V pro bag) (2 adults /100g of seeds) and the highest (40.67 adults /100g of seeds) population build up was recorded in gunny bag (standard check).

The Storage in PICS bags prevented survival of *S. cerealella*, by reducing the oxygen content in the atmosphere surrounding the grains inside the PICS bag, often to less than 3%, and the carbon dioxide content increases to a level where aerobic respiration is minimized also slows down the rate of feeding. The present findings are similar as suggested by Patel *et al*. (2018) [10] who reported that JBP, PPL, HDPEV, MCPV, ALPEV and PICS treatments were observed free from insect infestation in chickpea grain stored at the end of twelve months of storage period. The increase in insect population in the grain might due to higher moisture content and aeration which enhanced grain deterioration (Monira *et al.*, 2012) [9].

Seed germination

The germination of paddy seeds decreased with the advancement of storage period irrespective of storage containers. The highest seed germination (89.00%) was recorded with seeds packed in PICS bag which was on par with grain pro bag (88.67%) While, the lowest seed germination (68.33%) was recorded with seeds packed in gunny bag (standard check) at the end of storage period.

Among different packaging material, the moisture impervious containers like PICS bag, grain pro bag were found superior in maintaining seed germination for longer period than the pervious containers. The prolonged quality of seeds depends on thickness and impervious nature of these containers. The superiority of these packaging materials in maintaining seed germinability for longer period might be due to inverse relationship between seed moisture content and germination percentage. The present findings are in accordance with Vales *et al.* (2014) [13] who revealed that storing of dry pigeon pea in PICS bag recorded the seed germination of 88 per cent at the end of storage period. And also Patel *et al*. (2018) [10] reported that chickpea seeds stored in PICS bag recorded 87.33 per cent germination at the end of storage period.

Cost economics

The PICS bag proved to be superior by recording highest net returns of 1372.50 Rs followed by grain pro bag, zerofly bag with single layer polythene and polylined gunny bag which recorded 1363.60, 1301.50 and 1295.00 Rs, respectively. A lowest net return was recorded in gunny bag (1130.50 Rs). When additional savings over gunny bag was calculated PICS bag was found to be excellent by giving additional savings of Rs 157.00 followed by grain pro bag, zerofly bag with single layer polythene and polylined gunny bag which recorded 156.00, 154.00 and 152.60 Rs, respectively and additional savings over gunny bag in case of HDPE bag with single layer polythene was 146.25 Rs.

Table 1: Effect of packaging material on seed damage by angoumois grain moth on paddy

Treatments	Seed damage (%)					
	2 MAS	4 MAS	6 MAS	8 MAS	10 MAS	Mean
T_1: Gunny bag(standard check)	5.68 (13.79)^b	10.33 (18.75)^b	16.66 (24.09)^b	24.68 (28.85)^d	34.17 (34.55)^c	18.30
T_2: Polylined gunny bag (V pro bag)	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.67 (3.83)^b	1.33 (6.62)^{ab}	0.40
T_3: HDPE bag with single layer polythene	0.00 (0.57)^a	0.00 (0.57)^a	0.33 (1.91)^a	2.66 (9.36)^c	4.67 (12.46)^b	1.53
T_4: PICS bag	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.00
T_5 : Grain pro bags	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.33 (1.91)^a	0.06
T_6 : Zerofly bag with single layer polythene	0.00 (0.57)^a	0.00 (0.57)^a	0.00 (0.57)^a	0.33 (1.91)^a	0.67 (3.83)^a	0.20
S. Em ±	0.07	0.10	0.79	1.23	0.82	
CD @ 1%	0.31	0.43	3.42	5.33	3.52	

MAS- Months after storage.
Figures in parentheses are arcsine transformed values.
Figures in the column followed by same letters are not-significant at p=0.01 by DMRT

Table 2: Effect of packaging material on emergence of adults of *Sitotroga cerealella* on paddy

Treatments	No of live adults/100 g seeds					
	2 MAS	4 MAS	6 MAS	8 MAS	10 MAS	Mean
T_1: Gunny bag(standard check)	3.67 (2.02)^b	6.67 (1.34)^b	14.33 (3.85)^b	28.00 (5.33)^c	40.67 (6.41)^d	18.67
T_2: Polylined gunny bag (V pro bag)	0.00 (0.71)^a	0.00 (0.71)^a	0.00 (0.71)^a	1.67 (1.46)^b	2.00 (1.58)^b	0.73
T_3: HDPE bag with single layer polythene	0.00 (0.71)^a	0.00 (0.71)^a	0.67 (1.05)^a	3.00 (1.85)^{bc}	5.33 (2.41)^c	1.80
T_4: PICS bag	0.00 (0.71)^a	0.00 (0.71)^a	0.00 (0.71)^a	0.00 (0.71)^a	0.33 (0.88)^a	0.07
T_5: Grain pro bag	0.00 (0.71)^a	0.00 (0.71)^a	0.00 (0.71)^a	0.33 (0.88)^{ab}	1.00 (1.46)^{ab}	0.27
T_6: Zerofly bag with single layer polythene	0.00 (0.71)^a	0.00 (0.71)^a	0.00 (0.71)^a	0.67 (1.05)^{ab}	1.67 (1.22)^b	0.47
S. Em ±	0.09	0.12	0.09	0.12	0.09	
CD @ 1%	0.39	0.55	0.41	0.55	0.42	

MAS- months after storage
Figures in parentheses are $\sqrt{(x+0.5)}$ transformed values
Figures in the column followed by same letters are not-significant at p=0.01 by DMRT

Table 3: Effect of packaging material on seed germination of paddy by angoumois grain moth

Treatments	Seed germination (%)					
	2 MAS	4 MAS	6 MAS	8 MAS	10 MAS	Mean
T_1: Gunny bag (standard check)	94.33 (73.98)^b	91.00 (72.60)^b	84.33 (65.18)^c	77.67 (57.84)^e	68.33 (50.97)^c	83.13
T_2: Polylined gunny bag (V pro bag)	95.33 (77.54)^{ab}	94.00 (75.85)^{ab}	91.00 (70.78)^{ab}	89.00 (68.14)^c	86.67 (65.41)^{ab}	91.20
T_3: HDPE bag with single layer polythene	96.00 (78.46)^{ab}	93.67 (75.56)^{ab}	87.33 (69.57)^{bc}	82.00 (64.90)^d	80.67 (61.96)^b	87.93
T_4: PICS bag	97.33 (81.26)^a	96.00 (80.27)^a	94.33 (73.93)^a	92.33 (70.03)^a	89.00 (64.92)^a	93.80
T_5 : Grain pro bags	96.00 (78.46)^{ab}	95.00 (78.52)^a	93.67 (73.26)^{ab}	91.33 (68.32)^{ab}	88.67 (64.41)^a	92.93
T_6 : Zerofly bag with single layer polythene	97.00 (80.27)^a	94.67 (76.66)^{ab}	92.67 (71.31)^{ab}	89.67 (68.63)^{bc}	87.33 (63.92)^{ab}	92.26
S. Em ±	0.82	1.10	1.72	0.92	1.24	
CD @ 1%	3.56	4.73	7.44	3.95	5.35	

MAS- Months after storage.
Figures in parentheses are arcsine transformed values.
Figures in the column followed by same letters are not-significant at p=0.01 by DMRT

Table 4: Cost economics of different packaging materials against angoumois grain moth on paddy

Sl. No.	Treatment	Bag cost (Rs)	Cost of paddy seeds (Rs/ 50 kg)	Total cost (Rs)	Percent loss in yield	Loss in yield (Rs / 50 kg)	Additional savings over gunny bag (Rs)	Net returns (Rs)
1	Gunny bag (standard check)	35.00	1250	1285	12.62	157.50	-	1130.50
2	Polylined gunny bag (V pro bag)	50.00	1250	1300	0.39	4.90	152.60	1295.00
3	HDPE bag with single layer polythene	20.00	1250	1270	0.90	11.25	146.25	1258.75
4	PICS bag	123.00	1250	1373	0.04	0.50	157.00	1372.50
5	Grain pro bag + gunny bag	115.00	1250	1365	0.11	1.50	156.00	1363.60
6	Zero fly bag with single layer polythene	55.00	1250	1305	0.26	3.50	154.00	1301.50

Paddy = Rs 25 / kg

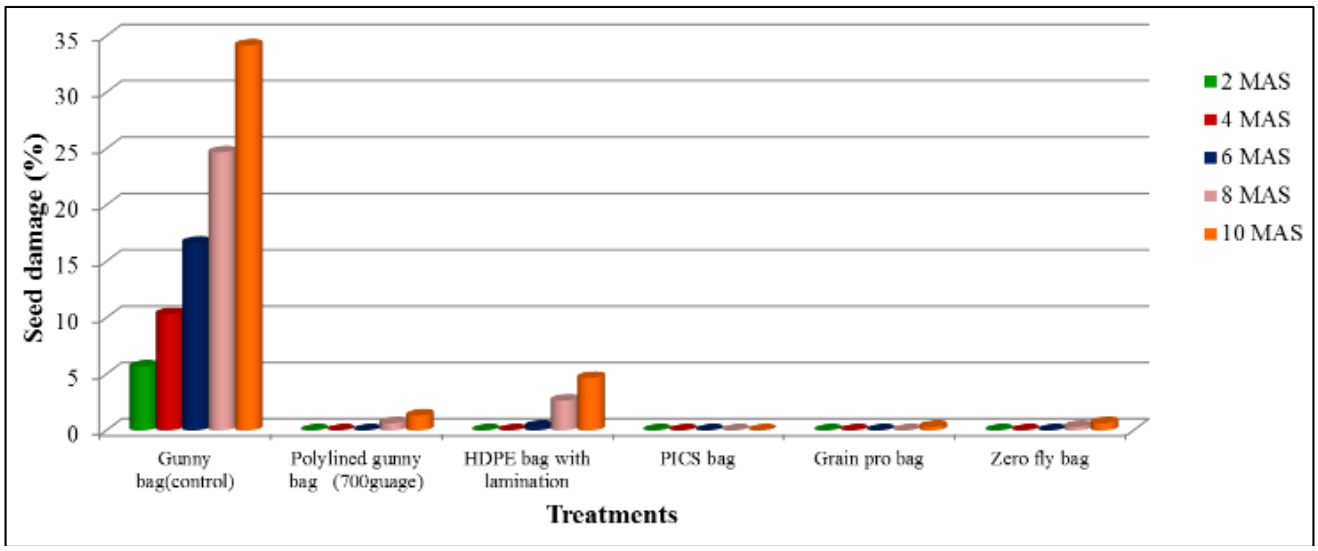

Fig 1: Effect of packing material on seed damage by Angoumois grain moth of paddy seeds during different months of storage

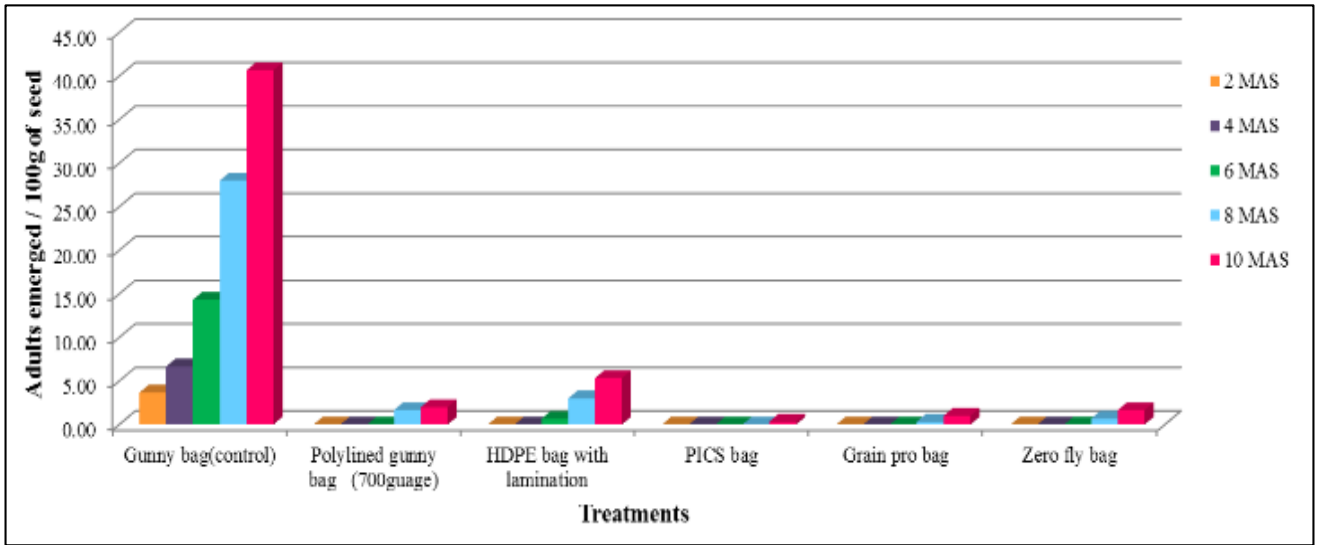

Fig 2: Effect of packaging material on emergence of adults of *S. cerealella* at different months of storage

Conclusion

The use of different packaging material is an effective alternative for controlling angoumois grain moth infesting the paddy seeds. Hence, it is evident that the PICS bag and grain pro bag were found to be ideal, eco-friendly and cost effective approach for the management of *S. cerealella* in stored paddy and maintained seed quality without any detrimental effect up to ten months of storage.

References

1. Annual report, 2017-18, ICAR-NRRI Annual Report, link: http://icar-nrri.in/annual-report/ Annual report, 2016-17.
2. Baoua IB, Amadou L, Lowenberg DJD, Murdock LL. Side by side comparison of grain pro and PICS bags for postharvest preservation of cowpea grain in Niger. J stored Prod. Res. 2013; 54: 13-16.
3. Bushra S, Aslam M, Aziz MA, Ahmed M. Grain damage, viability and weight loss in different barley cultivars due to *Sitotroga cerealella* (Oliv.) infestation. Archives of phytopathology and plant protection, 2013; 46(2):205-214.
4. Das A, Layek J, Ramkrushna GI, Patel DP, Choudhury BU, Krishnappa R *et al.* Modified system of rice intensification for higher crop and water productivity in Meghalaya, India: opportunities for improving

livelihoods for resource-poor farmers. Paddy and Water Environment. 2018; 16(1):23-34.
5. Hall DW. Handling and storage of food grains in tropical and subtropical areas (No. 90). Food & Agriculture Org., 1970; 90:16-22.
6. IRRI STAT, 2018. link: https://www.irri.org/world-ricestatistics.
7. ISTA., International rules of seed testing. Seed Sci. Tech. 2013; 27:25-30.
8. Martin D, Baribusta D, Huesing JE, Williams SB, Murdock LL. PICS bags protect wheat (*Triticum aestivvum* L.) grain, against rice weevil, *Sitophilus oryzae* (L.). J. Stored Prod. Res. 2015; 63:22-30.
9. Monira US, Amin MHA, Aktar MM, Mamun MAA. Effect of containers on seed quality of storage soybean seed. Bangladesh Res. Pub. J., 2012; 7(4):421-427.
10. Patel JV, Antala DK, Dalsaniya AK. Influence of Different Packaging Materials on the Seed Quality Parameters of Chickpea. Int J Curr. Microbiol. App. Sci., 2018; 7(12):2458-2467.
11. Quezada MY, Moreno J, Vazquez ME, Mendoza M, Albores MA, Martinez ME. Hermetic storagesystem preventing the proliferation of *Prostephanus truncatus* Horn. and storage fungi in maize with different moisture contents. Post-harvest Biol. & Technol. 2006; 39(3):321-326.
12. Shafique M, Ahmad M. Susceptibility of milled rice genotypes to Angoumois grain moth, *Sitotroga cerealella* Oliv. (Lepidoptera: Gelechiidae). SAARC Journal of Agriculture. 2003; 1:193-197.
13. Vales MI, Ranga Rao GV, Sudini H, Patil SB, Murdock, LL. Effective and economic storage of pigeon pea seed in triple layer plastic bags. J Stored Prod. Res. 2014; 58:29-38.