Andhra Pradesh J Agril. Sci. 5(1): 66-71, 2019

EVALUATION OF DIFFERENT BINS AND BAGS AS STORAGE STRUCTURES AGAINST *Caryedon serratus* (OLIVIER) IN GROUNDNUT

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Date of Receipt: 10.11.2017 Date of Acceptance: 5.6.2018

ABSTRACT

An investigation was carried out during 2015-16 to evaluate different bins and bags as storage structures for groundnut pods against infestation by *Caryedon serratus.* The data was recorded upto six months at 15 days interval. Oviposition preference, adult emergence and per cent pod damage by count observed was least in magic cover followed plastic bin and triple layered polythene bag. The per cent pod damage by weight recorded was lowest in plastic bin followed by magic cover and triple layered polythene bag. Whereas, per cent weight loss recorded was least in magic cover followed by triple layered polythene bag and plastic bin. All the biological parameters *viz.,* oviposition, adult emergence, per cent pod damage by count and weight and per cent weight loss due to *C. serratus* were noticed maximum in cloth bag and earthen pot

KEY WORDS: *Caryedon serratus*, storage bins and storage bags, oviposition, adult emergence, per cent pod damage, per cent weight loss.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a leguminous oilseed crop cultivated in the semi-arid and subtropical regions of the world. It is grown in nearly 100 countries in six continents between 40° N and S of the equator in nearly 24.6 m ha, with a production of 41.3 MT and productivity of 1676 kg ha^{-1} during 2016. China, India, Nigeria, USA and Myanmar are the leading groundnut producing countries in the world. Asia with 11.6 m ha (47.15%), and Africa with 11.7 Mha (47.56%), hold maximum global area under groundnut. Developing countries in Asia, Africa and South America account for over 97 per cent of world groundnut area and 95 per cent of total production. However, the productivity of Asia (2217 kg ha^{-1}) and Africa (929 kg ha^{-1}) is very poor as compared to America (3632 kg ha^{-1}) (FAO STAT, 2015). In India, 70 per cent of the groundnut area and 75 per cent of the production are concentrated in Gujarat, Andhra Pradesh, Tamilnadu and Karnataka. In Andhra Pradesh, it is grown in 6.82 lakh ha during *kharif* with a production and an average yield of 5.98 lakh tonnes and 876 kg per ha, respectively. During *rabi* it is grown in 0.93 lakh ha. with a production of 2.03 lakh tonnes, with an average yield of 2190 kg per ha. Anantapur district in the state with 0.74 million ha of area under cultivation is the largest producer of groundnut.

Out of 100 species of insect pests attacking the stored groundnut, pod bruchid *Caryedon serratus* (Olivier) is a major cosmopolitan pest of economic importance (Singh and Ansari, 1991). The groundnut bruchid, *C. serratus* is the primary storage pest of unshelled groundnuts in many parts of Asia and throughout West and Central Africa (Delobel, 1995). In India, storage losses of groundnut range between 10 per cent and 15 per cent (Ranga Rao *et al*., 2010). Bruchids can greatly reduce germinability of seeds and the qualities of oil produced from them and are considered to be economically important pests of stored groundnut in India. (Wightman *et al.,* 1987). At farmers level, groundnuts are often stored for 6 to 9 months from harvest to next sowing season. In view to find out cost effective suitable storage structures for storing groundnut pods at farmer's level, an experiment

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bins and bags against groundnut bruchid, *C. serratus* infestation.

MATERIALS AND METHODS

MAINTENANCE OF STOCK CULTURE OF *CARYEDON* SPP.

The infested pods containing the pupae collected from SRTC, Hyderabad were transferred to clean plastic jars (18×14×12 cm). The jars were covered with rearing cloth and kept in the laboratory until the adults emerged. Emerging adults were transferred to again clean plastic jars (12×10×6 cm) and supplied with groundnut pods for oviposition. Before offering to the adults, the groundnut pods were kept in hot air oven at 70° C for 5 minutes to get rid of any unwanted insect infestations, with regular monitoring, the culture of *Caryedon* spp. was maintained for different experiments.

The adults emerged from stock culture were used in further experiments. Male and female adult bruchids were identified (Davey, 1958) by observing the last visible segment of the abdomen. In male, the pygidium or sixth visible tergite projects downwards and observed hidden by the elytra. The fifth visible sternite was deeply incurved and seventh tergite projects between fifth sternite and the pygidium. In female, the pygidium was observed in dorsal view projecting beyond the elytra. The fifth sternite was fully extended and the ventral surface was more or less flat. The seventh tergite was not seen in the female.

TESTING OF DIFFERENT STORAGE STRUCTURES AGAINST GROUNDNUT BRUCHID, *C. SERRATUS* INFESTATION (BINS AND BAGS).

Groundnut pods of variety TAG 24 were procured from the local market and were shade dried to bring down the moisture content to 7.0 per cent.

Five kilogram capacity of earthen pots, aluminium bins, steel bins, plastic bins were purchased from local market and wooden boxes (5 kg capacity) were specially prepared. Single layered polythene bags and double layered polythene bags were also purchased from local market. The triple layer plastic bags were manufactured locally by order at M/s Sri Mahalakshmi Woven Sacks Pvt. Ltd., Hyderabad as per the technical specifications of the Purdue Improved Crop Storage (PICS) bags developed by Purdue University, USA. Triple layer plastic bags consists of three layers; inner and middle layers were made up of 80 micron thickness high density polyethylene (HDPE) material and do not allow diffusion of gases (Oxygen and Carbon dioxide) while the outermost layer is a normal woven sac made up of polypropylene and provides strength for handling.

Gunny bags and polythene lined gunny bags were purchased from local market and magic cover was purchased from Coromandel International Ltd. in Kurnool.

Twelve (12) different bins and bags were evaluated by considering as treatments. Each treatment was replicated thrice with 5 kg of pods. Ten pairs male and female adults were released in to all bins and bags. After 15 days, the adults were removed.

These bins and bags with eggs were stored at ambient conditions of 31.8^{0}C to 42.3^{0}C and 51.4 to 83.3 % RH. Destructive sampling was done by taking 100 gm in each replication at 15 days interval to record the infestation level in terms of number of eggs laid, number of adults emerged (per replication), per cent pod damage by count and weight, per cent weight loss as described in the above section and was continued till 180 days.

TREATMENTS

T_1	:	Earthen pot
T_2	:	Aluminum bin
T_3	:	Steel bin
T_4	:	Plastic bin
T_5	:	Wooden box
T_6	:	Single layered polythene bag
T_7	:	Double layered polythene bag
T_8	:	Triple layered polythene bag
T_9	:	Gunny bag
T_{10}	:	Polythene lined gunny bag
T_{11}	:	Cloth bag
T_{12}	:	Magic cover

OVIPOSITION AND ADULT EMERGENCE

At every 15 days, from 100 g representative sample, the number of eggs laid on selected pods and adults emerging from different treatments were counted. Adults were removed at every time. This process was continued up to 180 days. The data on oviposition and adult emergence was pooled and subjected to statistical analysis

POD IMAGE

At every 15 days, from selected 100 gm pods, from each treatment, the data was collected on number of damaged pods and healthy pods. Weights of both damaged and healthy pods were also recorded. The per cent damage of pods by count and weight were calculated with the help of following formulae

$$\text{Per cent pod damage (by count)} = \frac{\text{Number of bored pods}}{\text{Total number of pods}} \times 100$$

$$\text{Per cent pod damage (by weight)} = \frac{\text{Weight of bored pods}}{\text{Total weight of pods}} \times 100$$

WEIGHT LOSS

Weight loss was calculated by deducting the final weight of sample at the period of termination of the experiment *i.e.* at 180 days after the initiation of the experiment and from initial weight taken during initiation of the experiment and the data was converted to the percentage.

$$\text{Weight loss} = \frac{W1 - W2}{W1} \times 100$$

W1 = initial weight of pods

W2 = final weight of pods

RESULTS AND DISCUSSION

EFFECT OF BINS AND BAGS WITH RESPECT TO OVIPOSITION, ADULT EMERGENCE, PODS PER CENT POD DAMAGE (COUNT & WEIGHT) AND PER CENT WEIGHT LOSS OF *C SERRATUS IN* STORED GROUNDNUT UP TO 6 MONTHS

Six months after storage of groundnut pods in different bins and bags results presented in the Table 1 shows that, the mean number of eggs were lowest in magic cover (35.21), plastic bin (40.06) and triple layered polythene bag (55.08), where they were on par with each other, which is in other storage structures like gunny bag (61.71), steel bin (64.97), and aluminum bin (62.71), where the mean number of eggs were comparatively higher. In storage structures *viz.,* polythene lined gunny bag (77.53), wooden box (102.15) and double layered polythene bag (115.03) the mean number of eggs were lower than single layered polythene bag (164.78), earthen pot (176.28) and cloth bag (235.19) which had maximum mean number of *C. serratus* eggs. Where the latter two storage structures were on par with each other.

The data with respect to mean number of *C. serratus* adults at 6 months after storage revealed that minimum number of adults were emerged from three storage structures namely magic cover (19.56), plastic bin (21.56) and triple layered polythene bag (26.84) where they were on par with each other. The next best storage structures with respect to adult emergence were steel bin (29.08) and aluminium bin (30.56) where these two storage structures were non-significant with respect to adult emergence. In other storage structures like gunny bag (38.89), wooden box (45.81), polythene lined gunny bag (48.28), double layered polythene bag (57.30) , single layered polythene bag (94.96), and earthen pot (98.62) the number of adults emerged were significantly higher than the above structures. When only cloth bag was used as storage structure for storing of groundnut pod maximum number (135.25) of adults emerged after six months of storage.

The results on per cent pod damage by count after six months of groundnut pod storage showed that bags like magic cover (31.92), triple layered polythene bag

count and non-significant to each other but significantly different from other treatments. The other storage structures *viz.*, gunny bags (45.34), double layered polythene bag (48.29), steel bin (48.78), aluminum bin (49.56), polythene lined gunny bag (50.84) and wooden box (53.59) had recorded higher per cent pod damage but were statistically on par with each other. Though maximum per cent pod damage by count was noticed in earthen pot (60.71) and cloth bag (54.70) with respect to damage they were not significant to each other.

The per cent pod damage by weight showed that at six months after, lowest pod damage had been noticed in magic cover (46.98) followed by triple layered polythene bag (47.19) followed by gunny bag (49.99), polythene lined gunny bag (53.19) and double layered polythene bag (55.62) though statistically non significant.

Whereas, bin structures like plastic bin (43.46), steel bin (55.53), aluminum bin (56.58) and wooden box (57.55) showed less pod damage than earthen pot (65.75) and cloth bag (71.25) where the latter bin storage structures recorded maximum pod damage by weight at six months after storage.

The statistical analysis of results at six months after storage with respect to per cent weight loss parameter showed that magic cover had lowest per cent weight loss (37.80), followed by triple layered polythene bag (38.31) and plastic bin (41.32) where the pod weight loss was non-significant. In gunny bag (42.53), steel bin (49.38), polythene lined gunny bag (49.59), double layered polythene bag (50.32) and aluminium bin (54.33) comparatively lower weight loss were recorded. The per cent weight loss showed not much variation in earthen pot (62.29), single layered polythene bag (63.84) and wooden box (64.61). In cloth bag, highest per cent weight loss *i.e.*, 77.12 per cent was recorded.

The superiority of magic cover, triple layered polythene bad and plastic bin of oviposition, adult emergence, per cent pod damage by count (count and weight) and weight loss may be due to unfavorable structural composition (including chemical composition) that restricts the growth and multiplication of the pest and also external surfaces are not suitable for oviposition by the adults available in the treatmental area and for neonate grubs to enter in to the containers. The microclimate inside these synthetic made containers may be partially adverse for the test insect. As aluminium and steel bins are made with hard metals, the surface cannot be the comfortable place for ovipositing by the external bruchids. During the experimental period, after initiation of the infestation also, these metal bins may not be the highly suitable containers for population buildup when compared to remaining storage structures.

Polythene lined gunny bag was proved better than sole gunny bag because gunny bag without lining favours the pest with good number of spaces for the grubs to enter after hatching. Gunny bag with spaces on the surface also created good aerobic condition for the grubs present inside the bags Comparatively lower infestation in double layered polythene bag might also be due to more thickness of the bag than single layered polythene bag. Earthen pot and cloth bag were proved more suitable containers for the egg laying by the external adults on their smooth surfaces and later for entry of grubs inside and for further multiplication. As they maintain good moisture and optimum temperature conditions, the pest inoculum perpetuates comfortably.

Najitha Ummer (2012) working with groundnut bruchid reported that super bags and nylon bags recorded 15.72 and 31.11 per cent weight loss at 150 DAT. Both types of bags were significantly different to each other and also from other types of storage bags. Polythene lined thin netted jute bags, polythene lined cloth bags, thick netted double layered bags and single layered bags, thin netted double layered bags, single layered bags and cloth bags recorded 46, 48.34, 51.03, 51.7, 51.85, 52.65 and 53 per cent weight loss at 150 DAT and were on par to each other. Super bags recorded weight loss of 22.75 per cent and significantly different from all types of storage bags at 180 DAT. The remaining bags were on par to each other by recording 47.94, 49.82, 52.94, 53.12, 53.53, 57.38, 57.75 and 59.03 per cent weight loss in nylon bags, polythene lined jute bags, polythene lined cloth bags, thick netted double layered bags and single layered bags, thin netted double layered bags and single layered bags and cloth bags respectively.

Raghuram (2010) reported complete protection of maize stored in magic bags and super bags up to sixth months after storage with respect to number of rice

weevils emerged, grain damage by count and weight method and per cent weight loss. He also recorded maximum number of weevils, highest maize grain damage and weight loss in jute bags.

Similar findings were observed in the present experiment when groundnut pods were stored in magic bags only. But groundnuts stored in super bags recorded 15.33 to 136.33 number of adults, 0.85 to 82.67 per cent pod damage by count, 0.75 to 85.4 per cent pod damage by weight and 0.06 to 22.75 per cent weight loss during one to six months storage period which may be due to high inter granular space between groundnut pods compared to that of maize grains. Moreover, the beetles were able to make holes to the super bags but not to magic bags.

Anandhi *et al. (*2007) working with pulse beetle also recorded maximum number of adults and per cent weight loss in jute bags followed by jute bag lined with polythene and muslin cloth bags and cent per cent infestation in all three types of bags.

Man Mohan Sundri (2004) working with groundnut bruchid concluded that weight loss (per cent) after six months in different storage receptacles showed minimum weight loss that in metal bins (6.45%) followed by earthen pots (8.86%) and the maximum loss was in control (24.11%). The weight loss was statistically at par when groundnut pods were stored in plastic containers (9.87%), HDPE bags (11.13%) and jute bags (11.88%).

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Table 1. Effect of bins and bags with respect to oviposition, adult emergence of *C .serratus* in stored groundnut at fortnight intervals up to 6 months. The data on pods per cent pod damage (count & weight) and percent weight loss.

Treatments		Mean No. of eggs * /180 days	Mean no adults*/ 180 days	% pod damage by count ** /180 days	% pod damage by Weight ** /180 days	Weight Loss (%) ** /180 days
T1	Earthen pot	176.28 i (13.31)	98.62 g (9.98)	60.71 f (51.17)	65.54 cd (54.05)	62.29 e (52.09)
T2	Aluminum bin	62.71d (7.98)	30.56 c (5.62)	49.56 cde (44.73)	56.58 bc (48.77)	54.33 d (47.46)
T3	Steel bin	64.97 d (8.12)	29.08 bc (5.48)	48.78 cd (44.28)	55.53bc (48.16)	49.38 c (44.62)
T4	Plastic bin	40.06 b (6.40)	21.56 a (4.75)	40.22 b (39.32)	43.46 a (41.06)	41.32 ab (39.98)
T5	Wooden box	102.15 f (10.16)	45.81 e (6.84)	53.59 de (47.04)	57.55 bc (49.33)	64.61 e (53.51)
T6	Single layered polythene bag	164.76 h (12.87)	94.96 g (9.80)	51.04 de (45.58)	59.09 bc (50.22)	63.84 e (53.02)
T7	Double layered polythene bag	115.03 g (10.77)	57.30 f (7.64)	48.29 cd (44.00)	55.62 bc (48.21)	50.32 c (45.17)
T8	Triple layered polythene bag	55.08 c 7.49)	26.84 b (5.28)	39.51 b (38.92)	47.19 ab (43.37)	38.31 a (38.23)
T9	Gunny bag	61.71d (7.92)	38.89 d (6.32)	45.34 c (42.31)	49.99 ab (44.98)	42.53 b (40.69)
T10	Polythene lined gunny bag	77.53 e (8.86)	48.28 e (7.02)	50.84 de (45.46)	53.16 ab (46.80)	49.59 c (44.75)
T11	Cloth bag	235.19 j (15.37)	135.25 h (11.67)	54.70 e (47.68)	71.25 d (57.60)	77.12 f (57.47)
T12	Magic cover	35.21 a (6.02)	19.56 a (4.53)	31.92 a (34.38)	46.98 ab (43.24)	37.80 a (37.93)
SEm(±)		**0.12**	**0.09**	**0.97**	**2.14**	**0.68**
CD(P=0.05)		**0.35**	**0.26**	**2.85**	**6.29**	**1.99**

*Values in Parentheses are square root transformed value

** Values in Parentheses are angular transformed value

Means followed by same letters are not significantly different at $p < 0.05$ by DMRT.