Indian Journal of Entomology 85(1): 129-133 (2023) DoI. No.: 10.55446/IJE.2022.596

EFFICACY OF TWO-IN-ONE MODEL TRAPS AND SUN DRYING AGAINST *CALLOSOBRUCHUS MACULATUS* (F.) IN MUNGBEAN

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ABSTRACT

Detection of insect infestations is essential for quality assurance and helps in locating insect infestations, for early diagnosis of low-level infestation and to ascertain the success of control measures. This study evaluates the efficacy of two-in-one model trap against cowpea bruchid *Callosobruchus maculatus* (F.) in stored mungbean in six months of storage. Tamil Nadu Agricultural University (TNAU) developed two-in-one model traps were used. The observations on number of adult beetles trapped, % weight loss and grain damage were recorded at the end of each month, for six months. The results obtained conclude that use of one trap and sun drying of mungbean grains for five days is significantly effective in reducing the number of adult beetles. No weight loss and grain damage were recorded with this treatment, where only one trap/ container was used followed by sun drying for five days at the end of fourth month. Similar results were obtained up to six months. The % weight loss of 1.75 and 4.00% grain damage observed at the end of sixth month with one trap and three day sun drying of grains exhibit its efficacy.

Key words: *Callosobruchus maculatus*, grain damage, two-in-one model trap, grain damage, weight loss, mungbean, pulse beetle, losses, months, sun drying

Among pulses, mungbean, *Vigna radiata* (Linn.) Wilczek is important (Yadav et al. 1994), and traders mostly store these at least for few months. During this storage, pulses suffer enormous losses due to pulse beetle (Fletcher and Ghosh, 2002), the infestation of which starts in the field and subsequently carried to the stores (Khan et al., 2015). Amongst these pulse beetles, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae), also known as cowpea dhora, is a major pest (Park et al., 2003), and cause 87 to 100 % loss within a storage period of three to six months (Akinkurolere et al., 2006; Ojiako and Adesiyun, 2013). The grains are made unfit for human consumption (Atwal and Dhaliwal, 2005). Mungbean *Vigna radiata* is the most common host for *Callosobruchus* spp., in respect of oviposition, adult emergence (66.11-70.29%) and caused 50.37 - 57.58 % grain damage in storage (Ali et al., 1999). Owing to the hazards due to pesticides, several non-chemical/ non thermal strategies are used for disinfestations of stored grains (FAO, 2017). These provide ecofriendly alternatives (Ramazeame et al. 2012), and such alternate strategies are required for timely detection and management of stored grain pests (Martinez et al. 2000; Reed et al. 2001; Shadia and Aziz, 2011). Monitoring tools such as insect probe trap, pitfall trap, and two-in-one trap developed by Tamil Nadu Agricultural University (TNAU) were analysed for the management of pests of stored grains. These have been found effective. The present study is to establish the simple and easy method to detect the infestation of internal stored grain insects so as to forecast the risk of possible pest outbreak that may indicate the need for timely control strategies or their validation.

MATERIALS AND METHODS

Present study was carried out during 2018-19 in the Post-harvest Technology Laboratory, Department of Processing & Food Engineering, PAU, Ludhiana. For maintaining the stock culture of *C. maculatus*, sound and fresh grains of mungbean variety SML-668 (Punjab Agricultural University recommended variety) were sterilized in an oven at 55^{0}C for 4 hr before start of experiment (Mookherjee et al., 1968). Then freshly emerged adults of *C. maculatus* were taken from pure culture and released on sterilized mungbean grains in battery jars, covered with muslin cloth and fastened with rubber bands and these jars were kept at under room temperature for further multiplication of the insects. During the period of study (six months), weekly mean maximum and minimum temperature ranges were 29.9-42.1 ^{o}C and 16.5-28.1 ^{o}C, respectively during 2018. During 2019 the maximum to minimum temperature ranges were 30.0-43 ^{o}C and 18.1-28.5 ^{o}C. The relative humidity varied from 21-80 % during both

the years (2018 & 2019). Fresh grains of mungbean were provided periodically for the development of beetles and the culture so maintained was further used for undertaking various investigations. The experiment was conducted in completely randomized design. There were total four treatments and each treatment had eight replications.

For conduct of experiment, five kg of sterilized mungbean grains (Variety SML-668) were taken in the plastic container and twenty pairs of freshly emerged adults (2d old) of *C.maculatus* were released into these containers. For getting freshly emerged adults, petri plates containing fresh grains of mungbean were placed in the culture jars and removed after 24 hr. These petri plates containing freshly laid eggs were separated from the culture jars and such grains were placed in different containers. The freshly emerged adults from these containers were used for the studies. One week period was given for uniform multiplication of these pulse beetles in the mungbean grains. After one week, the released beetles were removed from the container and two-in-one model trap was placed in it. The containers were covered with muslin cloth. For treatment 1, after one month, trap was removed from the container and the number of adults trapped in the funnel of trap was counted. After taking the other observations on grain damage and weight loss, the trap was placed back into the container. This procedure was repeated for six months. In second treatment, after 30 days, the observations were taken as above and sun-drying of the grains (to kill the immature stages of pulse beetle) was done for 3 days and then trap was placed back into the container.

For sun drying, the grains were placed on tarpaulin sheet in the bright sunlight for five hours and then the grains were put back into the container. The sun drying was practiced at the end of each month continuously for 3 days. Similarly, in treatment 3, the sun drying was done continuously for 5 days. The temperature range for the sun drying period was 42.1- 43 ^{o}C. All the observations were taken at monthly intervals. The following treatments were evaluated: The observations on number of adults trapped were taken at the end of each month, the trap was removed from the grains and the number of adults trapped in the funnel of the trap, attached at the end, was observed. The % weight loss was calculated using Count and Weight method (Adams and Schulten, 1978). One thousand grains were taken randomly from the sample. The number of insect damaged and undamaged grains was counted and their weight was taken on an electronic weighing balance. The % grain damage was calculated from healthy (without holes) and insect damaged grains separated on thousand grain count basis. The data pertaining to different observations were subjected to Analysis of Variance using statistical software SPSS v 20.0 (SPSS, 2011). The comparison of means was done using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

After one month, number of adults trapped in storage container with one trap followed by sun drying of mungbean grains for three days (47.28/ 5kg) was statistically at par with adults trapped in storage container with one trap and sun drying followed for five days (50.17/ 5kg) (Table 1). The efficacy of TNAU developed two-in-one model trap for timely detection of bruchids in stored pulses was evident from the recorded lowest grain damage (5.5%) in the trials conducted at farmers level (where these traps were used) as compared to 13.5% grain damage with farmer's practice (without the use of traps) (Mohan, 2014; Debebe et al., 2008). At the end of third month, statistically lower number of adults (4.00) were trapped in storage container with one trap and sun drying for five days (T_3). The mean number of cigarette beetle, *Lasioderma serricorne,* adults trapped, increased with increase in the number of traps per bag stack (Rajesh et al., 2015). T_3 continued to perform better till the end of storage period with no entrapment of adults. The data on % weight loss of mungbean grains given in (Table 1) inferred those two treatments where one trap and sun drying of mungbean grains for three days (T_2) and one trap and sun drying of grains for five days (T_3) were statistically similar. Sun drying destroys existing insect pests and their different stages present in/on the grains (Debebe et al., 2008) It also helps to reduce spoilage and enhance the dormancy period of grains (Kumar and Singh, 2013). After four months, no weight loss of grains was observed in T_3 and it was statistically better as compared to all other treatments. Maximum % weight loss was observed in untreated control (20.00%). Similar trend was observed w.r.t. all treatments.

The data on % grain damage presented in Table 1 show that grain damage among different treatments after one month of storage ranged from 8.32 to 9.60. The grain damage (%) in storage container with one trap followed by sun drying of mungbean grains for

Table 1. Trapping efficiency of two-in-one model trap for *C. maculatus* adults

Treatment	No. of adults trapped after# (Mean± SE)					
	1st month	2nd month	3rd month	4th month	5th month	6th month
Storage container with grains with one trap	53.17± 0.03^{b}	28.00± 0.01^{c}	24.00± 0.08^{c}	20.00± 0.09^{c}	17.00± 0.08^{c}	14.00± 0.16^{c}
Storage container with grains with one trap + sun drying of grains for 3 days at the end of each month	47.28± 0.05^{a}	12.37± 0.06^{b}	10.17± 0.08^{b}	9.30± 0.04^{b}	10.67± 0.02^{b}	11.23± 0.03^{b}
Storage container with grains with one trap + sun drying of grains for 5 days at the end of each month	50.17± 0.06^{a}	6.51± 0.06^{a}	4.00± 0.03^{a}	0.00± 0.00^{a}	0.00± 0.00^{a}	0.00± 0.00^{a}
Untreated control	66.04± 0.12^{c}	110.80± 0.07^{d}	234.13± 0.16^{d}	281.38± 0.14^{d}	332.38± 0.13^{d}	436.25± 0.20^{d}
% weight loss after*# (Mean± SE)						
Storage container with grains with one trap	5.70± 0.18^{b}	4.00± 0.14^{c}	3.50± 0.23^{c}	3.28± 0.14^{c}	3.00± 0.12^{c}	2.50± 0.10^{c}
Storage container with grains with one trap + sun drying of grains for 3 days at the end of each month	5.13± 0.09^{a}	2.33± 0.13^{b}	1.85± 0.15^{b}	1.40± 0.10^{b}	1.67± 0.12^{b}	1.75± 0.12^{b}
Storage container with grains with one trap + sun drying of grains for 5 days at the end of each month	5.37± 0.19^{a}	1.25± 0.13^{a}	0.70± 0.14^{a}	0.00± 0.00^{a}	0.00± 0.00^{a}	0.00± 0.00^{a}
Untreated control	6.55± 0.11^{c}	10.02± 0.31^{d}	17.00± 0.22^{d}	20.00± 0.38^{d}	24.40± 0.48^{d}	29.00± 0.41^{d}
% Grain damage*# (Mean± SE)						
Storage container with grains with one trap	8.90± 0.15^{b}	7.20± 0.10^{c}	6.22± 0.14^{c}	6.02± 0.11^{c}	5.83± 0.08^{c}	4.20± 0.14^{c}
Storage container with grains with one trap + sun drying of grains for 3 days at the end of each month	8.32± 0.08^{a}	4.80± 0.09^{b}	4.02± 0.10^{b}	3.50± 0.16^{b}	3.81± 0.10^{b}	4.00± 0.09^{b}
Storage container with grains with one trap + sun drying of grains for 5 days at the end of each month	8.40± 0.07^{a}	2.50± 0.14^{a}	1.00± 0.15^{a}	0.00± 0.00^{a}	0.00± 0.00^{a}	0.00± 0.00^{a}
Untreated control	9.60± 0.07^{c}	17.21± 0.11^{d}	25.41± 0.13^{d}	29.33± 0.28^{d}	33.11± 0.19^{d}	38.55± 0.34^{d}

* Means within same column followed by same letter are not significantly different (Duncan's MRT, $P < 0.05$).
*1000 grain count basis

three days (8.32) (T_2) was significantly lowest and it was statistically at par with 8.40 observed in storage container with one trap and sun drying of mungbean grains followed for five days (T_3). After two months of storage, T_3 treatment was significantly better than all other treatments. In another studies, the number of insect catches in wheat bag stack increased with increase in number of traps used at each layer and minimum grain damage (1.30%) was observed (Hategikimana et al. 2013). Three traps/layer captured significantly higher number of insects as compared to one and two traps/layer. These workers concluded that among the monitoring tools, stack probe trap detected more infestation of major wheat storage insect-pests in the commodities as compared to spear sampling methods. At the end of fourth month, no further grain damage was noticed in treatment T_3 as this treatment had completely trapped the pulse beetles present in whole of the sample as evident in Table 1. Finally sixth months of storage gave, % grain damage varied of 0.00 in T_3 to 38.55 in untreated control. Results are also in agreement with Shadia and Aziz (2011) which stated that detection methods for stored grain insects helps in locating infestations for early diagnosis and to ascertain the success of fumigation or other control measures undertaken. Therefore, it can be concluded that use of two-in-one model trap and sun drying of mungbean grains for five days significantly performed better than all other treatments during six months storage of mungbean grains. The enormous quantitative and qualitative losses caused by stored grain insects are of serious concern to nutritional security throughout the world. Their timely detection is must to prevent heavy losses. The use of traps offers numerous advantages over the standard sampling procedure of collecting small volumes of grain and sifting or incubating them. Monitoring with these traps gives a quick sign of population growth. In addition to use of two-in-one model trap, sun drying of grains was found to be an effective approach for the management of pulse beetles as sun drying of grains helps to kill the immature stages of the insect. This practice can be easily adopted by farmers for timely detection, monitoring of pulse beetles.

ACKNOWLEDGEMENTS

The authors acknowledge the facilities provided under scheme 'Fund for Improvement of S&T Infrastructure (FIST) (project no. SR/FST/LSI/636/2015 (c) of the Department of Science & Technology (DST), Government of India.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHOR CONTRIBUTION

RK, DKS and KSS contributed equally in designing and performing the experiment and all of the authors contributed equally in data analysis and preparation of the manuscript.

REFERENCES

Adams J M, Schulten G M. 1978. Losses caused by insects, mites and micro-organisms. In: Post-harvest grain loss assessment methods, Harris KL, Lindblad CJ (eds.) Minnesota: AACC. 93 pp.

Akinkurolere R O, Adedire C O, Odeyemi O O. 2006. Laboratory evaluation of the toxic properties of forest anchomanes, *Anchomanes difformis* against pulse beetle *Callosobruchus maculatus* (Coleoptera: Bruchidae). Insect Science 13: 25-29.

Ali M R, Rahman M M, Rahman M M, Ali M, Quamruzzaman A K M. 1999. Studies on the host preference of pulse beetle, *Callosobruchus chinensis* Linn. to different pulses. Journal of Agricultural Education and Technology 2: 139-144.

Atwal A S, Dhaliwal G S. 2005. Agricultural pests of South Asia and their management, Kalyani Publishers, New Delhi.

Debebe A, Mohan S, Kuttalam S, Nagappan R. 2008. Cross border technology transfer-A case study with TNAU trapping technologies in Gondar, Ethiopia, Africa for the management of stored product insects. Research and Reviews in BioSciences 2: 48-50.

Divya S, Mohan S. 2009. TNAU egg removal device in the management of insect pests of stored Siddha and ayurvedic ingredients. Entomon 34: 269-271.

FAO. 2017.United Nation, International Centre of Insect Physiology and Ecology (ICIPE). Insect damage post-harvest operations 12(5): 192-194.

Hategikimana A, Mohan S, Ramaraju K, Thirupathi V. 2013. Efficiency of stack probe trap for detection, validation of fumigation and distribution of stored grain insects in bag stacks. Journal of Renewable Agriculture 1: 39-43.

Martinez M E, Jimenez S, Vazquez M E. 2000. Effect of *Sitophilus zeamais* and *Aspergillus chevalieri* on the oxygen level in maize stored hermetically. Journal of Stored Products Research 36: 25-36.

Mohan S. 2014. Monitoring and sampling tools for stored product insects should reach endusers an analysis, (Department of Agriculture, Ministry of Agriculture and Cooperatives, Thailand),https://doi.org/10.14455/doa.res.2014.36.

Mookherjee P B, Jotwani M G, Yadav T D, Sircar P. 1968. Disinfection of stored seeds by heat treatment. Indian Journal of Entomology 27: 476-80.

Ojiako F O, Adesiyun A A. 2013. Assessment of the curative potency of some plant materials on cowpea seeds with established infestation of *Callosobruchus maculatus* (Fabricus)(Coleoptera: Chrysomelidae: Bruchinae). Journal of Biology Agriculture and Healthcare 3: 83-93.

Park C, Kim S I, Ahn Y J. 2003. Insecticidal activity of asarones identified

in *Acorus gramineus* rhizome against three coleopteran stored-product insects. Journal of Stored Products Research 39: 333-342.

Rajesh A, Mohan S, Nelson S J. 2015. Efficacy of TNAU-Stack probe trap in detection, monitoring of pests and validation of fumigation in turmeric bag-stack storage. Current Biotica 9: 159-165.

Ramazeame L, Coumar A, Kumar A S. 2012. Botanical insecticidal management of pulse beetle, *Callosobruchus chinensis* Linn, Mysore Journal of Agricultural Science 46: 86-91.

Shadia E, Aziz A E. 2011. Control strategies of stored products pests. Journal of Entomology 8:101-122.

SPSS 2011. IBM SPSS Statistics for Windows, Release 20.0. IBM Corp, Armonk, NY.

Yadav D S, Panwar K S, Singh V K. 1994. Management of pulse crops in sequential cropping, (Indian Abstracts, Symposium on Pulse Research, New Delhi, India).

(Manuscript Received: March, 2022; Revised: May, 2022;
Accepted: May, 2022; Online Published: June, 2022)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e22541