

Evaluation of the Efficiency of Probe and Indicator Device traps for Catch Adults of the Cowpea weevil *Callosobruchus maculatus* Fab. (Coleoptera: Chrysomeloidea)

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DOI: <https://doi.org/10.36077/kjas/2023/v15i1.3591>

Received date: 3/4/2022

Accepted date: 3/5/2022

Abstract:

The Probe trap was tested with three types (empty, water, alcoholic extract of (*Vicia faba*) respectively and for three periods of time (1, 2, 3) days respectively to catch the cowpea weevil *C. maculatus* that infests the broad bean seeds prepared for cultivation. It gave a trap Probe catching percentage on the third day of placing the traps respectively (19.16, 62.5, 88.33)% respectively, and the lowest catching percentage on the first day was (5.83, 20, 41.67%) respectively, while the highest percentage of catch was for the Indicator device trap with three species (Grease as sticky material , water, *Vicia faba* flower extract) for the third day with placing traps (52.5, 70, 72.5%) respectively, and the lowest percentage of catching was on the first day, which was (27.5, 40, 47.5%) respectively. From the experiment, the efficiency of the Probe trap and the Indicator device trap, to which bean flower extract was added, in hunting *C. maculatus* adults for the same time period, where the extract increased the efficiency of the two traps, followed by water for the same period of time.

Keywords: *Callosobruchus maculatus*, Probe trap, Indicator trap, *Vicia faba*.

Introduction

Storage insect pests that feed on seeds are one of the vital problems of the major complex of legume crops, and cause great economic losses during the post-harvest period and during the storage period. (22). Legume beetles belong to the family Chrysomelidae (leaf eaters) that includes more than 1,700 species from 62 genera around the world (23).

The cowpea weevil *Callosobruchus maculatus* Fab. (Coleoptera: Chrysomeloidea) has annual weight losses of 30-50% or 62% (2), and these insects can cause significant losses in terms of quantity and quality (17), beetles may cause a complete loss of up to 100% within three to five months of storage (7 and 15), where insect pests contaminate seeds and through fecal secretions, sloughing skins, And the bodies of the dead stages as their presence in agricultural product is commercially undesirable The damage caused by insect pests also causes bacterial and fungal diseases like *Staphyococcus epidermidis* and *Aspergillus flavus* through the transmission of their spores (19 and 25), the presence of insects also causes product temperature to rise due to feeding activity resulting in hot spots (16).

It was noted that this stored insect pest infests over 20 types of leguminous grains, which affects their germination due to the damage caused by the larvae to their contents and secretion of excreta such as uric acid and decomposing materials (8). The percentage of what the larvae consume is 29-45.6% of the weight of the seeds, and the damage increases after the first larval stage (4).

Scientific institutions have been keen to control stored insect pests in different ways, especially chemical (pesticides of all kinds), but these methods can negatively affect the mammals, as they affect the ATPase enzyme, which breaks down ATP into ADP. Targeted and developing strains resistant to the action of pesticides from insects (27), so researchers directed to go towards alternative methods, including physical methods (air vacuum) (24) inert gases (27) plant powders (5), and pheromone traps (14 and 3) and temperature manipulation (13, 1 and 6) and microwave radiation (12 and 18), pitfall traps and indicator device taking into account the percentages of preserving the vitality of the seeds and their germination rates (9 and 20).

Materials and Methods

Insect breeding

The cowpea seed beetle, *C. maculatus*, was obtained from grain and fodder stores in Najaf governorate, broad bean seeds infected in September of the year 2020. The insects were reared after being diagnosed and distinguishing between male and female by the Natural Museum / University of Baghdad on healthy beans that impurities and broken parts were removed and sterilized by keeping them at a temperature of -20 °C for a period of 20 days to ensure the disposal of any stored insect infestation as a precautionary measure before vital tests, then were prepared where the seeds were placed in plastic containers of 1 liter size at a rate of 250 grams per container and 10 individuals for each male and female were placed in a plastic container for mating. After laying the eggs (The next day of mating), the adults are removed to ensure obtaining

uniform stages. The plastic containers were covered with Muslin and tied with a tight rubber band. The plastic containers containing the eggs were placed in the Binder type incubator of German origin at a temperature of 28 ± 2 And relative humidity of $60 \pm 10\%$ and the farm is constantly renewed to obtain several successive generations for the purpose of use (10).

Extraction process of the alcoholic extract of the flowers of *Vicia faba* L.

The extraction process was carried out in the laboratory of the Directorate of Agriculture in Najaf Governorate, where the alcoholic extract of the flowers of the *Vicia faba* plant was prepared by Harborne (11) from 20 g of dry flower powder, 200 ml of hexane was added, and the mixture was placed in an electric mixer for 15 minutes at The mixture was left at room temperature for 24 hours, then the mixture was filtered using Muslin, then filtered by Wittman No.1 filter paper, and the filtration process was repeated twice until use .

Using the Probe Trap

The trap, which consists of a transparent plastic tube closed on one side with an end that prevents insects from leaving it, is 25 cm long and 3 cm in diameter. It contains circular holes on the sides of the tube with a diameter of 3 mm to facilitate the entry of whole insects while wandering and attracting the alcoholic extract of the flowers of the broad bean plant into The seeds weigh 10 kg, which were placed in a plastic container with a tight cover, 40 cm long and 25 cm in diameter, with ventilation holes covered with a muslin to prevent the exit of 40 adults for each

duplicate, and to monitor the percentage of insects inside the trap that are attracted to the alcoholic extract of broad bean flowers or added to it with distilled water It was compared to an empty trap for three periods of time, 1, 2, 3 days, respectively.

The trap efficiency was calculated using the following equation

number of insects inside the trap

Catch percentage (efficiency of the trap)

$$= \frac{\text{number of insects inside the trap}}{\text{total number of insects}} \times 100\%$$

Using the Indicator trap device

The trap consists of a conical plastic mug with a height of 15 cm and a diameter of the upper nozzle 10 cm. The upper opening of the mug is covered with a tight plastic cover to prevent insects from coming out from the top. The base is 5 cm in diameter. It contains holes on the sides of the mug with a diameter of 3 mm for easy exit of the whole insect to wandering outside the seeds placed in the trap by weight 200 gm, with the addition of 20 pairs of male and female insects, and the conical part was fixed on a plastic tray with a diameter of 30 cm. The trap was placed inside a wooden cage, the sides of which were made of muslin, with dimensions (50 x 50 x 50) cm. The insects caught daily are calculated for a period of three days and three replicates, the efficiency of the trap is calculated with a comparison between the three types.

Statistical analysis

The analysis was performed using Statistical Analysis System version 9.1th (SAS) (26) to study the effect of different factors on the studied traits according to a

completely randomized design (C.R.D), and the significant differences between the means were compared using the Least Significant Difference (L.S.D) test at $P = 5\%$.

Results and Discussion

Efficiency of the Probe Trap for *C. maculatus* F.

The results of Table (1) showed the percentages of catch of adults of the southern cowpea beetle *C. maculatus* in an empty Probe trap, added to it water or *V. faba* flower extract was added as attractants and for periods of (1, 2, 3) days,

where the highest percentage of catch was during the time period 3 days of placing the types of traps in order (19.16, 62.5, 88.33)%, respectively, and the lowest catch rate in the 1 day period was (5.83, 20, 41.67)%, respectively, and the results of the table showed an increase in the catch rates of adults in the manufactured trap With an increase in time, as well as an increase in catching rates when adding water and adding flower extract to the trap, the statistical analysis of Table (1) indicated the significant statistical differences between the types of treatments as well as the exposure periods and the interaction between them.

Table 1 - Efficiency of the Probe trap in catching *C. maculatus*

Trap content	time / day			Average
	1	2	3	
	Percentage of catch%			
Empty	5.83	12.5	19.16	12.49
Water	20	36.67	62.5	39.73
flower extract	41.67	67.5	88.33	65.83
Average	22.5	38.89	56.66	---
LSD 5%		6.712 *		
Overlap		11.792 *		

*Based on LSD test at 5% probability level.

Efficiency of the Indicator device trap in catching *C. maculatus* F.

The results of Table (2) showed the percentages of *C. maculatus* adults caught in the Indicator device trap using Grease as an adhesive or water with a little washing powder or Grease added to it *V. faba* flower extract as an attractant and for the time periods (1, 2, 3) day respectively, where the highest percentage of catching was in the time period 3 days from placing the traps, and the percentage of catching from adults reached (52.5, 70, 72.5)% respectively, and the lowest percentage of catching was at the time period of 1 day, when the percentage of catching from

adults reached (27.5, 40, 47.5)%, respectively, and the highest percentage of catching was at the time period of 3 days, and the highest percentage of catching was (72.5%) in the trap when adding flower extract and the lowest catching percentage (27.5%) at the time period of 1 day in the trap With Grease as an adhesive only, and the results of the table showed a direct relationship between the percentages of catching and the increase in the time period, as well as an increase in catching rates when adding Grease as an adhesive, water and adding flower extract as an

attractant. The results of the statistical analysis indicated significant differences between the treatments except for the

treatment flower extract Refer to the water treatment as well as the exposure period from 3 days to 2 days.

Table 2- Efficiency of the I. device trap in catching *C.maculatus*

Trap content	time / day			Average
	1	2	3	
	Percentage of catch%			
Grease	27.5	45	52.5	41.67
Water	40	65	70	58.33
flower extract	47.5	70	72.5	63.33
Average	38.33	60.00	65.00	
LSD 5%			5.682 *	
Overlap			9.801 *	

*Based on LSD test at 5% probability level.

Efficiency of the Indicator device trap in catching *C. maculatus* F.

The results of Table (2) showed the percentages of *C. maculatus* adults caught in the Indicator device trap using Grease as an adhesive or water with a little washing powder or Grease added to it *V. faba* flower extract as an attractant and for the time periods (1, 2, 3) day respectively, where the highest percentage of catching was in the time period 3 days from placing the traps, and the percentage of catching from adults reached (52.5, 70, 72.5)% respectively, and the lowest percentage of catching was at the time period of 1 day, when the percentage of catching from adults reached (27.5, 40, 47.5)%, respectively, and the highest percentage of catching was at the time period of 3 days, and the highest percentage of catching was (72.5%) in the trap when adding flower extract and the lowest catching percentage (27.5%) at the time period of 1 day in the trap With Grease as an adhesive only, and the results of the table showed a direct relationship between the percentages of catching and the increase in the time period, as well as an increase in catching rates when adding Grease as an adhesive,

water and adding flower extract as an attractant. The results of the statistical analysis indicated significant differences between the treatments except for the treatment flower extract Refer to the water treatment as well as the exposure period from 3 days to 2 days. It was clear from the results of Tables 1 and 2 that the best rates of catching of the Probe trap and for the empty treatments, water, flower extract were on the third day with results reaching 19.16, 62.5 and 88.33%, respectively, and that the results of catching with broad bean flowers extract with results reached 41.67, 67.5 , 88.33%, respectively, Indicator device and the treatments of Grease, water, and flower extract were on the third day with results that reached 52.5, 70, 72.5%, respectively, and the results of catching with broad bean flower extract reached 47.5, 70.0, 72.5%, respectively, respectively, and it was clear from the results of Tables 1 and 2 that the best catch rates were in the probe trap, with a result of 88.33%.

Conflict of interest

The authors have no conflict of interest.

References

- 1- **Aidan, M. F.; A. S. Muhammad and Al-Mallahm N. M.2007.**Using high and low temperatures to control two flour beetles, *Tribolium confusum* (Duv.) (Coleoptera: Tenebrionidae) and the serrated grain beetle *Oryzaephilus surinamensis* (L.) (Coleoptera: Silvanidae). Research Journal of the College of Basic Education.5(3):78-90.
- 2- **AL-Azzawi, A. F.; I. K. Qado and AL-Jundari, W. S.1990.**Economic Insects, Dar Al-Hikma for Printing and Publishing. University of Baghdad. Iraq. pp. 652.
- 3- **Al-Zaidi, S.2014.**Applications of using pheromones and attractants in plant protection. The Arab Journal of Plant Protection.32(special issue (A13).
- 4- **Ayda, F. A. and E. F. Alyouse.1994.** Development of resistance (1) to some insecticides in cowpea weevil. Entomol. Soc., Egypt.15:19- 23.
- 5- **Aylan, A. Y.2014.**A laboratory study to evaluate the effectiveness of some plant powders against the southern cowpea beetle *Callosobruchus maculatus* (Fab.). Kufa Journal of Agricultural Sciences, 6(2):1-16.
- 6- **Bhalla, S.; K. Gupta; B. Lal; M. L. Kapur and Khetarpal, R. K.2008.**Efficacy of various non-chemical methods against pulse beetle, *Callosobruchus maculatus* (Fab.). Endure International Conference (12-15 October) on Diversifying Crop Protection, La Grande Motte. France (pp. 1-4).
- 7- **Boeke, S. J.; J. J. A. Van Loon; A. Van Huis; D. K. Kossou and Dicke, M.2001.**The use of plant material to protect stored leguminous seeds against seed beetles: A review (No. 2001-3). Backhuys Publishers.
- 8- **Deshpande, V. K.; B. Makanur; S. K.; S. Adiger and Salimath, P. M.2011.**Quantitative and qualitative losses caused by *Callosobruchus maculatus* in cowpea during seed storage. Plant Archives, 11(2):723-731.
- 9- **Duraimurugan, P.; K. Raja and Regupathy, A.2011.**An eco-friendly approach for management of pulse beetle, *Callosobruchus maculatus* through neem formulations assisted with pitfall trap. Journal of Food Legumes 24(1):28-32
- 10- **Ghafoor, M. sh. Mirza and R. R. Kader.2011.** Control of the southern cowpea beetle by some non-chemical methods. Research Journal of the College of Basic Education. Volume 11 (1):15-23.
- 11- **Harborne, J. B.1984.** Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis, Chapman & Hall. New York. USA. pp.288.
- 12- **Ismail, A. Y. and S. H. S. Al-Sinjari.2008.** Using microwave radiation to control the cowpea beetle *Callosobruchus maculatus* (fab.) (Bruchidae Coleoptera:) Journal of Education and Science, 21(4):12-19.
- 13- **Johnson, J. A. and K. A. Valero.2003.** Use of commercial freezers to control cowpea weevil, *Callosobruchus*

maculatus (Coleoptera: Bruchidae), in organic garbanzo beans. Journal of Economic Entomology, 96(6):1952-1957.

14- **Kaakeh, W.2000.** The use of synthetic pheromones in integrated pest management program (Review). Emirates J. Agricultural Sci., 12:1-32.

15- **Khan, A.2021.** Biopesticides: Alternatives for management of *Callosobruchus maculatus*. Journal of Biopesticides, 14(1):59-78.

16- **Mason, L. J. and M. McDonough.2012.** Biology, behavior, and ecology of stored grain and legume insects. Stored product protection, 1(7):1-14.

17- **Metcalf, R. L. and R. A. Metcalf, R.A.1993.** Destructive and Useful Insects: Their Habits and Control. R.R. Dinnelley and Sons Company. Chicago. Illinois. USA.

18- **Mohamed, E. A. I.; H. M. Elzun; Nadia A. El-Aidy and Zayed, G. M. M.2011.** Efficacy of microwave energy on:1-Cowpea weevil, *Callosobruchus maculatus* (F)some of chemical contents and viability for faba bean seeds. J. Plant Prot. and Pathology, Mansoura Univ., 2 (3): 283 – 294. DOI: 10.21608/JPPP.2011.86420.

19- **Mohapatra, D.; S. Kumar; N. Kotwaliwale, and Singh, K. K.2017.** Critical factors responsible for fungi growth in stored food grains and non-Chemical approaches for their control. Industrial Crops and Products, 108:162-182.

20- **Parimala, K.; K. Subramanian; S. M. Kannan and Vijayalakshmi, K.2013.**

Seed Storage Techniques -A Primer. Centre for Indian Knowledge Systems (CIKS) Seed Node of the Revitalising Rainfed Agriculture Network. pp.25.

21- **Radha, R. and P. Susheela.2014.** Efficacy of plant extracts on the toxicity, ovipositional deterrence and damage assessment of the cowpea weevil, *Callosobruchus maculatus* (Coleoptera: Bruchidae). Journal of Entomology and Zoology Studies. 2:16–20.

22- **Ramzan, M.; B. S. Chahal and Judge, B.K.1990.** Storage losses to some commonly used pulses caused by pulse beetle, *Callosobruchus maculatus*. Journal of Insect Science, 3(1): 106–108.

23- **Romero, J. and C. D. Johnson.2004.** Checklist of the Bruchidae (Insecta: Coleoptera) of Mexico. The Coleopterists Bulletin, 58(4): 613-635.

24- **Sabit, F. A.2009.** Laboratory studies on the use of heat and vacuum in controlling the Khabra beetle *Trogoderma granarum* (Everts.). Master's thesis, College of Agriculture. University of Baghdad. Republic of Iraq. pp.63.

25- **Salem, H. and M. Kaltenpoth, M.2022.** Beetle–bacterial symbioses: endless forms most functional. Annual Review of Entomology, 67:201-219. <https://doi.org/10.1146/annurev-ento-061421-063433>.

26- **SAS. 2012.** Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

27- **Selwitz, C. and S. Maekawa.1999.** Inert Gases in the Control of Museum Insect Pests. Getty Publications. USA. pp.122.