The 4th International Conference on Agriculture and Environmental Sciences (ICAES) 2023
Volume 2024
http://dx.doi.org/10.11594/nstp.2024.3906

NST Proceedings
OPEN ACCESS

Conference Paper

Beetle Preferences *Callosobruchus* Sp. On Some Types of Nuts

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ABSTRACT

Legume agricultural products are among the Indonesian populace's primary sustenance sources. Nevertheless, the production of legumes in Indonesia needs to be improved, necessitating the country to engage in imports from several nations to meet demand. One of the factors contributing to this low production is the post-harvest seed deterioration that transpires during long-term storage. The grain beetle pest, *Callosobruchus* sp. (Coleoptera: Bruchidae), stands as one of the stored-product pests that exhibit a broad host range, encompassing various types of legumes. As a strategy to mitigate the resultant damages, it becomes imperative to examine the preference for egg-laying by *Callosobruchus* sp. on different legume species. *Callosobruchus* sp. egg-laying preference was assessed within the entomology laboratory of SEAMEO BIOTROP. This evaluation employed two distinct methodologies: the choice and no-choice tests, executed across various legume types. The selected legumes encompassed seven species: snap beans, mung beans, yardlong beans, peanuts, cowpeas, red beans, and soybeans. The testing outcomes unveiled that, under the choice test, *Callosobruchus* sp. laid the highest number of eggs on mung beans, totalling 70 eggs, followed by yardlong beans with 58 eggs. Subsequently, within the no-choice test, the highest egg deposition was observed on mung and yardlong beans, amounting to 87 eggs. *Callosobruchus* sp. preferred egg-laying and optimal development as imago on yardlong beans. Conversely, peanuts were the least favoured for egg-laying by *Callosobruchus* sp. and were deemed unsuitable for imago development. The attraction of *Callosobruchus* sp. is influenced by several factors, including seed essential constituents, seed texture, and microenvironmental conditions.

Keywords: Callosobruchus sp., stored-product pests, egg-laying preference

Introduction

Storage is securing food commodities for a certain period before distribution or utilization in processing (Hakim & Irhamni, 2019). Based on the duration of use, storage can be categorized into short-term, medium-term, and long-term storage. The storage of food commodities holds paramount importance for a nation's logistics supply chain. Through this storage phase, the continuity of food supply is ensured, rendering food logistics a strategically significant aspect for a nation. The implications extend further, impacting political, defence, security, social, and cultural domains (Imanullah, 2017). Post-harvest losses in leguminous crops in Indonesia during the period of 2018-2022 represent a phenomenon with significant implications for food security and the national economy.

How to cite:
Wahyudin, M. A., Windriyanti, W., Widinni, T. A., & Rahmadhini, N. (2024). Beetle preferences *Callosobruchus* Sp. on some types of nuts. *The 4th International Conference on Agriculture and Environmental Sciences (ICAES) 2023*. NST Proceedings. pages 24-28. doi: 10.11594/ nstp.2024.3906

Leguminous crops, as vital protein sources in the dietary patterns of the population, play a strategic role in meeting the nutritional needs of Indonesia's populace. However, a major challenge lies in their vulnerability to various factors causing post-harvest losses (Pamujiati & Hadiyanti, 2021). The deterioration of leguminous crops during storage arises due to infestations by insects, resulting in losses reaching 20-50% (Radha & Susheela, 2014). Stored-product insect pests affecting leguminous commodities stem from the Bruchidae family, Coleoptera order, and the *Callosobruchus* genus, which is the primary pest causing weight loss in leguminous crops. Supported by Divya et al. (2016), who stated that nearly 80% of storage-related disruptions are caused by insects, including *Callosobruchus* sp.

The predominant bean beetle, *Callosobruchus* sp., exhibits a preference for various leguminous crops such as mung beans, yardlong beans, snap beans, red beans, peanuts, cowpeas, and soybeans. The activities of stored-product insect pests are influenced by environmental factors, encompassing physical and biological elements that interact. The physical environment encompasses temperature, light, wind, humidity, and illumination. Meanwhile, the biological environment includes food availability, predators, and parasitoids, creating competition among biological factors. Elevated losses during storage are attributed to suitable environmental conditions and ample food supply (Fernandez *et al*., 2014). Consequently, to mitigate the incurred damages, examining *Callosobruchus* sp. egg-laying preferences across various leguminous crops becomes necessary. The aim of this study is to conduct preference tests for *Callosobruchus* sp. egg-laying on different types of leguminous crops.

Material and Methods

Tools used in testing egg-laying preferences *Callosobruchus* sp. on several types of nuts are Petri dishes with a diameter of 15 cm, Petri dishes with a diameter of 9 cm, pudding cups, counters, analytical scales, HVS paper, tape, scissors, stationery, and cameras. The materials used in the test included chickpeas, green beans, peanuts, string beans, kidney beans, soybeans and *Callosobruchus* sp. imago obtained from the SEAMEO BIOTROP Entomology Laboratory collection.

Methods

Testing of egg-laying preferences of *Callosobruchus* sp. was carried out at the entomology laboratory, SEAMEO BIOTROP (Southeast Asia Regional Centre for Tropical Biology). This test is carried out using two methods, namely, the choice test method and the no-choice test method. The choice test method is carried out on a 15 cm diameter petri dish divided into seven parts. Then, prepare the beans for use by weighing each type of bean as much as 20 grams, then put them in a petri dish that has been divided before. After that, enter the insect Callosobruchus sp. A total of 10 pairs into a Petri dish with five repetitions. Petri dishes are stored for 24 hours. After that, imago *Callosobruchus* sp. removed from the saucer, then count many eggs of *Callosobruchus* sp. stuck to the surface of the nutshell. Then record the test results on the worksheet. Peanut samples were transferred to pudding cups for incubation for four weeks. After that, observations are made to calculate the number of hatched imago on the worksheet. The last step is to document the activities that have been carried out.

The no-choice method begins by weighing as much as 20 grams of each type of nut. Then, put each type of nut in a 9 cm petri dish. Next, infest *Callosobruchus* sp. imago each petri dish as many as five pairs into 7 Petri dishes per type of peanut; each treatment is repeated five times. Petri dishes are stored for 24 hours. After that, the imago is removed and counted many eggs stuck to the nut's surface. Each type of nut is put into a pudding cup and incubated for four weeks. After that, the number of imagos hatched in the pudding cup on each type of nut was observed and recorded on the worksheet. Then, document the activities that have been carried out.

Figure 1. Egg Laying Preferences of *Callosobruchus* sp. (a) No-Choice Test Method (b) Choice Test Method

Results and Discussion

Leguminous crops provide a conducive environment for developing the *Callosobruchus* sp. beetle. The survival of *Callosobruchus* sp. beetles relies not only on a single host plant but also on their ability to adapt to several other host species. The presence of *Callosobruchus* sp. beetles on their host plants is intricately linked to various aspects of their life cycle, including egg-laying sites, protective shelter, and sources of nourishment (Sodiq, 2009). The selection of host plants by insects for sustenance, oviposition, and protection is greatly influenced by the physical characteristics and chemical compounds inherent to these plants (Wagiman, 2019). The choice of plant species as sustenance generally remains limited to those within the same family or genus, even though certain pests may possess a wide range of hosts. Preference testing of *Callosobruchus* sp. beetles was conducted through two methods: the choice test and the no-choice test. The choice test method entailed assessing the attraction of *Callosobruchus* sp. beetles to various types of leguminous crops. Through this, *Callosobruchus* sp. beetles were observed to select preferred sites for shelter, food sources, and reproduction among the seven provided legume varieties. On the other hand, the no-choice test method involved evaluating the attraction of *Callosobruchus* sp. beetles to a single type of legume from the seven options provided. The utilization of these testing methods sheds light on the preferences of *Callosobruchus* sp. beetles towards particular legume species, aiding in understanding their behaviour and habitat selection patterns. This insight into the preferences of *Callosobruchus* sp. beetles can contribute to the development of more effective strategies for pest management and the preservation of leguminous crop quality during storage.

Table 1. Results of Observation of Preference of *Callosobrochus* sp. On some types of nuts

Types of Beans	Choice Test		No Choice	
	∑ Eggs	∑ Imago	∑ Eggs	∑ Imago
Chickpeas	7	1	46	0
String beans	28	25	64	48
Mung beans	70	32	87	38
Soybean	8	0	24	0
Red beans	14	0	35	0
Cowpeas	58	43	87	58
Peanut	1	0	2	0

The results of the observation regarding the egg-laying preference of *Callosobruchus* sp. on the seven provided legume varieties after a 24-hour infestation period revealed that the choice test method demonstrated *Callosobruchus* sp. laying eggs on all the offered legume types. Table 1 shows that in the choice test method, *Callosobruchus* sp. laid the highest number of eggs on mung beans, totalling 70 eggs, followed by cowpeas with 58 eggs. The lowest egg deposition by *Callosobruchus* sp. occurred on peanuts. Subsequently, in the no-choice test method, *Callosobruchus* sp. laid the most eggs on mung beans and cowpeas, amounting to 87 eggs, followed by string beans with 64 eggs.

Therefore, it can be inferred that *Callosobruchus* sp. exhibited a greater preference for egg-laying on mung beans.

Several factors influencing the attraction of *Callosobruchus* sp. to mung beans can be grouped into distinct aspects. Firstly, the physical characteristics of mung beans, such as shape, size, and surface structure of the seeds, can impact the insect's ability to lay eggs and locate suitable shelter. Secondly, the chemical content within yardlong beans, including chemical compounds involved in plant defence or nutritional components, also plays a role in attracting *Callosobruchus* sp. as a host (Verma et al., 2018). This aligns with the research conducted by Radha and Susheela et al. (2014), which stated that *Callosobruchus* sp. is attracted to mung beans due to their high carbohydrate and protein content, as well as their soft texture. Yardlong beans and cowpeas share the same genus with mung beans, hence *Callosobruchus* sp. also exhibits interest in these legumes. Additionally, Baidoo et al. (2015) posited that the aroma emitted by legumes stimulates the insect to deposit its eggs.

Furthermore, in the observation results of the fourth week using the choice test method as presented in Table 1, a decline was evident from the number of eggs to the number of adults. The highest number of adults emerged from cowpeas, totaling 43 insects, followed by mung beans with 32 insects. Similarly, the no-choice test method also exhibited a substantial decrease in the number of eggs to the number of adults. The highest number of adults emerged from cowpeas beans, amounting to 58 insects, followed by string beans with 48 insects, and mung beans with 38 insects. According to Mainali et al. (2015), the development of *Callosobruchus* sp. is influenced by the microenvironment.

The microenvironment is the condition in which a living organism resides to sustain its life, or in other words, the microclimate is a condition that directly impacts the survival of stored-product insects (Taradipha, 2019). The microclimate encompasses factors such as light, temperature, and humidity in the surrounding environment. One crucial aspect of the microenvironment influencing the development of *Callosobruchus* sp. is temperature. Temperature affects the rate of insect development from eggs to adulthood. Insects tend to develop faster as temperatures rise, which, in turn, can influence reproductive rates and potential population growth (Patty & Rumthe, 2020). Besides temperature, humidity also plays a significant role in regulating the microenvironment for *Callosobruchu*s sp. High humidity may create favorable conditions for insect development, while low humidity levels can impact the survival of eggs and larvae. According to Njoroge et al. (2018), *Callosobruchus* sp. thrives at temperatures of 25–27°C and relative humidity of 56-60%. Therefore, when conducting tests, attention should also be paid to the microclimate of the surrounding environment to ensure the optimal development of *Callosobruchus* sp.

Unlike other stored-product insect pests, *Callosobruchus* sp. exhibits distinct behavior. Adult insects do not consume food throughout their lifespan. Hence, it can be said that adult beetles do not directly cause damage. However, damage occurs indirectly due to the oviposition of female beetles on the surface of beans during storage (Hakim, 2003). After egg deposition, they hatch into larvae that feed on the seed coat and enter the cotyledons, eventually leading to perforation of the beans. Adult beetles emerge from the first generation through exit holes. Consequently, if the eggs do not receive sufficient nutrients from a bean, they fail to hatch, similar to eggs attached to beans such as snap beans, soybeans, red beans, and peanuts. Based on the aforementioned discussion, it is evident that the most preferred type of bean for *Callosobruchus* sp. egg-laying and optimal imago growth is cowpeas. Mung beans and String beans are merely favored locations for *Callosobruchus* sp. egg deposition but are suboptimal for imago growth. Meanwhile, chickpeas, soybeans, and red beans serve as egg-laying sites for *Callosobruchus* sp. without supporting imago development. Peanuts are the least favoured for egg deposition and are unsuitable for imago growth.

Conclusion

Test the preferences of *Callosobruchus* sp. beetles on several types of nuts with *the choice and no-choice test* methods, it can be concluded that the type of beans most preferred for *Callosobruchus* sp. laying eggs *and* being able to grow imago optimally is cowpeas. Green beans and string beans are only the preferred places for insects *Callosobruchus* sp. to lay their eggs but are not optimal for growing imago. While chickpeas, soybeans, and red beans are the only places to lay eggs, *Callosobruchus* sp. only but can not grow imago. Then the most unfavourable type of nut for laying eggs and unsuitable for growing imago is peanuts. Interest beetle *Callosobruchus* sp. Influenced by several factors, such as the essential content of seeds, seed texture, and microenvironmental conditions.

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