THE PREFERENCES OF *Sitophilus oryzae* ON TYPES AND COLORS OF CONTAINERS FOR POSTHARVEST COMMODITY STORAGES

J. Manueke[1*], J. Pelealu[1], M. Tulung[1], O.R. Pinontoan[1]

[1]*Sam Ratulangi University, Manado, Indonesia*

Abstract

This research was conducted at the Laboratory of Entomology, Department of Plant Pests and Diseases, Faculty of Agriculture, Sam Ratulangi University, Manado, Indonesia. The research objectives were to determine the types and colors of storage containers preferred by Sitophilus oryzae. The direct observation method was used on this experiment, by counting and observing the activities of S. Oryzae population. Results showed that the mostly preferred type of storage containers by S. oryzae was the gunny sack with population of 21.8, then followed by the bucket (19.0), and cloth sack (13.6), and the lowest population was found on plastic bag (10.2). The black container was the most preferred storage container by S. oryzae with the highest S. Oryzae population of 46.4, it was followed respectively by the blue storage container (33.2), the red storage container (28.4), the yellow storage container (12.2), and the lowest was on the white storage container (11.4). In terms of pest control, plastic bags and white containers can be used as one component for controlling storage pests, because it can suppress and reduced the populations of S. oryzae on this study.

Key words: preferences, *Sitophilus oryzae*, types of storage containers, color of storage containers, post-harvest commodities

INTRODUCTION

Postharvest materials are the end products in agriculture and industrial activities. Postharvest commodities have a very high value, because high costs are used through the agricultural activities, which include tillage, seeding, nursery, planting, maintenance, and harvesting. Postharvest products are part of the plants that are harvested with a variety of purposes, especially to provide added values and benefits for farmers and consumers. The storage products are subject to problems of pests, mainly from the class of insects. Pests attacking postharvest commodities, storage pests, have special properties that are different from pests that attack plants in the field. Postharvest pests have special abilities to adapt to conditions of the warehouse or place of storage and to overcome the hardness and dryness of postharvest materials [6],[14],[13],[15].

Host nutrient content and the presence of toxic compounds as well as the adequacy of food to support physiological processes of insects will determine the host. This is evident indicate by successful of the entire life cycle of insects on the host, starting on laying eggs, eggs hatching to larvae or nymphs, pupae and until it becomes an adult (imago). When plants or materials suitable as host, the insect can grow and multiply in plants or plant material ([2], [5]).

In seeking the host, usually insects start moving randomly until they find a particular direction by smell, or sight. Specific odors received through the senses; lead insects to get the correct habitat. For many insects, they attract to certain secondary compounds. Beside the insects can be attracted to the color and shape of the host, many insects use antennas as radar to serve as olfactory to taste or to detect something of interest of the host so the antennas direct the insects to find a desirable habitat [4],[9],[12],[8].

Plants or plant material are the host of insects if the insect can grow and multiply in the host, but different hosts can occur

*Corresponding author: jusufunsrat@gmail.com
The manuscript was received: 15.02.2015
Accepted for publication: 31.03.2015

between pre-adult and adult insects. For example, the pre-adults and adults of Order Lepidoptera, generally they have different hosts. Pre-adult insects live and eat on plant tissues, where the adults usually live and consume nectar from different plant species. Insects that only use plants or parts of plants for shelter or temporary resting place are called visitor insects. Visitor insects may be interested in the plant or plant material because of the colors and shapes, but they cannot grow and develop on that plant or the material. Several insects lay eggs on certain plant, but the plant is not a host, because it only the host of their pre-adult stages [3].

The research was conducted in order to find alternative control components in general postharvest pest control of *S. oryzae*. The study aims to determine the preferences of *S. oryzae* on several types and colors of storage containers.

MATERIAL AND METHOD

The research was done at the Laboratory of Entomology, Faculty of Agriculture, Sam Ratulangi University, Manado, Indonesia for three months. The study was conducted using observational and substitution methods. The complete randomized design (CRD) was implemented on the research. Preference tests of *S. oryzae* on rice were documented on the types and colors of storage containers. The types of storage containers used are gunny-sacks, plastic-bags, cloth-sacks, and bucket. Colors of storage container were red, white, black, blue, and yellow. Pest populations were observed on this study. This research was conducted in several stages: Preparation of test insects stock, sterilization material, preference test, observation, and analysis of the data. Pest population density was the number of individual pests found in each test feed. The pest population density was calculated according to the following formula:

$$P = \frac{n}{N}$$

Where: P = density of pest population
n = number of individuals for all observations (1 ... n)
N = replications observation number

Data of pest populations density were analyzed by ANOVA using SPSS17.0 for windows application program (Narimawati and Munandar, 2008). The differences of pest population were analyzed with one-way ANOVA followed by LSD at level α = 0.05 [6].

RESULTS AND DISCUSSIONS

The study of preferences of *S. oryzae* on types of storage containers showed a significant influence statistically. Data of effects of types of storage containers on population of *S. oryzae* were showed in Table 1.

Table 1 Density population averages of *Sitophilus oryzae* on types of storage containers on 30 days after infestation

No.	Storage Containers	Population Density (Average)	Standard deviation (Sd)	F	Significant
1	Gunny sack	21.8	1.92	30.02 **	0,001
2	Plastic bag	10.2	1.92		
3	Cloth sack	13.6	2.07		
4	Bucket	19.0	2,55		

Notes: ** = Significantly difference.

The data on Table 1 showed that the results of statistical tests on 0.001 value was <0.01. This means that each treatment was highly significancy. To know the difference effects among treatments, it was proceed to the LSD analysis. LSD test on data of the population *of S. oryzae* on several types of storage containers can be followed in Table 2.

Table 2. LSD Test of *Sitophilus oryzae* Population Density on types of storage containers on 30 days after infestation

No.	Storage Containers	Gunny sack	Plastic Bag	Cloth sack
1	Plastic bag	11.6 **	-	-
2	Cloth sacks	8.2 **	3:40 *	-
3	Bucket	2.8 nd	8.80 **	5.40 **

Notes: ** = significantly difference; * = difference; nd = no difference.

The data on Table 2 showed significant differences among gunny sacks, plastic bags, and cloth sacks. Plastic bag and cloth sack showed statistical difference, while the gunny sacks and buckets showed no difference.

The difference of *S. oryzae* population density on several types of storage containers can be followed in Figure 1.

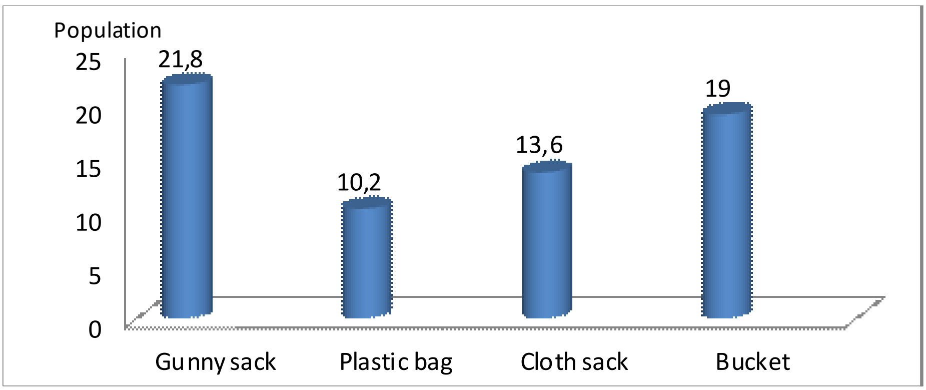

Figure 1 Histogram of Population Density of *Sitophilus oryzae* on Gunny sack, Plastic Bag, Cloth sacks, and Bucket

Histogram of the difference of population density of *S. oryzae* in storage containers showed that the highest population is on gunny sacks and the lowest is on plastic bag. The high population on gunny sack container due to the air circulation in gunny sack was lesser, compared to other storage containers. Gunny sack is a material that can absorb heat; when the air around the gunny sacks become hotter, the gunny sacks will become hot, and when the air around become cooler, the water vapor will be formed inside the gunny sacks, which will be absorbed by the material inside the gunny sacks. When the water content increased on materials will provide ideal conditions for the development of *S. oryzaes*. In addition, gunny sacks can absorb water from the surrounding air so the material inside the sack turn damp due to higher moisture content, that become an ideal condition to pests.

Container which has the highest population was gunny sacks (21.8), while the lowest was plastic bags (10.2). The low pest populations in the plastic bag was caused by the conditions that less support pest life. Air circulation in plastic bags is better than other storage containers, because the material is rather thin then others.

The usage of plastic bags as containers of postharvest materials can be recommended as one component of an integrated postharvest pest control for suppressing populations of *S. oryzaes*. The use of plastic bags is only one component on environmentally friendly pest control, but not the main component.

The results of the experiment of *S. oryzae* preferences on the color container showed significant different statistically. Populations density of *S. oryzae* on various color storage container can be followed on Table 3.

Table 3 Results of average *Sitophilus oryzae* population density on containers color, after 30 days of Infestation

No.	Storage containers color	Population density (average)	Standard deviation (Sd)	F	Significancy
1	Red	28.4	2:41	113.46 **	0.001
2	White	11.4	3.65		
3	Black	46.4	3.85		
4	Blue	33.2	3:27		
5	Yellow	12.2	1.92		

Notes: ** = significantly difference

Statistical test of the data on Table 3 showed that at value 0.001<0.01, it was highly significantly. This means that each treatment gave different effects. The differences among treatments are tested by LSD analysis. The LSD test of population density of *S. oryzae* on several different storage containers colors can be followed on Table 4.

Table 4 LSD test of *Sitophilus oryzae* population density of different color containers, after 30 days of infestation

No.	Storage containers color	Red	White	Black	Blue
1	White	17.0 **	-	-	-
2	Black	18.0 **	35.0 **	-	-
3	Blue	4.8 *	21.8 **	13.2 **	-
4	Yellow	16.2 **	0.8 tn	34.2 **	21.0 **

Notes: ** = significantly difference; * = difference; nd = no difference.

The data on Table 4 showed that the color of storage containers : red and white, red and black, red and yellow, white and black, white and blue, black and blue, black and yellow, and blue and yellow gave significant effects. Storage containers color of red and blue showed difference effects, while white and yellow colors has no effect. The differences of *S. oryzae* population density on several color containers can be followed on Figure 2.

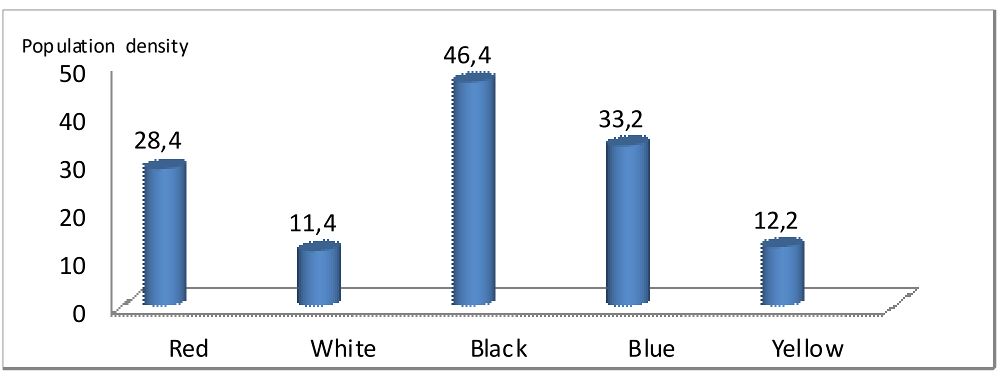

Figure 2 Histogram of Population density of *Sitophilus oryzae* on different color of containers

The observation of *S. oryzae* preferences on the five basic colors indicated that the solid black had the highest population *of S. oryzae* (46.4), followed respectively by the blue (33.2), red (28.4), yellow (12.2), and the lowest is white color (11.4). The high pest populations on black and blue containers indicated that *S. oryzae* interested either on invisible light beams or visible light, where black to blue has the wave length of 475 nm. Invisible lights were white and black, while visible lights consisted of purple, blue, green, yellow, orange, and red.

In addition, the preferences of *S. Oryzae* on black color is natural because this insect is a nocturnal insects, insect that is active at night. As postharvest pests, generally they prefer dark places. Every kind of insect has different sensitivities and interests of the spectrum and the wavelength of lights [1],[10]. According to [7] and [11]; that Coleoptera insects interested, particularly on color with short to medium wave length such as dark colors, blue and green; and this applies also to others nocturnal insects.

The usage of bright colored (white and yellow) storage containers can be recommended in control application of *S. Oryzae* and other general postharvest pests for an environmentally friendly control approach.

CONCLUSIONS

Based on the results and discussion, it can be summarized some of the following:

1. The types and colors of the storage containers affected the *S. oryzae* population density and the damage of postharvest material.
2. Gunny sack as storage container had the highest population density while the lowest population density is plastic bag.
3. The most preferred color was the black container and the least preferred was the white container
4. Plastic bag as storage and white color containers can be recommended as an alternative to pest control component of *S. Oryzae* that is environmentally friendly.

REFERENCES

[1] Borror, D.J, Ch. Triplelhorn dan N.F. Johnson, 1989. *Pengenalan Pelajaran Serangga*. Edisi Keenam. Penerbit Gadjah Mada University Press.Yogyakarta.

[2] Cotton, RT, 1980. *Tamarin-Pod Borer, Sitophilus linearis (Herbst.).* Journal of Agricultural Research. Washington DC Vol. XX. 6. *Http: //preserve.nal.usda. gov / jag / v20 / v20i6 / 200439 / a200439.htm*. Accessed: March 21, 2010.

[3] Hill, DS, 1990. *Pests of Stored Products and Their Control*. CRC Press, Inc. Publishers. Boca Raton. Ann Arbor. Boston.

[4] Kalshoven, LGE, and PA van der Laan. 1981. *Pests of Crops in Indonesia.* PT. New Ichtiar-Van Hoeve, Jakarta.

[5] Karindah, S., A. Purwaningsih, A. Agustin dan L. P. Astuti. 2011. *Ketertarikan Anaxipha longipennis Serville (Orthoptera: Gryllidae) Terhadap beberapa Jenis Gulma Di sawah Sebagai Tempat Bertelur.* Jurnal Entomologi Indonesia 8: 1, April 2011. Perhimpinan Entomologi Indonesia. Hal 27-35.

[6] Kartasapoetra, A.G., 1991. *Hama Hasil Tanaman Dalam Gudang*. Penerbit Rineka Cipta. Cetakan Kedua. Jakarta.

[7] Manueke, J. 1993. *Kajian Pertumbuhan Populasi Sitophilus oryzae dan Tribolium castaneum dan Kerusakan yang ditimbulkan pada Tiga Varietas Beras*. Tesis. Program Pascasarjana Universitas Gadjah Mada.Yogyakarta.

[8] Mallis, A., 2004. *Handbook of Pest control. The Behavior, Life History and Control of Household Pests.* Ninth Edition. Janie Johns, Wild Rice Press, Inc. GIE Media, Inc.

[9] Metcalf, RL, and WL Luckmann, 1982. *Introduction to Insect Pest Management*. Interscience. John Wiley & Sons. New York.

[10] Opara, U.L., 2013. *Effects of Preharvest Management on Postharvest Quality*. International Journal of Postharvest Technology and Innovation. 13 : 3. June 2013. p. 42-53.

[11] Samad, M.Y., 2010. *Pengaruh Penanganan Pasca Panen Terhadap Mutu Komoditas Hortikultura.* Jurnal Pasca Panen. Vol. 5 : 1. Desember 2012. Hal 29-37.

[12] Schoonhoven, L.M, T. Jermy, and J.J.A van Loon. 1998. *Insect - Plant Biology.* From Physiology to Evolution. Chapman and Hall. London.

[13] Surtikanti. 2004. *Kumbang Bubuk Sitophilus zeamais Motsch.(Coleoptera: Curculuionidae) dan Strategi Pengendaliannya*. Balai Penelitian Tanaman Serealia, Maros 90514. Jurnal Litbang Pertanian, 23/4/2004.

[14] Syarief, R. and H. Halid, 1993.*Teknologi Penyimpanan Pangan*. Kerjasama dengan Pusat Antar Universitas Pangan dan Gizi IPB. Penerbit Arcan. Jakarta.

[15] Yoakhim, Y.E., and M. Maramis, 2012. *Inventarisasi Serangga Pada Beras Yang Beredar Di Pasar Tradisional Manado*. Jurnal Ilmu Pertanian Eugenia 19 (2), Fakultas Pertanian Universitas Sam Ratulangi Manado. p. 103-110.

[16] Zainudin, M., 2000. *Metodologi Penelitian*. Chalia Indonesia. Jakarta.