The Effect of different Host Grains on the Biological Aspects of the Lesser Grain Borer *Rhyzopertha dominica* (Fab.) (*Bostrichidae: Coleoptera*)

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ABSTRACT

Laboratory experiments were conducted in Economic Entomology Department, Faculty of agriculture, Mansoura University and used non-choice test to evaluate some biological aspects of *Rhyzopertha dominica* on different host-grains and by One-way ANOVA statistical test to understand if the differences were significant or non-significant based on the host grains then a chemical analysis was done to investigate the most effective chemical ingredient on the susceptibility of *R. dominica*. The results showed that *R. dominica* reared on wheat grains have the shortest development period (25.40 ± 0.75, days) and the highest progeny for the first and second generations (46.80 ± 0.73 and 76.20 ± 4.27, individuals). Comparing with the other host grains, and wheat was the most susceptible host grain with susceptibility index (15.19 ± 0.39), percentage of protein, fibers, fats, ash, magnesium, zinc, and iron affect the biological aspects of *R. dominica*. The results indicated that there is a relationship between biological characteristics, the insect's ability to cause damage, and the type of host grains, as well as their chemical composition.

Keywords: Host Grains; biological aspects; *Rhyzopertha dominica*; constant temperature.

INTRODUCTION

The Poaceae family is one of the top plant families. It is also one of the most significant food sources in the world because it contains many plant species that are used to feed animals and poultry, as well as cereal crops that are a major source for human feeding. (Wheat, maize, rice, and oats), which people consume throughout the day and consume in very large quantities throughout the year, and some countries resort to importing them annually to meet the people's need for them. (Sarwar et al., 2013 and Shavanov, 2021) Stored grains are one of the most important products that people and animals depend on in their daily lives (Sarwar et al., 2013). Pests are estimated to destroy between 7% and 50% of all crops each year. (Pimentel and Rattan 2009; Sallam and Bothe 1999; Calliney et al. 2014; Oliveira et al. 2014). These insects also have an impact on the quality of grains, their nutritional content, and their suitability for human or animal consumption. (Stathers et al. 2020).

One of the most important insects that infest many types of stored grains in Egypt is the lesser grain borer *Rhyzopertha dominica*. This insect is found in most countries of the world. It belongs to the order Coleoptera family (*Bostrichidae*). This insect is considered one of the primary and dangerous insects that infect stored grains such as wheat, rice, and maize. This insect is classified as an internal primary pest being a borer. The development occurs in grain mass due to its adaptability and high vital capacity (Pires and Nogueira, 2018).

The female lays an egg on the kernel of the grain and the newly larvae swings in the nucleus and completes its growth. The adult feeds on the seed of the grain when it reaches maturity. The adult stage punctures the nucleus, creating an exit hole. Then the kernel of the grain is classified as damaged kernel due to insects grading purposes (Mason et al., 2012). Outbreak *R. dominica* causes direct product deterioration and indirect economic loss through product rejection due to injury and costs associated with eliminating the injury. Another hidden loss negative effects on grain quality often go unreported as a result for nutritional damage caused by *R. dominica*. (Arthur et al. 2020).

The present experiment aims to investigate the effect of different host-grains on the biological aspects of the lesser grain borer *R. dominica* under laboratory conditions.

MATERIALS AND METHODS

The present study was carried out in the laboratory of Entomology belonging to the Economic Entomology Department, Faculty of Agriculture, Mansoura University for two years 2021 and 2022.

Insect culture

On wheat grains, the grains were sterilized at -18 °C for 48 hours to eradicate any visible and concealed insect and mite infestations. To equilibrium the moisture content of these grains, they were conditioned for at least a week in an incubator at 35±1 °C and 60±5% R.H. These grains were used to mass raise the insect in glass jars with a capacity of 2 liters. The insects used for the infestation were collected from the Agricultural Research Center in Sakha, Kafr El-Sheikh. The adults that emerged were used in the experiments.

effect of host grains on the biological aspects.

The lesser grain borer *R. dominica* biological experiments were conducted in the laboratory at a constant temperature degree of 35 ± 1 °C, and 60 ± 5% relative humidity (R.H.) on each host grain Wheat (*Triticum aestivum*), maize (*Zea mays*), rice (*Oryza sativa*), and oat (*Avena sativa*) under Completely Randomized Design (CRD). Observations were made on progeny, weight loss,
While oat during the first generations lost more weight, which represented by: (0.65 ± 0.02 g) and the least weight loss for the first generation was on maize (0.40 ± 0.02g) during the second generation the highest weight loss was on rice followed by wheat and represented by, 1.08 ± 0.08 and 1.01 ± 0.08 g, respectively, while the least weight loss for the second generation was on maize which represented by 0.74 ± 0.02g. The susceptibility index where was the highest on wheat grains followed by oat grains which represented by 15.19 ± 0.39 and 14.34 ± 0.40, respectively. Meanwhile, the lowest susceptibility index was recorded on maize grains and presented by 11.62 ± 0.30 (Table 1).

The results of statistical analysis indicated that a significantly differences in developmental, F1and F2 progeny and susceptibility index according to the different host grains at 35±1°C for rearing the insect pest, while were no significant differences on weight loss for F1 between oat, rice and wheat, maize, while on weight loss of F2 there were no significant differences on wheat, maize, and rice grains.

Several authors (Breese, 1960; Golebiowska, 1969; Rao and Wilbur, 1972 and Campbell and Sinha, 1976) assessed the grain loss consumed by the lesser grain borer R. dominica in the laboratory, and there were differences in weight loss between authors, which could be due to different experimental conditions or the hardness of grains or strains of R. dominica. According to (Kumar, 2017 and Nayak and Daglish, 2018) the susceptibility index varied between different host- grains and it agrees with the research findings. The development period on wheat grain was the shortest 25.40 days these result in agreement with (Birch, 1953 and Ede, 2012). (Perez-Mendoza et al., 1999) indicated that R. dominica reared on rice or wheat were more active than those reared on Maize what explain that the weight loss was the least on Maize grains.

| Table 1. Effect of Different Host Grains on The Biological Aspects of The Lesser Grain Borer R. dominica at 35±1°C. |
|---------------------------------|-------|-------|-------|-------|
| Host Grains | Biological aspects | Wheat | Maize | Rice | Oats |
| Developmental period | 25.40 | 27.0 | 26 | 26.20 |
| ±0.75a | ±0.40a | ±0.68a | ±0.52a |
| F1 progeny | 46.80 | 23.2 | 32.0 | 42.60 |
| ±0.73a | ±1.43d | ±1.05c | ±0.52b |
| F2 Progeny | 76.20 | 39.40 | 49.20 | 67.2 |
| ±4.27a | ±2.99c | ±2.22b | ±2.52a |
| F1 Weight loss | 0.49 | 0.40 | 0.62 | 0.65 |
| ±0.04b | ±0.02b | ±0.05a | ±0.02a |
| F2 Weight loss | 1.01 | 0.74 | 1.08 | 1.00 |
| ±0.08a | ±0.02a | ±0.08a | ±0.03b |
| susceptibility index | 15.19 | 11.62 | 13.05 | 14.34 |
| ±0.39a | ±0.30c | ±0.29b | ±0.40a |

Mean ± SE followed by the different letters in a row are significantly differences at 5% level of probability (Duncan’s Multiple Range Test). (n=5, df=3).

The obtained present data illustrated in Fig. (1) cleared that the weight loss percentage of host grains resulting to feeding R. dominica during the two generations F1 and F2 according to the different temperature degrees. The highest weight loss percentage for F1 and F2 were recorded on rice (6.16 and 10.76%) followed by oat (10.14 and 4.88%) for the two generations, respectively. Meanwhile, the lowest weight loss for F1 and F2 recorded on maize and presented by 7.40
and 4.02%, respectively. Statistical analysis indicated that, there was no significant differences temperature in the weight loss percentage on wheat, rice, and oat grains for F1.

Data arranged in Table (2) showed the chemical composition of four host-grains of Poaceae family (Wheat, Maize, Rice, and Oat), and a group of chemical components and elements were estimated. It can be noticed that Wheat was the shortest developmental period and the highest progeny in the two generations and the highest susceptibility index where the highest percentage of protein (11.03%) on the other hand wheat was the lowest on fibers (0.76%), and fats 1.20%. Also, low percentage of ash (0.90 %), magnesium (1.02 mg.100g⁻¹), zinc (1.69 mg.100g⁻¹), and iron (0.83 mg.100g⁻¹) while oat was the highest on weight loss and highest percentage of fats (7.13%) in addition to moisture (13.13%) also was the highest content of those elements’ potassium (349.61mg.100g⁻¹), phosphorus (476.96 mg.100g⁻¹), magnesium (112.93mg.100g⁻¹) and calcium (53.19mg.100g⁻¹).

While Maize was the most resistant host grain with the lowest susceptibility index and longest developmental period, it was noticed that Maize contains the highest amount of phenol (170.46 mg.100g⁻¹) and oil (3.96 mg.100g⁻¹).

According to results all cereal grains are highly preferred by *R. dominica*. Furthermore, wheat is the most preferred host grain when compared to other cereals. Progeny can be influenced by various types of cereal grains, which are influenced by the quality of grains. The quality can be measured by chemical properties, these have an impact on the development of insects. The suitable nutritional content in cereals can increase the progeny of *R. dominica* (Arthur et al., 2012 and Toews et al. (2001) mentioned that the chemical structure of grains can strongly influence the progeny of *R. dominica*. the chemical characteristics of grains are one of the most effective factors affecting the development of *R. dominica* (Astuti et al., 2013).

The percentage 12-14% of moisture of grain is the optimum temperature for *R. dominica* development is between at 26 -34 °C (Birch, 1945 and Edde, 2012). And this result agrees with the research results.

**REFERENCES**


Awwadalla, S. S. et al.


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**Rhyzopertha dominica**

*Tأثر الحبوب المختلفة العائمة على الخصائص البيولوجية لناقات الحبوب الصغرى (Fab.) (Bostrichidae: Coleoptera).*

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قسم الحشرات الاقتصادية - كلية الزراعة - جامعة المنصورة.

المخلص

جرحت التجربة بعمل الحشرات الفائت نتائج الحشرات الاقتصادية بكلية الزراعة جامعة المنصورة. استخدمت التجربة لاختبار عدم الاختيار لقيام بعض المواد البيولوجية لحشرة ناقلة الحبوب الصغرى على حبوب مئوية مختلفة واستخدام اختبار *ANOVA* للإحصائيات لأدوات التجربة. تم إجراء اختبارات منفصلة لقياس مدى الاختلافات بين بعض المكونات الكيميائية والخصائص الفسيولوجية لِناقات الحبوب الصغرى من حبوب مختلفة. النتائج أظهرت أن بعض الحبوب الصغرى كانت قد نجحت في إحداث الأضرار على حبوب المحاصيل، بينما لا تزال النتائج تتعلق بالناقات التي تمتزج بين نباتات مختلفة. الأضرار المحسوبة على النباتات كانت تختلف حسب الظروف البيئية والظروف الفسيولوجية للنباتات. النتائج أظهرت أن بعض الحبوب الصغرى كانت قد نجحت في إحداث الأضرار على حبوب المحاصيل، بينما لا تزال النتائج تتعلق بالناقات التي تمتزج بين نباتات مختلفة. الأضرار المحسوبة على النباتات كانت تختلف حسب الظروف البيئية والظروف الفسيولوجية للنباتات.