International Journal of Agriculture and Earth Science (IJAES) E-ISSN 2489-0081
P-ISSN 2695-1894 Vol 8. No. 6 2022 www.iiardjournals.org

The Efficacy of Three Botanical Leaf Powders *(Ocimum gratissimum*, *Azadirachta indica*, and *Carica papaya*) in the Control of Rice Weevil (*Sitophilus oryzae*)

Okore, O. O., *Ekedo, C.M, Ibediugha, B. N., Ehisianya, C. N., and Sunday, D. I.
Department of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike, P.M.B. 7267, Umuahia, Abia State, Nigeria

D.O.I: 10.56201/ijaes.v8.no6.2022.pg69.75

ABSTRACT

Rice is an economically important crop and the most important staple food for the world's population. The aim of the study was to evaluate the efficacy of three botanical leaf powders, scent leaf, neem and paw-paw in the control of rice weevil Sitophilus oryzae on stored rice grain. The leaf powders were mixed with the rice grain at the quantities of 3g, 6g, 9g and 12g per 20g of rice. In the control, no treatment was used. The plant leaves were dried under room temperature and ground into fine powders. The experimental design adopted for the experiment was Complete Randomized Design (CRD) and each treatment was replicated four times for each experiment. Ten (10) adult S. oryzae unsexed were introduced into each vial including the control and were subsequently covered with muslin cloth held tightly in place by a rubber band to avoid their escaping. The experiments were monitored for 96 hours. The results showed that all the plant leaf powders were good grain protectants. Scent leaf recorded its highest percentage mortality of 40% in 6g, 9g, and 12g after 48 hours, whereas neem had its highest percentage mortality of 40% in 6g and 12g at 48 hours, while paw-paw recorded its highest mortality of 40% in 9g and 12g at 48 hours. No mortality was recorded in the control experiment. These botanical leaves powders especially scent leaf should be incorporated into grain protection practice of resource poor farmers and small scale rice dealers.

Keywords: *Rice, Rice weevil, Botanical leaf powders, Efficacy*

INTRODUCTION

Rice (*Oryza sativa* Linn.) is an economically important crop and the most important staple food for the world's population. More than 90% of the world's rice is produced and consumed in Asia. Thailand is one of the major rice exporter countries of the world, making 70% of export good and values worth over 114,077 million yearly (Omar *et al*., 2007). The rice plant is vulnerable to various kinds of pests, from the seeds to the stored grains. Rice losses occur when the milled grains are attacked by stored product pests; the important one is the rice weevil, *Sitophilus oryzae* L. (Coleoptera: curculionidae). Damages caused by rice weevil seriously affect the availability of food for a large number of people worldwide. Without a control measure, the weevils rapidly grow, develop, and damage the stored rice grains. The quality of rice grains is so poor that they do not meet the requirement for normal consumption, exportation, and industrial purposes. Chemical control of rice weevils has been used, such as rice fumigation with insecticides (Dal Bello *et al*., 2001). Using synthetic chemicals as insect pest control has given rise to a number of problems, including adverse effects on the environment and human health (Odeyemi *et al*., 2008). Recently, there has been considerable pressure from consumers opposed to the use of synthetic insecticides in foods (Padin *et al*., 2002). Alternative means for rice weevil control are considerably needed to be developed, especially from natural plant products which are from the secondary metabolites of plants. Plant secondary metabolites are chemicals that plants make for their vital function such as protection from pest infestation and Ultraviolet radiation, attraction for pollinating insects, coloring, scent, waste or plant hormones (Odeyemi *et al*., 2008). Many plant products have been evaluated for their toxic properties against different stored grain pests, especially from crude extracts (Isman, 2006). They are largely accessible and non-toxic to humans and the environment. The economic significance of rice, the devastating nature of *S. oryzae* to the crop, as well as the availability of botanical materials in the country; provided the reason for the present study with the overall objective of assessing the efficacy of *Carica papaya*, *Ocimum gratissimum* and *Azadirachta indica* leave powder as alternatives to synthetic pesticides for the control of rice weevil, *S. oryzae*.

Materials and Methods

Study Area

This research was carried out at the final year Laboratory of the Zoology and Environmental Biology Department, Michael Okpara University of Agriculture Umudike, Abia State. Umudike is located in the tropical rain forest zone of Nigeria on latitude $05^{0}26^{1}$ - $5^{0}25^{1}$N and longitude $07^{0}34^{1}$ – $7^{0}36^{1}$E (NRCRI, 2003).

Insect culture

The adult of *S. oryzae* used for the experiment were cultured in plastic buckets covered with muslin cloth in the laboratory at 27± 2°C, 60 to 65% relative humidity and 12h: 12h light: dark regime. *S. oryae* were collected from infested rice from a small scale dealer in Amawom Oboro, Ikwuano L. G. A., Abia state. The weevils were reared for two weeks. The dark brown adults were used for the experimental studies.

Rice used for the experiment.

The Nigerian *Oryza sativa L*. (local rice) used for the experiment, were purchased from ubani market in Umuahia North L.G.A of Abia state. A pre-experiment was conducted to ascertain whether the rice was free from chemicals to avoid altering the results. The experiment was conducted in the laboratory for 4 days (same as in control in the methodology). After the pre-experiment no mortality was recorded, hence the rice was free from chemicals and they were used. The rice was further sterilized by putting in an oven for two hours.

Collection and preparation of plant materials.

The fresh leaves of paw-paw (*Carica papaya*), scent leaf (*Ocimum gratissimum*) and neem (*Azadirachta indica*) were collected from the plant trees around Olokoro Umuahia North L.G.A, Abia State. The leaves of the plant were dried under laboratory condition. The dried leaves were ground separately with a machine grinder into powder and these were sieved to obtain fine powders. The plant leaf powders were put into air tight containers separately to ensure that the active ingredients were not lost. The powders were stored in a cool dry place until when needed.

Methodology

The leaves powders at different weights (3, 6, 9 and 12g) were used to test their efficacy against the rice weevil (*S. oryzae*). These were introduced into 20g of clean rice grain and thoroughly mixed together by agitating the vials manually. A control treatment in which no powder was added was also set up. The treatments were replicated four times for each experiment (Okore *et al.*, 2017).

Ten (10) (dark brown coloured) adults of *S. oryzae* unsexed (taken from the stock culture kept in the laboratory), were introduced into each vial including the control and were covered with muslin cloth held tightly in place by a rubber band to prevent the insects from escaping. Using the method reported by Law-Ogbomo and Enobakhare (2007) and Okore *et al* (2017), the mortality counts of the weevils were recorded at 24, 48, 72, and 96 hours post treatment. The numbers of dead insects which did not respond to pin probes, were counted and recorded for all the experimental vials. The counting was done by pouring the content of each vial on a small white tray and insects sorted out of the mixture using a pin probe.

Statistical analysis

The data gathered were analyzed in SPSS using simple descriptive statistics of frequencies and percentages, and results were presented in tables.

Results

All the leaf powder with different quantities recorded a significant mortality for the weevil. The highest mortality rates occurred in 48 hours in all the plant leave quantities and the least mortality count was recorded in 96 hours for each of the quantities.

Mortality rate of *S. oryzae* in *O. gratissimum*

The effectiveness of *O. gratissimum* in the control of *S. oryzae* is shown in Table 1. The 3g, 6g and 12g quantity recorded the highest total mortality of 40 each, while 9g recorded 39 mortality. In the 6g, 9g and 12g weights, the highest mortality rates occurred at 48 hours while for 3g the highest mortality rate was recorded on the 72nd hour.

Table 1 Mortality rate of *S. oryzae* treated with *O. gratissimum* in stored rice

Time	0g	3g	6g	9g	12g
24 hours	0(0.00)	9(22.50%)	12(30.00%)	4(10.00%)	4(10.00%)
48 hours	0(0.00)	11(27.50%)	15(37.50%)	19(47.50%)	19(47.50%)
72 hours	0(0.00)	16(40.00%)	10(25.00%)	15(37.50%)	17(42.50%)
96 hours	0(0.00)	4(10.00%)	3(7.50%)	1(2.50%)	0(0.00%)

Total	0(0.00)	40(100.00%)	40(100.00%)	39(97.50%)	40(100.00%)

Numbers indicate dead weevils; numbers in brackets show percentage mortality.

Mortality rate of *S. oryzae* in *A. indica*

The effectiveness of *A. indica* in the control of *S. oryzae* is shown in Table 2. The 6g and 12g quantity recorded the highest total mortality of 40 each, followed by 9g that recorded 39 while 3g recorded 35 mortality. In the 6g, 9g and 12g weights, the highest mortality rates occurred at 48 hours while for 3g the highest mortality rate was recorded on the 96th hour.

Table 2 Mortality rate of *S. oryzae* treated with *A. indica* in stored rice

Time	0g	3g	6g	9g	12g
24 hours	0(0.00)	0(0.00%)	11(27.50%)	10(25.00%)	12(30.00%)
48 hours	0(0.00)	6(15.00%)	15(37.50%)	17(42.50%)	18(45.00%)
72 hours	0(0.00)	13(32.50%)	10(25.00%)	9(22.50%)	9(22.50%)
96 hours	0(0.00)	16(40.00%)	4(10.00%)	3(7.50%)	1(2.50%)
Total	0(0.00)	35(87.50%)	40(100.00%)	39(97.50%)	40(100.00%)

Numbers indicate dead weevils; numbers in brackets show percentage mortality.

Mortality rate of *S. oryzae* in *C. papaya*

The effectiveness of *C. papaya* in the control of *S. oryzae* is shown in Table 3. The 9g and 12g quantity recorded the highest mortality of 40 each, followed by 6g that recorded 36 while 3g recorded 33 mortality. In the 6g, 9g and 12g weights, the highest mortality rates occurred at 48 hours while for 3g the highest mortality rate was recorded on the 96th hour.

Table 3 Mortality rate of *S. oryzae* treated with *C. papaya* in stored rice

Time	0g	3g	6g	9g	12g
24 hours	0(0.00)	6(15.00%)	8(20.00%)	9(22.50%)	12(30.00%)
48 hours	0(0.00)	9(22.50%)	13(32.50%)	15(37.50%)	18(45.00%)
72 hours	0(0.00)	8(20.00%)	9(22.50%)	11(27.50%)	9(22.50%)
96 hours	0(0.00)	10(25.00%)	6(15.00%)	5(12.50%)	1(2.50%)
Total	0(0.00)	33(82.50%)	36(90.00%)	40(100.00%)	40(100.00%)

Numbers indicate dead weevils; numbers in brackets show percentage mortality.

Mortality rate of *S .oryzae* in all the botanical powders.

The results of the evaluation of the three botanical powders in the control of *S. oryzae* within the 96 hours of the experiment are shown in figure 1. *O. gratissimum* recorded the highest mortality of 159 (99.36%), followed by *A. indica* 154 (96.25%). The least mortality was recorded for *C. papaya* with 148 (92.50%). No mortality was recorded in the control experiment.

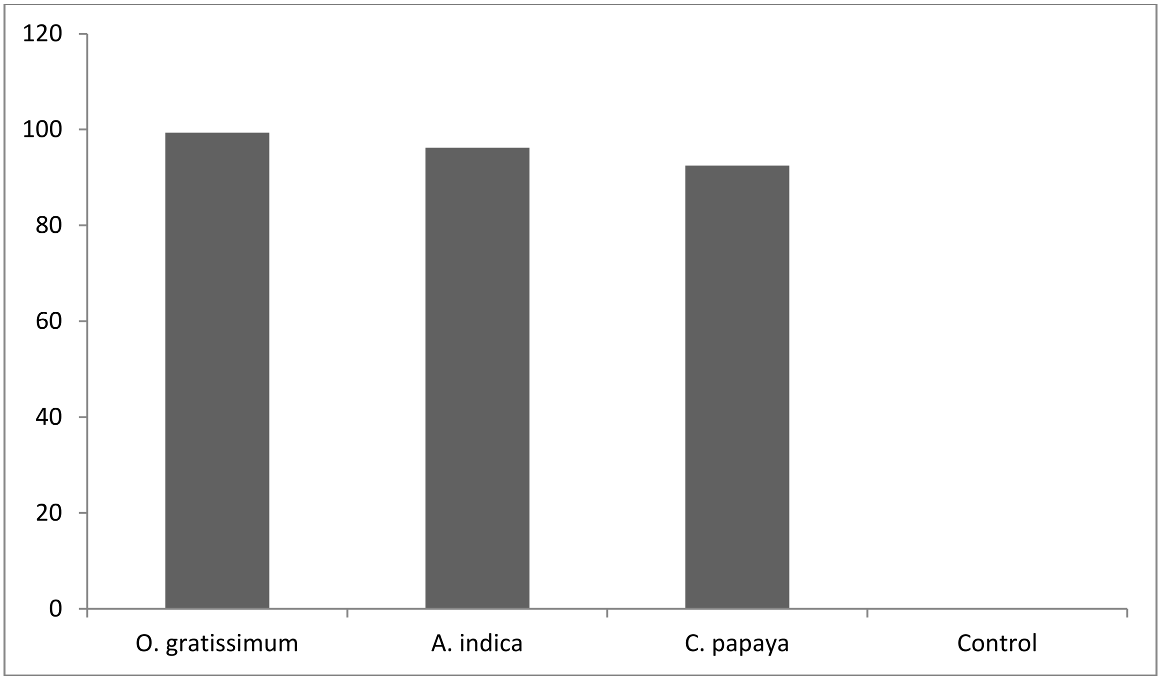

Figure 1: Comparing the mortality rates of *S. oryzae* in all the treatments.

Discussion

The study on the efficacy of three botanical leaf powders in the control of *S. oryzae* showed that the botanicals can be good protectants of rice grain (*O. sativa*) against rice weevil *(S. oryzae).* All the botanicals used in this study showed some insecticidal properties by significantly reducing the number of rice weevil in the experimental vials. The results lend credence to the fact that botanical seed powder can be used to control the rice weevil infestation in stored rice. The utilization of different plant products as stored products protectant has been reported by Law-Ogbomo and Enobakhare (2007), Araya and Emana (2009) and Ukpai *et al* (2017). This shows that the resource poor farmers and rice dealers can use botanicals in the control of rice weevil.

O. gratissimum recorded the highest mortality in all the botanicals with 159 death rates. This highest mortality rate recorded in all of the different weights of the leaf powders was from *O. gratissimum*. This shows that *O. gratissimum* is a good protectant of rice against *S. oryzae.* Law-Ogbomo and Enobakhare (2007) reported that *O. gratissimum* is a good protectant of stored rice grains against weevil infestation.

A. indica showed significant mortality effects on *S. oryzae*. The leaf powder of *A. indica* was toxic to the weevils. A total of 154 *S. oryzae* were recorded dead with *A. indica*. The 6g and 12g treatments had the highest mortality of (40) each, while the other mortalities are were as follows 9g (39) and 3g (35). This result is similar to the work of Omotoso (2014) where higher dose of a protectant has been reported to work effectively in the control of stored grains. Reduced biological activities were observed in the treated rice and the weevils abstained from feeding. This could have been as a result of the antifeedant property of the plant seed dust, which prevented them from feeding. This may have led to the death of the weevils.

C. papaya showed some insecticidal property in the protection of rice grain against *S. oryzae*, though it recorded the least mortality of 148 for the period of the experiment. The highest mortality was recorded in the treatment with 9g and 12g (40) each followed by 6g (36) and 3g (33). The use of plant powders could have resulted in death of insects as a result of physical barrier effects of the plant materials (Muzemu *et al*., 2013). This is because the powder has the tendency of blocking the spiracles of the insects thus impairing respiration leading to the death of insects. While feeding on whole grains, *S. oryzae* can pick up lethal doses of the treatment thus resulting in stomach poisoning (Law-Ogbomo and Enobakhare, 2007) and subsequent death.

Rice weevils treated with *O. gratissimim* had the highest weevil mortality (34.49%) compared to the other botanicals (Fig 1). However, the difference in effectiveness was not significant in the other botanicals.

Conclusion

Many researchers have recently concentrated their efforts on the search for active natural products from plants as alternatives to conventional insecticides. Some of these researchers reported that plant materials and local traditional methods are much safer than chemical insecticides and suggested that their use needed exploitation.

This present research findings have shown that some botanicals like *Ocimum gratissimum Azadirachta indica* and *Carica papaya* can serve as good protectant of rice grain in the control of *Sitophilus oryzae* during storage and *O. gratissimum* should be incorporated into grain protection practice of resource poor farmers and small scale rice dealers.

ACKNOWLEDGEMENTS

The authors are grateful to God Almighty who gave us the grace to carry out this work. We wish to thank the Head of Department of Zoology and Environmental Biology for granting us the laboratory space for this work.

REFERENCES

Araya, G. and Emana, G. (2009). Evaluation of Botanical Plants Powders against *Zabrotes subfasciatus* (Boheman) (Coleoplera: Bruchidae) In Stored Haricot Beans under Laboratory Condition. *African Journal of Agricultural Research*, **6**(10): 1073-1079.

Dal Bello, G., Padin, S., Lastra, C. L., and Fabrizio, M. (2001). Laboratory evaluation of chemical biological control of the rice weevil (*Sitophilus oryzae* L.) in stored grains. *Journal of Stored Products Research*. **37**: 77-84.

Isman, M. B. (2006). Botanical insecticides, deterrents and repellents in modern agriculture and an increasingly regulated world. *Annual Review Entomology*. **51**: 45-66.

Law-ogbomo, K. E. and Enobakhare, D. A. (2007). The Use of Leaf Powders of *Ocimum gratissimum* and *Vernonia amygladina* for the Management of *Sitophilus oryzae* (L) in Stored Rice. *Journal of Entomology*, **4:** 253-257.

Muzemu, S., Chiamba, J. and Goto, S. (2013). Screening of Stored Maize (*Zea mays* L) Varieties Grain for Tolerance against Maize Weevil *Stophilus zeamais* (motsch). *International Journal of Plant Research* **3(3):**17-22.

National Root Crops Research Institute (NRCRI) (2003). Metrological station. National Root Crops Research Institute Umudike, Umuahia.

Odeyemi, O. O., Masika, P., and Afolayan, A. J. (2008). A review of the use of phytochemicals for insect pest control. *African Plant Protection*. **14**: 1-7.

Okore, O. O., Ibediugha, B. N., Ubiaru, P. C. and Igbokwe, E. C. (2017). Efficacy of *Carica papaya*, *Citrus sinensis* and *Picralima nitida* against Cowpea bruchid *Callosobruchus maculates* and maize weevil, *Sitophilus zeamais* in storage. *Animal Research International*, **14**(3): 2892-2897

Omar, S., Marcotte, M., Fields, P., Sanchez, P. E., Poveda, L., Mata, R., Jimenez, A., Durst, T., Zhang, J., Mackinnon, S., Leaman, D., Arnason, J. T., and Philogene, B. J. R. (2007). Antifeedant activities of terpenoids isolated from tropical Rutales. *Journal of Stored Products Research.* **43**: 92-96.

Omotoso, O. T. (2014). Evaluation of The Powder of Three Medicinal Botanicals in the Control of Maize Weevil, *Sitophilus zeamais* motschulsky. *Nature and Science*. **12(11):**184-190.

Padin, S., Dal Bello, G., and Fabrizio, M. (2002). Grain loss caused by *Tribolium castaneum*,*Sitophilus oryzae* and *Acanthoscelides obtectus* in stored durum wheat and beans treated with *Beauveria bassiana*. *Journal of Stored Products Research.* **38**: 69-74.

Ukpai, O. M. Ibediugha, B. N. and Ehisianya, C. N. (2017). Potential of seed dusts of *Jatropha curcas* L., *Thevetia peruviana* (PERS.), and *Piper guineense* SCHUMACH. against the maize weevil, *Sitophilus zeamais* (MOTSCHULSKY, 1855) (Coleoptera: Curculionidae) in storage of corn grain. *Polish Journal of Entomology*, **86**: 237-250.