**BIOACTIVITIES OF SELECTED BOTANICALS AGAINST WHEAT GRAIN WEEVILS (*Sitophilus granarius*) IN STORED WHEAT GRAINS**

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**ABSTRACT**

The experiment was conducted to ascertain the efficacy of leaf powder of three botanicals (*Azadirachta indica, Moringa Oleifera and Ocimum gratissimum*) against *Sitophilus granarius* in stored wheat grains. Phytochemical screening of the leaves revealed the presence of flavonoid and phenol in Moringa, Alkaloids, flavonoids, Tannin, Glycosides and Saponin in *A. indica* while *O. gratissimum* contained Alkaloid, flavonoid, Tannin, Phenolic compound and Saponin. Adult *S. granarius* were cultured and exposed to different doses of the powder, 0g (control), 5, 10, 15, 20, 25 and 30g to assess their percentage mean mortality after 96hrs exposure. The result obtained showed that plant powder of *M. oleifera* recorded the highest percentage mean mortality of 93.33% after 96hrs exposure when compared with other treatments, followed by *O. gratissimum* (88.30%) then the least by *A. indica* (71.7%). The control (0g) does not evoke any weevil mortality. The leaf powder of *M. oleifera* evoked the highest percentage mean mortality. *A. indica, M. oleifera* and *O. gratissimum* had LD50 values of 4.40g, 2.70g, 3.00g and LD90 value of 32.40g, 9.80g and 10.80g respectively. It was concluded that the leaf powder of *A. indica*, *M. oleifera* and *O. gratissimum* could be used for the protection of stored wheat from *S. granarius* infestation.

**Keywords**: *Azadirachta indica, Moringa Oleifera, Ocimum gratissimum*, *Sitophilus granarius,* phytochemical.

**INTRODUCTION**

Crop protection is an indispensable measure required to achieve success in farming operation. The protection of farm produce from storage pests especially insects does not end in the field but adequate concern must be given to farm produce especially grains when in storage. Grains such as maize, rice, wheat, millet, sorghum form a crucial part of daily human food consumption and livestock feed, therefore there is need to protect these food/feed materials from storage pest. It has been estimated that between one quarter and one third of the world grain crop is lost each year during storage (WA, 2019). Wheat which is regarded as an important food with high nutritional benefits is one of the most vulnerable grains being damaged by storage insect known as *Sitophilus granarius* (Wheat weevil).

To mitigate the effect of *Sitophilus granarius* and other grain weevils, crop farmers adopt several methods. The most widely adopted among these methods is the use of synthetic insecticides and pesticides to curtail the likely menace created by weevils. In the past the use of synthetic insecticides has recorded a lot of success in curtailing the damage caused by weevils but recently health and environmental concerns have made researchers to seek alternative means of controlling weevils as the residual effects of synthetic chemicals cannot be overlooked.

Crop farmers and researchers opt for botanicals as an alternative to control storage weevils in stored grain as these natural products are regarded as cheap, health and environmental friendly. This study therefore intends to assess the potency of three botanical leaf powder (*Azadirachta indica*, *Moringa oleifera* and *Ocimum gratissimum*) as a natural remedy to mollify the effects of *Sitophilus granarius* in stored wheat grains.

**MATERIALS AND METHODS**

**Experimental Site**

The study was conducted in the Environmental Biology Laboratory, School of Pure and Applied Science, The Federal Polytechnic Ilaro, Ogun State, Nigeria

**Experimental Materials**

All the botanicals used for this study and other experimental materials such as wheat grain and petri dishes were locally sourced within Ilaro, Ogun State, Nigeria.

**Identification of Botanicals**

The botanicals used for this study were physically recogized in the Department of Botany, Federal University of Agriculture Abeokuta, Ogun State, Nigeria.

**Preparation of Botanicals**

Leaf samples of *Azadirachta indica*, *Moringa oleifera* and *Ocimum gratissimum* were thoroughly washed with clean distilled water, air dried in a clean room with a room temperature of 24-270C for 3weeks. Samples were ground into fine powder using electric blender when confirmed dried with moisture of about 12%. The grinded samples were further passed through 2mm sieve to remove larger particles. Each sample was placed in moisture free clean plastic container with cover to avoid samples losing their insecticidal property and labeled for further use.

**Preparation of Wheat Grain and Rearing of *Sitophilus granarius***

Healthy wheat grains were kept in a clean airtight transparent plastic for 2months to effect the infestation of grain weevil (*Sitophilus granarius*). At two months, the grains were already attacked by grain weevil (*Sitophilus granarius*). The newly emerged adult weevils were selected and used for the experiment.

**Phytochemical Screening**

Phytochemical screening was done to determine presence or absence of secondary metabolites such as tannin, alkaloids, flavonoids, saponin, phenol, phenolic compounds and glycosides. This was done according to established procedures.

**Study Design**

The adult survival of *S. granarius* was observed using the method of Dawit and Bekelle (2010). Ten clean disinfected healthy wheat grains were selected into sterilized petri-dishes. 0g (control), 5g, 10g, 15g, 20g, 25g and 30g of each of the plant powder were thoroughly mixed with the wheat grain using a clean spoon to ensure admixture. Treated grains were left undisturbed for 30minutes after which 10 adult *S. granarius* was introduced into each of the petri-dishes containing the treated wheat grain. Treated and untreated grain in petri-dish were covered with clean muslin cloth to avoid germs interference and placed in an incubator. Observations were made after 96 hours to record weevil mortality. The treatments were setup in triplicates. The petri-dishes were arranged in a Completely Randomized Design

**Statistical analysis**

Statistical analysis (Standard Deviation, Standard Error of Mean, % Mean Mortality and Significance level) of the experimental data was performed using the computer software SPSS for windows version 16.0. MS EXCEL 2007 and Finney (1971) Probit table were used to find the Probit values for LD50 and LD90.

Percentage weevil mortality was calculated by using the formula;

% Mortality = Number of dead weevil × 100

 Number of weevil tested

**RESULTS**

Table 1 shows the qualitative analysis of phytochemicals present in the leaves of *Moringa oleifera, Azadirachta indica* and *Ocimum gratissimum*. The secondary metabolites examined were Alkaloids, flavonoids, tannin, glycosides, phenolic compound, phenol and saponin. In all the phytochemicals examined, only flavonoids and phenol were present in Moringa, phenolic compound and phenol were absent in Neem while glycosides and phenol were absent in Scent leaf.

**Table 1: Qualitative screening of the leaves of *M. oleifera, A. indica* and *O. gratissimum* for Phytochemicals**

|  |  |
| --- | --- |
| Plant | Phytochemical |
| Alkaloids | Flavonoids | Tannin | Glycosides | Phenolic compound | Phenol | Saponin |
| Moringa | - | + | - | - | - | + | - |
| Neem | + | + | + | + | - | - | + |
| Scent | + | + | + | - | + | - | + |

* **= Absent; + = Present**

Table 2 shows the effect of *Azadirachta indica* leaf powder in curtailing the potential damage of *Sitophilus granarius* in stored wheat grain after 96hrs of storage. *Azadirachta indica* leaf power shows a great deal of potential in controlling wheat grain weevil. Highest weevil mortality was observed at 20 and 25g doses while 30g dose recorded same value as 10g and 15g dose. LD50 and LD90 were observed at 4.4g and 32.4g dose respectively.

**Table 2: Empirical probit values, lethal concentration, % mortality, % mean weevil mortality, SD and SEM mortality evoked by the activity of Neem (*Azadirachta indica*) leaf powder extract on weevils at 96hrs.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Quantity applied(g) | No of weevil introduced | No of affected weevil | % Mortality | Log10 Conc. | Empirical Probit | % Mean Mortality±SD | SEM | LD50 | LD90 |
|  |  |  |  |  |
| 0 | 10 | 0 | - | - | - | 43±2.795 | 1.056 | 4.4 | 32.4 |
| 5 | 10 | 6 | 60 | 0.70 | 5.25 |  |  |  |  |
| 10 | 10 | 7 | 70 | 1 | 5.52 |  |  |  |  |
| 15 | 10 | 7 | 70 | 1.18 | 5.52 |  |  |  |  |
| 20 | 10 | 8 | 80 | 1.30 | 5.84 |  |  |  |  |
| 25 | 10 | 8 | 80 | 1.40 | 5.84 |  |  |  |  |
| 30 | 10 | 7 | 70 | 1.48 | 5.52 |  |  |  |  |

\*Significance level at P0.05

SD = Standard Error; SEM = Standard Error Mean

Table 3 reflects the potential of *Moringa oleifera* in mitigating the damaging potential of *Sitophilus granarie.* Effect of treatment was significant (P<0.05). Total weevil mortality was observed at dose 20g, 25g and 30g. No weevil mortality was observed at 0% inclusion. LD50 and LD90 were observed at 2.7g and 9.8g respectively.

**Table 3: Empirical probit values, lethal concentration, % mortality, % mean weevil mortality, SD and SEM mortality evoked by the activity of *Moringa oleifera* leaf powder extract on weevils at 96hrs.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Quantity applied(g) | No of weevil introduced | No of affected weevil | % Mortality | Log10 Conc. | Empirical Probit | % Mean Mortality±SD | SEM | LD50 | LD90 |
|  |  |  |  |  |
| 0 | 10 | 0 | - | - | - | 56±3.606 | 1.363 | 2.70 | 9.80 |
| 5 | 10 | 8 | 80 | 0.70 | 5.84 |  |  |  |  |
| 10 | 10 | 9 | 90 | 1 | 6.28 |  |  |  |  |
| 15 | 10 | 9 | 90 | 1.18 | 6.28 |  |  |  |  |
| 20 | 10 | 10 | 100 | 1.30 | 7.33 |  |  |  |  |
| 25 | 10 | 10 | 100 | 1.40 | 7.33 |  |  |  |  |
| 30 | 10 | 10 | 100 | 1.48 | 7.33 |  |  |  |  |

\*Significance level at P0.05

SD = Standard Error; SEM = Standard Error Mean

Table 4 depicts the effect of *Ocimum gratissimum* on *Sitophilus granarie* after 96hrs storage*.* Treatment had significant (P<0.05) effect on the weevil as the %mortality appear to be dose dependent. Total weevil mortality was observed at the highest dose (30g) while no mortality was observed at 0g inclusion level. LD50 and LD90 were 3.00g/10grain and 10.80g/10grain respectively.

**Table 4: Empirical probit values, lethal concentration, % mortality, % mean weevil mortality, SD and SEM mortality evoked by the activity of Scent leaves (*Ocimum gratissimum)* leaf powder extract on weevils at 96hrs.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Quantity applied(g) | No of weevil introduced | No of affected weevil | % Mortality | Log10 Conc. | Empirical Probit | % Mean Mortality±SD | SEM | LD50 | LD90 |
|  |  |  |  |  |
| 0 | 10 | 0.00 | - | - | - | 53±3.409 | 1.288 | 3.00 | 10.80 |
| 5 | 10 | 8.00 | 80 | 0.70 | 5.84 |  |  |  |  |
| 10 | 10 | 8.00 | 80 | 1 | 5.84 |  |  |  |  |
| 15 | 10 | 9.00 | 90 | 1.18 | 6.28 |  |  |  |  |
| 20 | 10 | 9.00 | 90 | 1.30 | 6.28 |  |  |  |  |
| 25 | 10 | 9.00 | 90 | 1.40 | 6.28 |  |  |  |  |
| 30 | 10 | 10.00 | 100 | 1.48 | 7.33 |  |  |  |  |

\*Significance level at P$<$0.05

SD = Standard Error; SEM = Standard Error Mean

**Graphical representation of Mortality (%) against quantity (g) on weevil**

Figure 1 shows the graphical comparison among the various botanicals used. Among all the treatment used Moringa powder had percentage mortality of 100% at 20g, 25g and 30g. Also, Scent powder had 100% at 30g. At

Figure 1: Percentage mortality (%) of the weevils against quantity of botanical (g) applied.

Figure 2 shows the mean percentage mortality evoked by each botanical. Result shows that moringa powder recorded the best efficacy with the highest percentage mean mortality of 93.3% and having LD50 and LD90 2.70g and 9.80g respectively while the least performance was observed in Neem leaf powder with LD50 value of 4.4g and LD90 value of 32.4g.

Figure 2: Percentage mean mortality of the weevils evoked by the various botanicals

**DISCUSSION**

The popularity of botanical pesticides is once again increasing steadily and some plant products are being used globally as green pesticides (Dubey *et al*., 2008). An ideal fumigant should be biologically active, easy to be removed by aeration, not absorbed by grain, not flammable and not corrosive. But presently only few of the synthetic chemicals available as fumigant meet these criteria. This present study shows the efficiency of few of the numerous available botanicals as a promising agent to mitigate the destructive activtity of *S. granarius*.

It was clearly shown in this study that the three botanicals used were able to control the effects of *S. granarius*. Their pesticidal and insecticidal potential could be attributed to the presence of non-nutritional phytochemicals such as flavonoids, tannin, saponin and others present in them (Isman, 1997; Katie *et al*., 2006; Meyer *et al*., 2006). Control (0g) had no effect on *S. granarius* as no weevil mortality was observed after the 96hrs exposure. This corroborates the report of Bodroža-Solarov *et al*. (2008), who observed no weevil mortality when untreated wheat grains were subjected to *Sitophilus zeamais.*  This could be as a result of the grains/seeds used not having natural resistance against the weevils. From the result obtained *M. oleifera* had the most significant effect as higher grain mortality was recorded in all the quantity used after 96hrs exposure likewise it shows that less quantity 2.70g and 9.80g is needed to evoke LD50 and LD90 compare to 4.4g (LD50) and 32.4g (LD90) for *A. indica* and 3.00g (LD50) and 10.80g (LD90) for *O. gratissimum.*. Ojo *et al*. (2013) reported the potency of Moringa leaf powder as a strong botanical agent in controlling *Callosobruchus maculates* in stored cowpea. But on the contrary, Mahmoud and Zedan, (2018) noticed less effect of moringa leaf powder in controlling maize weevil when compared with other four botanicals used in their experiment. The less efficiency of Moringa in their work could be due to the grain-powder ratio used and the strain of Sitophilus (*Sitophilus zeamais*) targeted. On the average %mean mortality noted, *M. oleifera* had the highest mean weevil mortality, *O. gratissimum* had the second best while *A.indica* showed the least effect. Devi *et al.* (2014) recorded nearly similar value of 70.74% when *Sitophilus oryzae* (rice weevils) were exposed to *A. indica* leaf powder after 35days treatment. The similarity in the works could be as a result of the plant part used (leaf).

The perforation index and grain weight loss were not examined in this study but no physical damage were observed in the grains used. In general, *Moringa oleifera* leaf powder were found to be the best among the three botanicals used in controlling *S. granarius* in stored wheat grains

**CONCLUSION**

In conclusion this study shows that the leaf powder of *A. Indica, M. oleifera* and *O. gratissimum* are effective to protect wheat grains, therefore farmers can easily prepare them and apply to their grains in the store. The three botanicals are cheap, easy to prepare, environmental and health friendly, hence farmers should adopt their use in mitigating the damaging effects of *S. granarius.* In addition, more research should be conducted to ascertain the effectiveness of these botanicals in controlling other weevils in other stored grains and also other parts of the plants such as stem, stem barks, roots and seeds should be adopted in research so as to determine their potency in controlling stored grain weevils.

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