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TOXICIDAL EFFICACY OF *Azadirachta indica* (A. Juss) KERNEL AND *Ocimum basilicum* (Linn.) LEAF AGAINST MAIZE GRAIN WEEVIL (*Sitophilus zeamais* Motsch.)

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ABSTRACT

Studies were carried out to determine the efficacy of the kernel powder of *Azadirachta indica*, and leaves of *Ocimum basilicum* against *Sitophilus zeamais*. 0.5, 1.0, 1.5 and 2.0g of powder of *A. indica*, and *O. basilicum* /50g of maize grains, were tested along with the synthetic conventional insecticide, Coopex (0.25g/50g) under laboratory conditions (28-32^{0}C and 65-70% r.h.). In all trials, the mortality among adults of *S. zeamais* reared on maize treated with the powders of *A. indica* and *O. basilicum* was observed to be high (55%/0.5 g). Percentage mortality among adults was significantly ($P<0.05$) different from the untreated (control). Thus, both the plant materials were found to significantly affect the survival of the *S. zeamais* at different concentration rates. Effect of the powders on the emergence of adult *S. zeamais* was significant ($P<0.05$) and reduced the F_1 progeny emergence.

Keywords: *Sitophilus*; *Azadirachta* kernel*; Ocimum* leaves

INTRODUCTION

Among the insects feeding on cereals, *S. zeamais* and *S. oryzea* cause the greater amount of economic loss in maize kernels (Kossau and Bosque-Perez, 1995). *S. zeamais* may be the most dangerous as it may develop on various foods. Experimental study has demonstrated that the introduction of 3 pairs of *S. oryzea* in a silo could destroy 5,000 kg of wheat in only 28 days (Rider, 1982; Dobie, 1984). Dobie (1984) estimated that a Sitophilus individual would eat 4g from a rice kernel weighing 20g during its development period from egg to adult. Danjumma (2008) also observed that ten adults *S. zeamais* eat 5.22g from 50g of maize from egg to adult. FAO (1990) reported that *Sitophilus* species destroy 96 million tons of cereal grains annually all over the world, a quantity of food sufficient to feed over 375 million people. The extent of damage to sorghum and millet grains in storage in northern Nigeria due to this pest ranges between 4 and 10 per cent (Bamaiyi, 2004).

Use of plant material in the control of these insect pests have been suggested and worked on by a number of researchers. According to Iloba and Ekrakene (2006), synthetic insecticides are expensive for subsistence farmers and they may pose potential risks owing to the lack of adequate technical knowledge related to their safe use. Delobel and Trans (1993) stated that plant products helped in the protection of crops against pests and disease vectors in Africa. Plant parts and extracts are being used in many parts of the world to kill or repel insects. Plants are known to produce a range of secondary metabolites which possess multiple mode of action including acute toxicity, repellency, anti-feedant, and or inhibition of oviposition, growth, development and reproduction (Uko and Kamalu, 2001). Uko and Kamalu (2001) found that a vast array of plant extracts and materials have been evaluated against stored product insects such as neem seed extract used against bean weevil. In the present work, the efficacy of *A. indica,* and *O. basilicum,* in comparison to a conventional pesticide *(*Coopex) for control of *Sitophilus spp*. was studied

MATERIALS AND METHODS

Laboratory culture of *S. zeamais* was raised by adding 50 pairs of freshly emerged adults obtained from infested maize to 200g sterilized maize grains in a large Kilner jar. The culture was maintained in the Entomology Laboratory of the Department of Zoology, Usmanu Danfodiyo University, Sokoto for 49 days at 28-32^{o}C. The newly emerged adults of F_1 generations were then used to infest the maize samples used for the experiment.

Kernels of *A. indica* (Neem), and Fresh leaves of *O.basilicum* (Farm basil) were obtained from the Fadama in Usmanu Danfodiyo University, Sokoto. Both materials were shade dried for ten days followed by grinding and sieving into powder, using 5mm mesh.

The maize (*Zea mays* L.) used in the study had been previously sterilized in a deep freezer at 0^{o}C, before weighing 50 g into each petridish. Each plant powder was applied at four levels (or concentrations) of 0.5, 1.0, 1.5 and 2.0 g in to 50 g of maize. Coopex (Permethrin 0.5%) at 0.25 g concentration was used as standard. The control was tested without any treatment. The whole experiment was replicated three times. All the petridishes, except the control were vigorously shaken to ensure proper mixing of maize grains with the plant powder or Coopex.

Each petridish was infested with five pairs of newly emerged *S. zeamais.* The petridishes were labeled, covered and kept in the laboratory for seven days. Observations were made at 24, 48 and 72hrs to record the mortality among introduced adults. Dead insects were removed and live ones left. After 7 days, the remaining insects were removed from all the petridishes and the grains were kept undisturbed for 7 weeks to allow the emergence of adults following any oviposition, which might have occurred during the experimental period.

The data obtained were subjected to analysis of variance using Statistical Analysis System (SAS, 2003) and means found to be significant were separated using least significant difference (LSD).

RESULTS AND DISCUSSION

Mortality among Adults

All the plant powders tested caused mortality among *S. zeamais*, which was found to be directly proportional to the amount of powder used for treatment of grains. Table 1 showed that both plant powders caused almost fifty percent mortality even at low doses.

Higher mortality of 56.67 percent was observed among adults reared on maize treated with 0.5 g of *A. indica* within seven days of post infestation. Increasing the amount of plant powder to 1.0 g resulted in significant ($P<0.05$) effects on the mortality of adult *S. zeamais* (Table 1). Increased concentration of the powders from 0.5 to 1.0 g resulted in an increase in the mortality to 96.67 per cent within 6-7 days of their introduction in to maize. Coopex took an average of 4.33 days to cause 100 per cent mortality, while control had 13.33 per cent mortality within the same period.

It can also be deduced from the same Table 1 that both plants powder had significant effects on the mortality and longevity of the weevils. The rate of mortality was also observed to be affected by the increase in amount of powder. Thus, the effects of the various powders on survival of the weevil were found to be closely related. However, highly significant ($P<0.05$) differences were observed between the test materials and control.

It was also observed that *A. indica* powder significantly affected mortality of adults probably due to Azadirachtin. 100 percent of the introduced adults died within seven days of post infestation which is similar to the findings of Bamaiyi (2004) who used 0.5g of *A. indica* to 20g of maize and found 100 per cent mortality.

The effects of *O.basilicum* on the survival of the adult weevils in all four levels were significant ($P<0.05$). Alves *et al.* (2007) also observed similar effects and attributed them to the presence of certain chemical compounds found in the plant such as eugonal, linolool, methyl cinnamate, camphor and thymol. It was noted that the higher the amount/concentration (1.5-2g/50g) of the powder, the more efficacious, causing 96 per cent adult mortality within 6-7 days of post application (Table 1). These results are in conformity with the findings of Yusuf *et al*. (1998) who observed that four grams of *O.basilicum* to 100 gram of maize (4g/100g) caused 60 per cent mortality of adult *S. zeamais* in few days.

Emergence of Adults

Table 2 shows that the different powders negatively affected the emergence of adults. It also shows that, there were significant effects on emergence of adults in the treated and untreated grains. *A. indica* powder was most effective in affecting the emergence than *O. basilicum* (Table 2), as fewer (5.33) adults emerged from the grains treated with 0.5g of *A.indica* powder. Significant difference were also observed among both plant powders tested, and also when compared with coopex and untreated (control).

Maize treated with 2.0 g of both plant powders showed significant decrease in the number of emergence of adults. No adult emerged on maize treated with *A. indica* and coopex as there was no egg was lying. *A. indica* was found to be more efficacious having similar effects to coopex when used in higher amounts, while *O. basilicum* was less effective. Only 2.33 per cent adults emerged from the treated maize at the end of seven weeks, which was enough time for the full life cycle of *S. zeamais* in all the treatments. Up

to 42 adults emerged from the untreated (control) grains. These observations agree with the findings of Makanjuoola (1989) who reported that, dipping seeds in 80 per cent concentration of *A. indica* extract significantly reduced damage of *S. zeamais* on maize and *C. maculatus* on cowpea when introduced at the time of storage or after the grain had been stored for 5 months, by reducing egg hatch of F_1 generation. Similarly, Lale (1992) also reported a significant reduction in oviposition of *S. zeamais* and *C. maculatus* at 150-200 gm/15g concentrations.

Table 1. Mortality among adults of *S. zeamais* reared on maize treated with varying amounts of powders of *A. indica* seed and *O. basilicum* leaves

Treatments	Mean mortality among adults of *S. zeamais* and duration of days (7days)			
	Plant powder applied (g)/ 50g of grains			
	0.5	1.0	1.5	2.0
A. indica	$56.67^{b} \pm 2.96$ (7.0)	$96.67^{ab} \pm 2.96$ (6.7)	$100.00^{a} \pm 0.00$ (6.7)	$100.00^{a} \pm 0.00$ (5.6)
O.basilicum	$46.67^{c} \pm 2.96$ (6.7)	$93.33^{b} \pm 2.9$ (6.5)	$96.67^{ab} \pm 2.96$ (6.7)	$100.00^{a} \pm 0.00$ (6.7)
Coopex (0.25g)	$100.00^{a} \pm 0.05$ (4.7)	$100.00^{a} \pm 0.05$ (4.4)	$100.00^{a} \pm 0.00$ (4.3)	$100.00^{a} \pm 0.05$ (5.0)
Control	$20.00^{d} \pm 1.42$ (7.0)	$13.33^{c} \pm 2.96$ (5.7)	$16.67^{c} \pm 2.96$ (6.3)	$20.00^{b} \pm 0.00$ (6.7)
LSD	4.381	4.753	4.716	4.753

Mean in a column followed by same letter are not significantly different (P>0.05). Values in brackets indicate number of days from post infection

Table 2. Emergence of adults of *S. zeamais* reared on maize treated with varying amounts of powders of *A. indica* and *O. basilicum*

Treatment	Average no. of adults emerged in three months (90 days)			
	0.5g	1.0g	1.5g	2.0g
A. indica	$5.33^{b} \pm 0.54$ (59)	$2.33^{a} \pm 0.55$ (67)	$1.67^{a} \pm 0.54$ (71)	$0.00^{a} \pm 0.00$ (80)
O. basilicum	$14.67^{c} \pm 0.54$ (66)	$10.67^{b} \pm 0.54$ (70)	$6.00^{b} \pm 0.58$ (69)	$2.33^{b} \pm 0.54$ (80)
Coopex (0.25g)	$0.00^{a} \pm 0.00$ (85)	$0.00^{a} \pm 0.00$ (87)	$0.00^{a} \pm 0.00$ (87)	$0.00^{a} \pm 0.00$ (88)
Control	$39.33^{d} \pm 0.54$ (49)	$42.00^{c} \pm 1.30$ (55)	$41.67^{c} \pm 0.88$ (53)	$41.33^{c} \pm 1.22$ (50)
LSD	1.415	1.510	1.141	1.339

Mean in a column followed by same letter are not significantly different (P>0.05). Values in brackets indicate number of days from post infection

From this finding the average developmental period of *S. zeamais* was observed to vary from 49-70 days under the laboratory conditions, and an average of 52 eggs per female were laid within three months (Table 2). These results disagree with Lale (1992); Dobie (1984); Hill and Waller (1990) who reported that the developmental period of *S. zeamais* ranges from 32-37 days at 28-31^{0}C and 70% relative humidity, and can lay up to 300 eggs per life cycle. This observed difference could be attributed to the combined effect of sterilization of the grains before the experiment and the toxicity of the plant materials used.

The marked differences in the mortality and emergence of *S. zeamais* reared on treated and untreated maize indicate that the powders of the different plants tested had marked effects on developmental stages which in turned affected emergence. The effects of both plants powder on the mortality and emergence of adult weevil was observed to be directly proportional to their concentration. It can be concluded that both plant powders used had significant ($P<0.05$) effects on the control of *S. zeamais* at 2.0 g/ 50 g of maize grains. This dosage is recommended for storage.

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