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THE POTENTIAL OF SOME PLANT POWDERS AS BIOPESTICIDES AGAINST *SITOPHILUS ZEAMAIS* (MOTSCH.) (COLEOPTERA: CURCULIONIDAE) AND *CALLOSOBRUCHUS MACULATUS* (F.) (COLEOPTERA: BRUCHIDAE) ON STORED GRAINS: A REVIEW

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ABSTRACT
Powders prepared from parts of different plant species indigenous to Nigeria were tested by various Nigerian scientists under laboratory conditions for their insecticidal activities against the common insect pests of maize and cowpea, i.e. Sitophilus zeamais and Callosobruchus maculatus during storage. Results showed that at certain concentrations, the plant materials had both ovicidal and larvicidal effects. They also reduced adult emergence, progeny development and increased mortality of the adults. Some have anti-feedant effects on the insect pests. Looking into the side effects of synthetic pesticides, the studies demonstrated that these plant parts can play an important role in protection of stored grains from insect invasion during storage.

Key words: Biopesticides, Callosobruchus maculatus, Plant powders, Sitophilus zeamais Stored grains

INTRODUCTION

The heavy post-harvest losses and quality deterioration caused by storage pests are a major problem facing agriculture in developing countries such as Nigeria (Adedire and Ajayi, 1996).

Natural methods of plant protection are assuming new importance as an alternative to commercial synthetic products, which are expensive, unavailable at critical periods and may pose health hazards to man and livestock (Opareake and Dike, 2005). In many storage systems, use of fumigants is the most economical tool for managing stored grain pests; however, storage pests are fast developing resistance to phosphine (Bell and Wilson, 1995; Chaudry, 1995; Lee *et al*. 2001).

There are a number of botanical plants known for their insecticidal value, but there was no much progress in isolating toxic substances from the plants and do some scientific work to promote them to the level or synthesizing in the industry, so that they can be marketed to generate extra revenue to the community and country (G/selase and Getu, 2009). Plant-derived materials are more readily biodegradable. Farmers can easily and cheaply produce these plant materials for their use. The use of some natural compounds in the protection of grains requires them to be applied in high concentrations, which often exceeds the threshold of acceptable flavour to the consumer (Nazer *et al*., 2005). The integration of insecticidal natural products from locally available plants appear to be quite safe and promising (Jillani *et al*., 1988).

The maize weevil, *Sitophilus zeamais*, is a serious pest of stored grain in Africa (Asawalam and Emosairue, 2006). It is a ¼ inch long, reddish brown to black snout weevil. In maize or *sorghum*, attack may start in the mature crop when the moisture content of the grain has fallen to 18-20% (Parugrug and Roxas, 2008).

This paper is aimed at reviewing some of the previous investigations conducted by some researchers on the use of locally available plants as grain protectants against *S. zeamais* and *C. maculatus*. It is also intended to create awareness to our local farmers on the need for using these plant powders in protecting their grains against insect pests during storage.

Some locally available plants tested with insecticide properties

Table 1 shows list of some of the plants tested by various researchers and confirmed their potential insecticidal activities against the two insect pests of stored grains of maize and cowpea:

Repellency effect

A lot has been done with regard to the use of seed powder of *A. indica* for the control of insect pests of stored products. Parugrug and Roxas (2008) worked on the insecticidal action of five plants against maize weevil, *S. zeamais* and found that at 24 hours of exposure, ratings of 7.00 (High Repellency) were recorded in powdered *A. indica* and carbaryl, whereas *C. citratus* had repellency rating of 5.80 (Moderate Repellency) at the same hour. *S. sinensis* peel powder was also found to be effective in repelling *Z. subfasciatus* on haricot bean seeds (Dawit and Bekelle, 2010).

Ovicidal Effects

If the plant powders reduce adult longevity and fitness, the number of eggs laid will often be lower as well. Moreover, the mechanical effect of large quantities of powders themselves could have an effect on oviposition (Rajapakse, 2006).

Table 1: List of Some Local Plants Evaluated for their Insecticidal Properties.

S/N.	Scientific Name	Common Name	Local Name	Family	Part/Parts Evaluated
1.	*Azadirachta indica*	Neem	Dogon-Yaro	Meliaceae	Seeds
2.	*Jatropha curcas* L.	Physic nut	Bini-da-zugu	Euphorbiaceae	Leaves, Bark and Seeds
3.	*Citrus sinensis* L.	Orange	Lemon-zaki	Rutaceae	Peels
4.	*Capsicum frutescens* L.	Chilli	Barkono	Solanaceae	Fruits
5.	*Piper guineense* L.	Black pepper	Masoro	Piperaceae	Seeds
6.	*Allium sativum* L.	Garlic	Tafarnuwa	Liliaceae	Bulb
7.	*Cymbopogon citratus* Staph.	Lemon grass	-	Gramineae	Stem
8.	*Allium cepa*	Onion	Albasa	Liliaceae	Bulb
9.	*Nicotiana tabacum* L.	Tobacco	Taba	Solanaceae	Leaves

Umar (2008) obtained results which showed that at the rate of 2.0g/ 20.0g seeds, the leaf powder of *J. curcas* reduced oviposition by 30% compared to the treatment, when he worked on the comparative potentials of leaf, bark and wood powders of *J. curcas* as protectants of stored cowpea against *C. maculatus*. Abdullahi and Muhammad (2004) reported to have observed that *P. guineense* had higher ovicidal effects on *C. maculatus* attacking cowpeas. This finding agrees with that of Lale (1992), Yahaya and Magaji (1997) and Yahaya (2002).These effects of *P. guineense* could be attributed to its guineensine 1 component and its irritating smell which prevent physical contact and caused suffocation among the adult weevils.

Powder of *A. cepa* was also found to affect the oviposition of *C. maculatus*. Cowpea seeds treated with the powder of *A. cepa* at a concentration of 6 g/ 100 g seed treatment exhibited a mean number of eggs laid / 20 seeds as 17.7 while the control was 152.0 (Oparaeke and Dike, 2005).

Effects on Adult Mortality

Toxicity, either through fumigation or through direct contact, is usually the major action of plant powders against adult insects in the laboratory tests (Rajapakse, 2006). 0.5g of *A. indica* seed powder admixed with 20g maize grains caused 100% mortality in adult *S. oryzae* within three days (Ivbijaro, 1983). A powder of *C. sinensis* peels was found to be effective on the mortality of *Z. subfasciatus* (Dawit and Bekelle, 2010). They recorded 67% mortality of *Z. subfasciatus* when the beans were treated with 15g of sun dried powder of orange peel, and also there was a significant reduction in progeny mergence of the insect. This mode of action could be attributed to stomach poison since the weevils feed directly on the grains (Adedire and Ajayi, 1996). The effect of leaf powder of *J. curcas* on the mortality of *C. maculatus* was assessed by Umar (2008) and a percentage mortality of 8.4% for seeds treated with the leaf powder at the rate of 2.0g/ 20g of cowpea seeds was recorded which could be due to presence of hydrogen cyanide and curcin (toxalbumin) (Duke, 1985). A lot of work has been done to investigate the efficacy of powder of *C. frutescens* on the survival of insect pest including *S. zeamais* and *C. maculatus*. Adedire and Ajayi (1996) recorded 100% mortality of *S. zeamais* treated with *C. frutescens* 28 days after treatment on maize grains. Similarly, Asawalam *et al.* (2007) reported *C. frutescens* to have shown 75% mortality of *S .zeamais* 33 days after treatment. The results indicated that *C. frutescens* effectively protected maize grains against weevil attack. It exhibited fumigant mode of action since it has a characteristic pungent smell and pepperish in nature. *A. cepa* and *P. guineense* were tested and found to be effective in controlling insect pests of stored grains. Adedire and Ajayi (1996) reported 48.75% adult mortality of *S. zeamais* treated with *A. cepa* 28 days post treatment and 100% mortality when treated with *P. guineense* after 3 days post treatment. Abdullahi and Muhammad (2004) assessed the toxic potentials of some plants powders on survival and development of *C. maculatus* and recorded 100% mortality 8 days after treatment when *P. guineense* was used at the rate of 1 g/ 50 g cowpea seeds. Asawalam *et al.* (2007) also recorded 79% (highest) mortality of *S. zeamais* treated with *P. guineense* on maize grains. Okonkwo and Okoye (1996) reported that *P. guineense* contains piperine and chavicine, which are insecticidal, while Lale (1992) included piperidine and alkaloids as the major active components in *P. guineense* seeds. An investigation was conducted to compare the products of *A. sativum* and *C. citratus* in the control of *C. maculatus* on stored cowpea grains by Oparaeke and Dike (1996). They found that both of the plant powders showed effectiveness by exhibiting 100% mortality 7 days after treatment. Danjumma *et al.* (2009) also found that *A. sativum* is effective in killing adult *S .zeamais* and recorded 96.67% mortality at the rate of 2.0 g/ 50 g maize grains. The mode of action of these two plant powders may be due fumigant and anti-feedant effects. *A. sativum* powder contains allicin as the major constituent. Leaf powder of *N. tabacum* was also found to be effective in killing adult insect pests. Asawalam *et al.* (2007) reported 71% mortality of *S. zeamais* treated with this plant powder on maize grains. It was also reported that 2.0 g of *N. tabacum* applied in 50 g of maize grains resulted 100.00% mortality of *S. zeamais* (Danjumma *et al.,* 2009). *N. tabacum* was reported to possess contact, stomach and respiratory poisoning properties attributed to the active constituent nicotine (Stoll, 1988).

Effects on Adult Emergence

Plant powders often reduce the emergence of adult beetles from the seed (Rajapakse, 2006). Some of these plant powders were found to have effect on adult emergence of insect pests attacking stored grains such as cowpea and maize.

Abdullahi and Muhammad (2004) recorded 40.9% adult emergence of *C. maculatus* on cowpea treated with *P. guineense*, while Asawalam and Emosairue (2006) and Asawalam *et al.* (2007) recorded 10.0% and 5.0% adult emergence of *S. zeamais* on maize treated with the same plant powder respectively. *C. frutescens* and *N. tabacum* were also reported to affect adult emergence of *S. zeamais* on maize grains revealing 10.0% and 12.0% emergence respectively (Asawalam *et al.,* 2007).

CONCLUSION

Many synthetic insecticides have been found effective against stored product pests but proved to be hazardous to men and domestic animals. In addition, the risk of developing insect resistance and the high cost-benefit ratio of synthetic insecticide have pushed researchers to find alternative insecticides. They 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. In many areas of Africa and Asia locally available plants and materials are being widely used to protect stored products against damage by insect infestations, as alternatives to chemical insecticides.

RECOMMENDTIONS

- Further work should be done to identify and isolate active compounds contained in these plant powders to determine the efficacy and methods of formulations. This may involve chemists, biochemists and environmental scientists.
- These botanical powders should be incorporated into grain protection practice of resource-poor farmer.
- In addition, there is the need to investigate the shelf life of the powders to find out if repeated application is needed after a given period.

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