COMPARATIVE EFFICACY OF INSECTICIDAL PLANTS ON THE MANAGEMENT OF GROUNDNUT BRUCHID (*CARYEDON SERRATUS*)

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ABSTRACT

Laboratory study was conducted to determine the efficacy of four insecticidal plant extracts *Azadirachta indica* A. Juss., *Lantana camara* L. (Verbenaceae), *Eupatorium odoratum* L. (Asteraceae), *Tephrosia vogelii* Hook against the groundnut bruchid beetle (*Caryedon serratus*), and a synthetic insecticide (Cypermethrin) (10EC) under ambient condition of temperature and relative humidity (30°C and 72%). Two hundred grammes of unshelled groundnut was weighed into jute bags and treated with powders of the insecticidal plants. Both treated and untreated bags of groundnut were then infested with newly emerged adult of *C. serratus* (20 per bag) and covered. The experiment was laid out in a Completely Randomized Design (CRD) with four replications. Parameters assessed included number of egg oviposited, number of eggs hatched (eclosion) and number of adults that emerged from each treatment, total developmental period (egg – adult), sex ratio of the emerged adults and finally percentage germination of the treated seeds. Data collected were analyzed using analysis of variance and means were separated using Duncan multiple range tests at 5% level of significance. The lowest mean number of eggs was laid in *A. indica*, *L. camara* and *T. vogelii* treated seeds compared with the control which recorded the highest number. Similarly, results obtained showed that *L. camara*, *T. vogelii*, and *A. indica* powder significantly reduced damage by *C. serratus* and increased germination percentage compared with *E. odoratum* and control. In conclusion, *L. camara*, *T. vogelii*, and *A. indica* have the potentials as alternatives to synthetic insecticides in the management of *C. serratus* by farmers.

KEY WORDS

Caryedon serratus, damage, groundnut, germination percentage, insecticidal plants, synthetic insecticide.

A major arable crop cultivated in the tropical and subtropical regions of the world is the leguminous crop - groundnut (*Arachis hypogaea*) of the family Fabaceae. Groundnut (*Arachis hypogaea*) is commonly stored as staple for man has several benefits - the grains are cheap source of protein to man (Alabi *et al.*, 2003) and in recent times, largely depends on it because of the rising cost of meat, fish and egg and other protein products. Groundnut is rich in vitamins, minerals and oil. Its other importance is in the livestock industry, fibre production (Rachie, 1985) and restoration of soil fertility/erosion control (Okigbo, 1978). Reasonable losses of between 20 – 50% have been reported on stored groundnut due to attack by groundnut bruchid (*Caryedon serratus*) and may sometimes reach 100% if not controlled (Alabi *et al.*, 2003). Apart from direct damage to the grains, losses may also occur as a result of contamination with the insect waste materials such as faeces, nitrogenous wastes and exuviae (Emoisairue *et al.*, 2004). Effort has been made by farmers in the management of groundnut bruchid amongst which includes the use of synthetic and non-synthetic insecticides. Of recent, many researchers have turned to the use of botanicals and plant products in the control of pest due to the hazardous effects of synthetic insecticides on the environment (Omongo *et al.*, 1997). The protection of stored products by the use of plant materials is a common practice among smallholder farmers in Africa. Repellent, anti-feedant, and insecticidal substances have been identified in a large variety of plant species, long before the “industrial insecticide revolution” in the 1930’s and 1940 when compounds such as nicotine and pyrethrum were the only effective insecticides (Green *et al.*, 1979). Azadirachtin, a component of *Azadirachta indica* A. Juss. is presently considered as a

promising alternative to synthetic insecticides, and is currently used by developed and developing countries for the control of insect pests (Okweche, *et al.*, 2013).

Recently, attention has been given to the possible use of plant products or plant derived compounds as promising alternatives to synthetic insecticides in controlling insect pests of stored products (Rajapakse *et al.*, 2002; Rajapakse and Ratnasekera, 2009). The aim of the experiment was to investigate the efficacy of *Azadirachta indica* A. Juss., *Lantana camara* L. (Verbenaceae), *Eupatorium odoratum* L. (Asteraceae), *Tephrosia vogelii* Hook against the groundnut bruchid (*Caryedon serratus*), in comparison it with synthetic insecticide (Cypermethrin) (10EC)).

MATERIALS AND METHODS

A laboratory experiment was conducted to determine the efficacy of four insecticidal plants: *Azadirachta indica* A. Juss., *Lantana camara* L. (Verbenaceae), *Eupatorium odoratum* L. (Asteraceae), *Tephrosia vogelii* Hook against the groundnut bruchid (*Caryedon serratus*), and a synthetic insecticide (Cypermethrin) (10EC)). Plant materials used for the experiments were collected and dried for 5 days and then ground into powder using Thomas Wiley laboratory grinding machine and then sieved through 0.02 mm diameter sieve. 25 g each of the powder was mixed with 1 kg each of unshelled groundnuts. Each bag including the control was then infested with 20 newly emerged (less than 24 hr old) *C. serratus* adults from the laboratory culture comprising of 10 males and 10 females. Each treatment was replicated four times at 24 hr intervals and was randomly assigned to positions at a temperature of 26°C and relative humidity of 75 to 90%. Data were collected on the total number of egg oviposited, number of eggs hatched (eclosion) and number of adults that emerged from each treatment. The total developmental period (egg – adult) and the sex ratio of the emerged adults were also recorded and analyzed using analysis of variance. Germination percentage of the seeds was assessed by placing the seeds in a germination medium and assessed at 5, 7 and 10 days after germination trial. Dead adults were removed from the bags and counted. Number of eggs laid between 13 and 30 days after infestation. The results were then subjected to analyses using analysis of variance and means separated using New Duncan Multiple Range Test (NDMRT) at 5% level of significance.

RESULTS OF RESEARCH

The insecticidal plants and synthetic insecticide were found to have effects on oviposition and development of the bruchid (*C. serratus*) on groundnut. The results showed that *A. indica* and Cypermethrin, the most effective insecticides with mean numbers of 0.45 egg each were significantly ($P < 0.05$) different from other and the control which recorded the highest mean number of 50.10 eggs. *E. odoratum*, *L. camara* and *T. vogellii* with mean numbers of 8.45, 5.20, and 5.20 were significantly ($P < 0.05$) different from the control where no insecticide was applied. Similar trend was observed in the mean number of eggs hatched with control having the highest number of 42.8 eggs hatched and the least recorded in *A. indica* and Cypermethrin. However, all the bruchid exposed to Cypermethrin and *A. indica* treated bags died within 24 hours, *L. camara* and *T. vogellii* recorded 9.14 and 9.10 mortality representing 46% while the least mortality of 1.00 and 3.32 was recorded in control and *E. odoratum* which were not significantly ($P < 0.05$) different. All adults of *C. serratus* were killed in *A. indica* and Cypermethrin treated bags showing a non significant ($P < 0.05$) difference between the two treatments while *E. odoratum*, *L. camara* and *T. vogellii* recorded an average of 30% emergence indicating a non significant ($P < 0.05$) difference between them but were significantly ($P < 0.05$) different from *A. indica* and the control experiment. A significantly higher developmental period 23.2 days was recorded in *E. odoratum* and control experiment compared with *L. camara* and *T. vogellii* with developmental periods of 19.2 and 18.3 days respectively. The result showed a non significant ($P < 0.05$) effect on the sex ratio with males and females having similar result. The mortality of *C. serratus* on groundnut treated with insecticidal plants and synthetic insecticide was studied. It showed that

Cypermethrin treated bags recorded 100% mortality at 18 hours after infestation followed by *A. indica* recording 100% after 24 hours. *L. camara* and *T. vogelli* treated bags recorded 85 and 80% respectively after 24 hours of infestation. Control experiment had the least percent mortality (5%) after 24 hours while *E. odoratum* recorded 50 % mortality after 24 hours of introduction of the bruchids. Result of percentage germination of groundnut treated with the various insecticides: an average of 97% germination was recorded from Cypermethrin, *A. indica*, *L. camara* and *T. vogelli* treated seeds while 65% was recorded from *E.odoratum* treated seeds and the control experiment respectively.

DISCUSSION

Long term use of synthetic insecticides have culminated into serious health and environmental issues (Nathan and Kalaivani, 2006) which redirect the researchers to look for some safer alternatives and ecologically acceptable pesticides (Wood and Granados, 1991) with no or less residual effect and resistance development property, for the control of important insect pests. The results of the present study indicate that, *A. indica*, *L. camara* and *T. vogelli* can be used successfully against groundnut bruchid. Of the four insecticidal plants used for the protection of stored groundnuts, *E. odoratum* was less effective on the survival of *C. serratus* adults. The reason why the plant is used in spite of their lack of effectiveness is not clear. Their common feature is a strong smell, which is believed to repel or kill insects, but this is obviously not always the case. However, Shivanand *et. al.*, 2009 had reported a significant population and damage by *H. amigera* on cabbage in *E. odoratum* garden egg treated plants compared with *L. camara* and *T. vogelli* recording lower population of same pest. Neem extracts and neem based insecticides are reported effective on a wide range of insect pests on field crops (Baidoo *et al.*, 2006, Okweche, *et. al.*, 2013). The use of compounds such as neem (*Azadiractha indica*) extract or extract from *T. vogelii* has been attempted in stem-borer in Africa and elsewhere (Ploaszek, 1998). Neem is indigenous to India and is now widespread in Asia, Africa, Central and South America, Australia and many other countries where it has been introduced. It has been reported that, several centuries before synthetic insecticide became available, farmers in India protected their crops with natural insecticides found in neem fruits and leaves (Polaszek, 1998). The insecticidal properties of neem products as reported by many authors (Schmutterer, 1990; NRC, 1992; Emosairue and Ukeh, 1996) have therefore been confirmed in this study. Emosairue and Ukeh (1996) reported that the behavior of insect towards a neem- treated seeds is a manifestation of repellence and phagodeterrence due to antifeedant effects. Ukeh *et al.* (2007) reported that neem has high contact toxicity on insect pest resulting in complete death of the pests or rendering them inactive. Furthermore, neem powder has been used to control storage insect pests such as *Callosobruchus maculatus* on cowpea grain (Ivbijaro, 1983; Sowunmi and Akinnusi, 1983). However, Jackai (1993) stated that, though reports from many parts of the world are in favour of neem as reliable botanical for insect pest management and free of danger. Recently, evidences on neem efficacy on insect pests of cowpea and some other crops in Nigeria have mounted and many cowpea researchers have given useful information on the potentials of neem in insect pests control (Amatobi, 2000; Oparaeke, 2005).

The report on chemical constituents of *L. camara* showed that the plant contains some active ingredients known as terpenes which is effective against insect pest and mosquito larvae (Sarath, *et.al.*, 2004). Powders or extracts of *T. vogelii*, *A. indica* an *L. camara* have been shown in the past to be toxic to insects to insects such as *Callosobruchus maculates* (Ukeh D. A. 2009), maize stem borers (Okweche, *et. al* 2013). It was considered at that time that *T. vogelii* itself had a potential as an economic source of rotenone, however, the rapid development of the chemical industry interrupted the spread of insecticides of vegetable origin (Golob *et al.*, 1999). The report on the chemical constituent of *L. camara* showed that it contains some active terpenes which may be the probable reason for the activity against *C. serratus*. The nature of the active compound of *T. vogelii*, *A. indica* an *L. camara*, which could possibly be the one responsible for its anthelmintic properties, will be the subject of

further investigation by the authors. Its mode of action, persistence and spectrum of activity against other stored products insects, as well as the optimal size of particles and level of application necessary to afford complete protection of stored grain, will also be determined.

Out the four species of plant used against the bruchid, the extract of three plants (*A. indica*, *T. vogelii*, and *L. camara*) could induce mortality of *C. serratus*. It is doubtless that these plants will provide eco-friendly compounds for vectors control as these plants are widely used as spice and in therapeutics, it will not cause any harm to the flora and fauna. These plant products matched the efficacy of Cypermethrin whose undesirable side effects emanating from its use pose problems to the human environment and danger of mammalian toxicity; hence, *A. indica*, *T. vogelii*, and *L. camara* powder are recommended to farmers for the preservation of groundnut seeds against infestation of bruchid beetles during storage. The practice of mixing plants or parts of plants to stored grain appears to be more a token of allegiance to tradition than an effective control measure. The longevity of *C. serratus* adults varies, according to Adenekan M. O (2013) from 10 to 35 days at 25°C and 60% R.H. The study has shown that *A. indica*, *L. camara* and *T. vogelii* powders at an admixture rate of 25 g/kg groundnuts significantly reduced adult longevity, 98.8 and 90.0% of adults respectively, dying within 13 days.

CONCLUSION

The following conclusions can be made from the results of this study. The extracts from *A.indica*, *L. camara* and *T. vogelii* have toxic effects on the groundnut bruchid (*C. serratus*) and this can be recommended for use by resource poor farmers.

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