JOURNAL OF FRUIT AND ORNAMENTAL PLANT RESEARCH

VOL. X
2002

SKIERNIEWICE, POLAND

Kehinde A. Kemabonta, Francis Okogbue
Nigeria Stored Products Research Institute
P.M.B 12543 Lagos, NIGERIA

Chenopodium ambroisoides (CHENOPODIACEAE) AS A GRAIN PROTECTANT FOR THE CONTROL OF THE COWPEA PEST *Callosobruchus maculatus* (COLEOPTERA BRUCHIDAE)

ABSTRACT. *Chenopodium ambroisoides* (Chenopodiaceae) was investigated for its insecticidal and ovipositional activity against *Callosobruchus maculatus* (Coleoptera). Ethanol extract of the plant was applied to a day-old eggs and topically, on adult C. *maculatus*. Adults that emerged from treated eggs and treated F1 adults decreased significantly in number when compared with the control. Application of C. *ambroisoides* (5.0% extract) caused 54% mortality of *C. maculatus* adults after 5 days, reduced oviposition by 72.5% as compared to the control and thereafter, reduced emergence of F1 adults to 55% as compared to 81% in the control.

Key words: *Chenopodium ambroisoides, Callosobruchus maculatus,* stored product pest, natural insecticide

INTRODUCTION. The use of plant materials for the protection of field crops and stored commodities against insect attack has a long history

(Golob and Webley, 1980; Rees et al., 1993). Many of the plant species have also been used in traditional medicine by local communities (Dales, 1996). *Chenopodium ambroisoides* (Chenopodiaceae) known as the Mexican tea, wormseed (in Yoruba language-Ewe imi) is used as a fragrance component in creams, perfumes and soaps (Duke, 1985). The oil is also used in both human and veterinary medicine. In addition, it has been used as a traditional protectant for stored beans and groundnuts in the Congo (Peterson et al., 1989) and, it has been found to protect stored commodities against insect attack (Su, 1986; Deila bel and Malonga,1987)

The constituents of *C. ambroisoides* include 20-30% terpenoids, p-cymene, limonene and terpene. It also contains ascaridole (Su, 1991), methyl salicylate, myrcene and geraniol (Duke, 1985). *C. ambroisoides* can therefore be of potential interest as a replacement for the more conventional stored products protectants, especially in situations where resistance is producing increasing control problems.

The objective of the study is to therefore study the insecticidal and ovicidal effect of *C. ambroisoides on Callosobruchus maculatus*.

MATERIALS AND METHODS. All the experiments were carried out at the laboratory of the Nigerian Stored Products Research Institute-Lagos, Nigeria, under a fluctuating relative humidity and temperature of 81.5 ±9.3 %, 27.4 ± 5.3 ^{o}C, respectively.

Ovicidal effect of *C. ambroisoides*

Fifty eggs of *C. maculatus* were treated 1, 2 and 4 days after oviposition on cowpea seeds (one egg per seed). Ethanolic extract of *C. ambroisoides* at concentration of 1, 3 and 5% was applied on the egg containing seeds while the control was treated with ethanol only. The treatment was replicated four times. The treated seeds were placed in transparent petri dishes of 8.5 cm in diameter with a perforated screen lid. The petri dishes were held together with a rubber band to prevent insect from getting in or out of the dish. The dishes were kept aside for the adults to emerge. The developmental

period and the number of adult that emerged from each replicate was noted.

Insecticidal effect of *C. ambroisoides* on adults of *C. maculatus*

C. maculatus adults of ages 0.5, 12 and 24 hrs were used for this experiment. There were four replicates and each consisted of 2 males and 3 females on 20 g of cowpea seeds.

These bruchids were treated with 1.0, 3.0 and 5.0% ethanolic extract and thereafter the seeds were placed in transparent vials with screened lid. Mortality of adult insect and the number of eggs laid were recorded after 5 days. The adults were then discarded. The eggs laid were kept for adult emergence and the number of F1 adults that emerged was recorded.

RESULTS

Effect of *C. ambroisoides* extract on *C. maculatus* eggs

The adults that emerged from the treated seeds were significantly less numerous than in the control at all ages (Tab. 1). Moreover, a number of adult that emerged decreased as concentration increased. Ovicidal activity was greatest on one-day-old eggs (at 5% concentration). Adult emergence from treated eggs was reduced to 16.05% compared to 68.5% in the control. There was no significant difference in the development period of treated and untreated eggs of different ages at all concentrations (Tab. 2).

Table 1. Number of F1 adults that emerged from eggs of *C. maculatus* treated with *C. ambroisoides* extract

Concentration of *C. ambroisoides* extract [%]	Age of treated eggs [days]		
	1	2	4
Control	34.25a*	36.00a	35.75a
1.0	23.75b	23.50b	24.75b
3.0	16.50c	16.00c	17.25c
5.0	8.25d	11.50d	13.00d

* Means followed by the same letter in the columns are not significantly different at $P \leq 0.05$ according to DMRT

Table 2. Effect of *C. ambroisoides* extract on the development period of treated eggs of C. *maculatus*

Concentration of *C. ambroisoides* extract [%]	Age of treated eggs [days]		
	1	2	4
Control	22.50a8	22.75a	21.75a
1.0	21.00a	21.20a	20.45a
3.0	21.00a	20.25a	22.25a
5.0	21.00a	21.25a	21.50a

* Explanation – see Table 1

Percentage mortality of adults of *C. maculatus* of different ages treated at with *C. ambroisoides* extract at different concentrations is shown in Table 3. Mortality increased significantly with increase in concentration of the extracts. At 5% concentration of the extract there was 54.86% mortality of adult *C. maculatus* compared to the control that had 10.20% mortality. There was however, no significant difference in the mortality of adults treated at different ages (Tab. 3).

Table 3. Percentage mortality of adults of *C. maculatus* treated with *C. ambroisoides* extract

Concentration of *C. ambroisoides* extract [%]	Age of treated adults [hrs]		
	0.5	6	12
Control	10.20d*	10.50c	9.10b
1.0	22.43c	12.02b	13.55b
3.0	37.88b	16.27b	15.43b
5.0	54.86a	52.46a	48.24a

* Explanation – see Table 1

Topical applications of *C. ambroisoides*

C. maculatus extract reduced egg laying within 0.5 to 12 hrs. Number of eggs oviposited declined significantly with increase of *C. ambroisoides* extract concentration. It also affected, though not significantly, fecundity of *C. maculatus* treated at different ages (Tab. 4).

Table 4. Effect of different concentration of *C. ambroisoides* on oviposition of treated adults or *C. maculatus*

Concentration of *C. ambroisoides* extract [%]	Age of treated adults [hrs]		
	0.5	6	12
Control	144.50d*	148.50d	146.00d
1.0	120.25c	124.50c	103.25c
3.0	96.00b	99.00b	101.50b
5.0	72.50a	86.20a	86.90a

* Explanation – see Table 1

Table 5 shows the percentage of F1 adult that emerged from egg oviposited by treated adults. Number of adults that emerged decreased with increase in concentration of *C. ambroisoides*. When the adults were treated 0.5 hr after hatching, only 56% of adults emerged from eggs laid by them as compared to 81% in the control.

Table 5. Percentage emergence of F_1 adults from eggs laid by treated adults

Concentration of *C. ambroisoides* extract [%]	Age of treated adults [hrs]		
	0.5	6	12
Control	81.00	71.79	76.54
1.0	70.66	71.68	74.58
3.0	56.76	58.33	58.62
5.0	55.86	51.04	56.09

DISCUSSION. The number of adults that emerged from treated eggs decreased significantly when compared with the control at all ages. Moreover, number of eggs laid by treated adults was lower than that in the control. Thus, *C. ambroisoides* can prevent the hatching of the eggs of *C. maculatus* and said to be ovicidal. Rajapakse (1990) observed in his experiment a significant reduction of *C. maculatus* oviposition when treated with extract of *Citrus credmatifolia* seeds.

There was no significant difference in the development period between treated and untreated eggs of different ages at all concentrations used. Thus, *C. ambroisoides* does not appear to

interfere with the developmental processes of *C. maculatus.* Application of *C. ambroisoides* (5.0% extract) caused 54% mortality in adult *C. maculatus* after 5 days, reduced oviposition and thereafter, reduced emergence of F1 adults. Similar results were obtained by El-Ghar and El-Shah (1987) who reported that 5.0% (w/w) extract of *Altriplex lentiformia* (Chenopodiaceae) applied to cowpea caused 58% mortality in adult *C. chinen* within 3 days and prevented F1 population emergence. Moreover, topical application of the oil of *C. ambroisoides* at 40 µg/insect and 50 µg/insect caused 100% and 90% mortality in adult *C. maculates* and *L. serricorne* respectively (Su, 1986).

In conclusion, extracts of *C. ambroisoides* were positively toxic on *C. maculatus* adults and ovicidal to treated eggs but did not seem to affect the developmental process of *C. maculatus*. Nevertheless, this plant can be exploited for the control of other stored products pests.

REFERENCES

Dales M.J. 1996. A review of plant materials used for controlling insect pests of stored products. Bulletin 65 Chatman, Natural Resources Institute, UK.

Deila bel A., Malonga P. 1987. Insecticidal properties of six plant materials against *Caryedon serratus* (ho.) (Coleoptera: Bruchidae). J. STORED PROD. RES. 23: 173-176.

Duke J.A. 1985. Handbook of Medicinal Plants. Florida, US: CRC Press Inc.

El-Ghar G.E.S.A., EL-Shah A.E. 1987. Effect of some plant extracts as surface protectants of cowpea seeds against the pulse beetle, *Callosobruchus chinensis*. PHYTOPARASITICA 15: 109-113.

Golob P. Webley D.J. 1980. The use of plant and minerals as traditional protectants of stored products. Bulletin 138 Chatman, Natural Resource Institute, UK.

Peterson G.S., Kandil M.A., Abdallah M.D., Farag A.A.A. 1989. Isolation and characterization of biologically active compounds from some plant extracts. PESTICIDE SCI. 25: 337342.

Su H.C.F. 1986. Laboratory evaluation or the toxicity and repelling of dill seed extract to confused flour beetles. J. ENTOMOL. SCI. 21: 169-174.

Su H.C.F. 1991. Toxicity and repellency of *Chenopodium* oil to four species of stored product insects. J. ENTOMOL. SCI. 1: 178-182.

Rajapakse R.H.S. 1990. Effect of five botanicals as protectants of green grain against the pulse beetle *Callosobruchus maculatus* In: Fuji K., Gatehouse A.M.R., Johnson C.D., Nichel R., Yoshida T. (eds), Proceedings of the Second International Symposium on Bruchids and Legumes, Okyama, Japan, September 1989. Kluwer Academic Publishers, pp. 85-90.

Rees D.P., Dales M.J. Golob P. 1993. Alternative methods for the control of stored product insect pests. A bibliographic database Chatman, Natural Resources Institute, UK.