

SEASONAL VARIATION IN THE INSECTICIDAL ACTION OF CHILLI PEPPER (*Capsicum frutescens*) PRODUCTS ON THE COWPEA BRUCHID (*Callosobruchus maculatus* F.) INFESTING STORED COWPEA SEEDS IN MAIDUGURI, NORTH-EASTERN NIGERIA

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Abstract

Seasonal variation in the efficacy of 0.0 (control), 1.0, 2.5 and 5.0g extracts of each of ground seed, ground rind, ground wholefruit and unground wholefruit of chilli on the reproduction of *Callosobruchus maculatus* were investigated during the hot (April/May; 21.1 - 34.7°C; 13.0 - 37.0% R.H) and the cold (November/December; 20.1 - 24.0°C; 13.0-26.0% R.H) dry seasons in Maiduguri. Oviposition and adult development were significantly reduced in treated seeds than the untreated control and in the cold dry than in the hot dry period. The form and dose differential efficacy responses of chilli on the depression of both fecundity and adult development in *C. maculatus* were in the decreasing order of ground seed > wholefruit > ground rind > unground rind and 5.0g chilli > 2.5g > 1.0 g.

1. Introduction

Cowpea, *Vigna unguiculata*(L.) Walp, is a leguminous crop cultivated essentially for its protein nutrition. Nigeria produces about 70% of the world's output of cowpea (Blade *et al.* 1997; Shoyinka *et al.*, 1997). However, complete loss of the grain has been reported due to high infestation by *C. maculatus* (Booker, 1967; Tun, 1979).

Currently, research efforts are being focused on the use of biointensive approaches, particularly the use of biopesticides for the control of *C. maculatus* and other tropical pests (Lale, 2002; Ajayi and Lale, 2001; Lale, 1995; Adedire and Ajayi, 1996; Jackai, 1993). Chilli peppers have been reported to be effective against storage weevils (Williams, 1981; Ajayi *et al.* 1987; Lale, 1992). Chilli contains volatile insecticidal compounds (Daziell, 1937; Cogley and Steel, 1976). However, their effectiveness as a source of these compounds could be influenced by the part of fruit chosen for use (Lale, 1992).

In this study, the toxicity of chilli products on *C. maculatus* was assessed during the two dry periods that cowpeas are handled in this region.

2. Materials and Methods

The study was conducted in Maiduguri during the hot (April/May; 21.1-34.7°C; 13.0-37.0% R.H) and the cold (November/December; 20.1-24.0°C; 13.0-26.0% R.H) dry seasons. Adults of *C. maculatus* used in the experiment were obtained from a culture of bruchids maintained in the laboratory (18.5 - 26.7°C and 11.2 - 37% RH); the experiment was also carried out under these conditions. Freshly threshed, clean Borno brown cowpea seeds, susceptible to *C. maculatus* and fresh fruits of *Capsicum frutescens* were purchased from the local market. The

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capsicum fruits were thoroughly sun dried. The dry wholefruit, rind and seed were separately ground with an electric micromill grinder.

The experiment was laid out in a randomized complete block design arranged in a split-split plot with the seasons as the main plot, the chilli forms as the sub plot and the chilli doses as the sub-sub plot.

During the hot dry period, each of the ground powders and unground wholefruits (chilli forms) were separately extracted using analytical grade acetone (99% purity), after which the acetone was evaporated. Some 1.0g, 2.5g and 5.0g of each extract was weighed and admixed with 50g of cowpea seeds in a kilner jar; 50g cowpea seeds treated with acetone only was included as a control. Each treatment was replicated 4 times. Sixteen day - old adults (10 females and 6 males) of *C. maculatus* were introduced into each jar and allowed to oviposit for 6 days after which they were removed. The number of eggs deposited in each jar was counted. The resulting emerging adults were also counted for 14 days beginning from the first emergence. The same procedures were followed for data collection in the cold dry period.

3. Results and discussion

3.1 Results

Table 1 show that the number of eggs deposited by *C. maculatus* on cowpea seeds and the resulting adult emergents were significantly higher in the hot dry than the cold dry period. Similarly, number of eggs and adult emergents were significantly higher in unground wholefruit and ground rind, respectively, than the other treatments; the lowest number of adults emerged in ground seed (Table 2). Both number of eggs and adult emergents were significantly lower in cowpea seeds treated with chilli than in the untreated control. There were significant interactions between seasons and chilli treatments.

Table 1: Effect of seasons and chilli products on oviposition and percentage adult emergence in *Callosobruchus maculatus* at Maiduguri, northeastern Nigeria

Treatments	Egg count	Percentage adults emerged
Seasons (A)		
Hot dry	119.5a	48.9a
Cold dry	66.3b	46.6b
S. E. \pm	0.04	0.08
Forms (B)		
Unground wholefruit	101.3a	47.3c
Ground wholefruit	91.8c	50.0b
Ground wholefruit	92.8b	50.9a
Ground seed	86.4d	43.9d
S. E. \pm	0.36	0.15
Dose (g) (C)		
1.0	126.6b	42.4b
2.5	55.5c	37.7c
5.0	50.4d	27.4d
0.0	139.9a	64.8a
S. E. \pm	0.26	0.06
Interaction		
A x B	S	S
A x C	S	S
B x C	S	S

Means that carry different letters in a column are significantly different at 5% level of probability according to Duncan's Multiple Range Test. S = significant

Table 2: Combined effects of seasons and chilli forms on oviposition and adult emergence in *Callosobruchus maculatus* at Maiduguri, northeastern Nigeria

Treatment	Egg count	Percentage adults emerged
Hot dry x Unground wholefruit	124.1a	49.6c
Hot dry x Groundwholefruit	119.0b	50.4b
Hot dry x Ground rind	117.3b	52.6a
Hot dry x Ground seed	117.6b	43.1g
Cold dry x Unground wholefruit	78.4c	43.9f
Cold dry x Groundwholefruit	64.7e	49.5c
Cold dry x Ground rind	68.3d	47.9d
Cold dry x Ground seed	55.1f	45.8e
S. E. \pm	1.02	0.42

Means that carry different letters in a column are significantly different at 5% level of probability according to Duncan's Multiple Range Test.

Egg numbers in untreated seeds or seeds treated with 1.0 or 2.5 g chilli during the hot dry period were significantly higher than in seeds in the other treatments (Table 3). The numbers of eggs in untreated seeds were significantly higher than in those treated with different doses and forms of chilli (Table 4); the lowest number occurred in seeds treated with 5.0g ground rind. Percentage adult emergence was significantly different between treatments, with the percentage being lower in cowpea seeds treated with 5.0g ground seed and higher in the untreated control.

Table 3: Combined effects of seasons and chilli doses on oviposition and adult emergence in *C. maculatus* at Maiduguri, northeastern Nigeria

Treatment	Egg count	Percentage adults emerged
Hot dry x 1.0g	172.3a	42.6c
Hot dry x 2.5g	67.4d	37.1f
Hot dry x 5.0g	65.5e	25.3h
Hot dry x 0.0g	172.8a	68.8a
Cold dry x 1.0g	80.9c	41.9d
Cold dry x 2.5g	43.6f	38.8e
Cold dry x 5.0g	35.1g	31.7g
Cold dry x 0.0g	107.0b	58.2b
S. E. \pm	0.80	0.13

Means that carry different letters in a column are significantly different at 5% level of probability according to Duncan's Multiple Range Test.

Table 4: Combined effects of forms and doses on oviposition and adult emergence in *C. maculatus* at Maiduguri, northeastern Nigeria

Treatment	Egg count	Adult emergence
Unground wholefruit x 1.0g	142.7a	40.9g
Unground wholefruit x 2.5g	63.5f	38.1h
Unground wholefruit x 5.0g	57.8g	31.1k
Unground wholefruit x 0.0g	139.6bc	64.9c
Ground wholefruit x 1.0	124.3e	44.3e
Ground wholefruit x 2.5g	55.6i	38.3h
Ground wholefruit x 5.0g	49.3jk	31.4i
Ground wholefruit x 0.0g	140.3b	65.5b
Ground rind x 1.0g	131.1d	45.4d
Ground rind x 2.5g	56.0hi	43.3f
Ground rind x 5.0g	46.2m	32.3i
Ground rind x 0.0g	138.3c	65.4b
Ground seed x 1.0g	108.3c	38.7h
Ground seed x 2.5g	47.7lm	28.4l
Ground seed x 5.0g	48.4kl	14.8m
Ground seed x 0.0g	143.9a	92.1a
S. E. \pm	0.80	0.13

Means that carry different letters in a column are significantly different at 5% level of probability according to Duncan's Multiple Range Test.

3.2 Discussion

Several workers (e.g. Dick and Credland, 1984; Credland, 1986) reported that the number of adults that can emerge from cowpea seeds depend on the numbers of eggs initially present on the seeds. The significantly lower percentage adult emergence in treated than untreated cowpea seeds suggests that chilli significantly reduced reproduction and development in *C. maculatus*. Earlier, chilli pepper has been shown and reported to reduce oviposition and suppress adult emergence in *C. maculatus* and other tropical pests (Cowles *et al.*, 1989; Lale, 1992).

The significantly lower adult emergents in cowpea seeds treated with ground seed (Table 2) and 5.0g dose (Table 3) of chilli in the hot dry period despite having higher numbers of eggs suggest that under the comparably intense heat of the hot dry period, higher amounts of capsaicin may have volatilized thereby exerting proportionately higher effects on the development of bruchid eggs; capsaicin, the insecticidal ingredients of chilli is highly volatile (Daziel, 1937; Cowles *et al.*, 1989). The increase in the activity of chilli against the bruchids during the hot dry period, the period that cowpeas stay longer in stores, implies that the pestiferous activity of *C. maculatus* can be considerably minimized by using chilli products. This is important because developmental period is shorter and population build-up is faster in

C. maculatus, and thus damage potential is expected to be higher, during the hot dry period when the activity of chilli is also higher and more suppressive on the bruchids; high temperature and relative humidity induce increased physiological activity in *C. maculatus* (Ofuya, 2001). The lower percent bruchid emergence during the cold dry period may be as a result of a combination of chilli activity and, longer developmental period in *C. maculatus* during this season (Tun, 1979).

4. Conclusion

Since bruchid infestation is low during the cold dry period, i. e. the period that cowpea seeds are taken into stores from the field, the application of chilli at this stage will suppress the development of the expected field-to-store infestation. A repeat application of chilli during the hot dry period will further suppress the expected increase in infestation during this period and protect the seeds from bruchid damage.

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