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EFFECTS OF BLACK PIPER AND TURMERIC VOLATILES ON POST EMBRYONIC DEVELOPMENT, SEX RATIO AND REPRODUCTION IN *CORCYRA CEPHALONICA* (STAINTON) (LEPIDOPTERA: PYRALIDAE)

Km Rama, K. P. Shahi and P. H. Pathak

Entomology Laboratory, Department of Zoology, D.D.U., Gorakhpur University, Gorakhpur – 273 009, Uttar Pradesh, India

ABSTRACT

Post-embryonic development, adult emergence and reproductive potential of rice moth, *Corcyra cephalonic*a (Stainton) were adversely affected in varying degree when individuals were treated to the volatiles of Black Piper (*Piper nigrum*) /Turmeric (*Curcuma longa*) for a stipulated period during their larval lives. A significant alteration in egg output and egg hatchability was observed in the moths obtained after such treatments. The findings reported here can be interperated as resulting from the "carry-over" of the detrimental effects of the volatiles. These findings serve as a pointer for considering these botanical products as potential ingredients, to be utilized technologically in an integrated pest management programme aimed at checking the population buildup of this harmful insect in a problem area. Its utilization will be environmentally 'friendly' and socially acceptable.

KEYWORDS: *Corcyra cephalonica*, postembryonic development, sex-ratio and reproduction, Black Piper and Turmeric volatiles.

INTRODUCTION

The effect of vapours emitted by products/components of certain non-host plants on the reproductive biology of the rice moth, *Corcyra cephalonic*a (Stainton) - major pest of stored commodities[12] has been variously reported[1,3,4,7,8,9,10,11]. The acquisition of more information with respect to sex-ratio, postembryonic development period and reproductive potential is important and necessary for the proper appreciation of ecological and physiological relationship between the pest and volatiles of non-host plant products, if the larvae of this noctuid were subjected for a stipulated period to the vapour action of Black Piper (*Piper nigrum*) and Turmeric (*Curcuma longa*). The findings obtained from such a study are incorporated in this communication.

MATERIALS AND METHODS

Culture of C. cephalonica was maintained in the laboratory on a diet composed of 'Jowar' (Sorghum bicolor (L.) Moeuch) and 5% yeast [5]. Newly emerged larvae of males and females (all individuals <24 hr oil) were drawn from the culture for this investigation.

Turmeric rhizome and black piper seed were taken from the market and used as powdered in all the experiments.

For assessing the impact of volatiles of selected materials (Turmeric & Black Piper) on the post-embryonic development, adult emergence and subsequent reproductive potential of the pest, three series of the tests were conducted, each comprising five sets of 20 larvae (a set constituting a replicate). These larvae were housed in a glass containers (70mm diameter, 90mm height) covered on the top by black muslin fastened by elastic bands and provided with an adequate quantity of the same diet mixture as that used in the culture. In one series, the larvae were maintained for first 15 days of their lives in a chamber permitted by the volatiles emanating from 25 gms of Turmeric/Black Piper in powdered form, contained in a glass vial (75mm bottom diameter and 71mm top open end diameter: 10mm height) placed on the floor of the chamber. In the second series, the larvae were similarly exposed but commencing from the 16th day after hatching and in the third series larvae were continuously hold for 30 days after hatching in the same manner. The number of adult males and females that finally emerged and their total post-embryonic developmental period were recorded in all the three sets of experiments.

The general layout of the oviposition trials was similar to that described earlier[3,4,8]. The number of eggs deposited by the females was recorded daily for the first 4 days, the period when the females were generally prolific in their egg laying and the hatchability of the eggs were also noted. The data pooled from five independently run

tests, were subjected to suitable statistical analysis[6].

All the tests performed at 27^0 C ± 2^0 under 85% ± 5% r.h., were accompanied by appropriately designed controls wherein the new born larvae were not exposed to such vapour action.

RESULT AND DISCUSSION

An increase ($P < 0.01$) in total post-embryonic developmental period of males and substantial increase in the number of adults that finally emerged were characteristically noticed in the males of *C. cephalonica* that passed their first 15 days of larval lives or continuously held for 30 days in an environment laden with Black Piper volatiles (Table 1). Considerable decrease ($P < 0.01$) in the total post-embryonic developmental period and no significant change in female population that finally emerged, were also noticed in all the 3 series of experiments with Black Piper (Table 1). Presumably the volatile(s) released from the Black Piper powder detrimentally affected the basis insect development regulating neuroendocrinal mechanism[13, 2] in these treated individuals. An opposite phenomenon was observed[8] with respect to male population and post-embryonic developmental period of female of *C. cephalonica* on exposure to eucalyptus oil volatiles during their larval life.

There was a marked increase in egg output only in those reproductive pairs whose larval development for the first 15 days took place in an environment of Black Piper volatiles ($P < 0.01$) while marked decline in egg hatchability was observed in all the reproductive pairs of all the test series (Table 2). These observations reflect a 'carry over' of the deleterious effect of the volatiles from this aromatic compound on reproductive fitness of the insect. Although a marked decline has been reported[3,4,8] both in egg output and egg hatchability in reproductive pairs whose larval development for the first 15 days occurred in an environment having volatiles of eucalyptus oil.

A significant decrease in the total post-embryonic developmental period of females ($P < 0.01$) was noticed when individuals were reared under environment laden with vapours of turmeric powder in all the test series. However, in case of males a similar phenomenon was observed with the individuals who were treated only for first 15 days of their larval life. No substantial increase/decrease in the number of adults that finally emerged was observed with any of the test series (Table 1). A significant shorter time taken to reach eclosion by the male and female individual followings exposure during their larval stage needs to be explained. Quite possibly the boosting effect of the Turmeric volatiles caused an overall acceleration in the post-embryonic developmental rate of

individuals during its rearing. An identical phenomenon was Eucalyptus oil treatment was provided for 5 minutes during adult life to their parents[8].

Data comparison of larval treatments involving volatiles of Turmeric powder did not manifest any significant outcome with respect to egg output and egg hatchability in this insect pest (Table 3).

These findings serve as a pointer for considering these botanical products as potential ingredients, to be utilized technologically in an integrated pest management programme aimed at checking the population buildup of this harmful insect in a problem area. Its utilization will be environmentally 'friendly' and socially acceptable.

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Table 1. Post-embryonic development Period and Emergence of Adult Males and Females of *Corcyra cephalonica* Exposed or Unexposed to Black Piper and Turmeric Volatiles (Data pooled from 5 replicates of 20 larvae each per test) £

Experimental regimen (larval exposure to volatiles)	N	Adult score: Mean nos. emerging (± SE)		Mean no. of days to adult stage (± SE)	
		M	F	M	F
A. Black Piper:					
(a) (i) For first 15 days after hatching.	100	12.0±0.7**	6.8±0.5^{NS}	30.9±0.2**	33.6±0.2**
(ii)Unexposed (Control)	100	8.6±0.7	9.2±1.4	28.5±0.3	38.9±0.3
(b) (i)For 15 days from the 16 day after hatching.	100	11.2±0.9^{NS}	8.0±1.0^{NS}	28.5±0.1^{NS}	31.5±0.2**
(ii)Unexposed (Control)	100	8.6±0.7	9.2±1.4	28.5±0.3	38.9±0.3
(c) (i)For 30 days after hatching.	100	12.0±0.7**	9.4±0.7^{NS}	32.1±0.3**	32.7±0.2**
(ii) Unexposed (Control)	100	8.6±0.7	9.2±1.4	28.5±0.3	38.9±0.3

B. Turmeric: (a) (i) For first 15 days after hatching.	100	10.4±1.0^{NS}	9.6±1.0^{NS}	26.9±0.3**	28.9±0.3**
(ii)Unexposed (Control)	100	8.6±0.7	9.2±1.4	28.5±0.3	38.9±0.3
(b) (i) For 15 days from the 16 day after hatching.	100	7.2±0.7^{NS}	7.8±0.9^{NS}	28.5±0.2^{NS}	30.7±0.3**
(ii)Unexposed (Control)	100	8.6±0.7	9.2±1.4	28.5±0.3	38.9±0.3
(c) (i)For 30 days after hatching.	100	8.2±0.4^{NS}	9.6±1.0^{NS}	28.4±0.2^{NS}	31.5±0.3**
(ii) Unexposed (Control)	100	8.6±0.7	9.2±1.4	28.5±0.3	38.9±0.3

F = Female; M = Male; N = Total no. of larvae from all the five replicates employed at the beginning of each treatment; SE = Standard Error.

** P < 0.01; * P < 0.05; NS = Not Significant (P > 0.05); (t-test) (Paterson, 1939) (All in relation to corresponding control values); £ = New born larvae (>24 hours old).

Table 2. Estimates of oviposition and hatchability of eggs laid by mated females of *C. cephalonica* in tests whose larvae were exposed/not exposed to the volatiles of Black Piper for the selected period of their larval life (data pooled from 5 females per tests)

Experimental regimen (larval exposure to volatiles)	Mean number of egg laid	Mean egg hatchability
(a) No exposure (Control)	427.0^{a}	352.2 ^{a}
(b)For first 15 days after hatching.	569.6^{b}	285.2 ^{b}
(c) For 15 days from the 16 day after hatching.	420.6^{a}	223.2^{c}
(d) For 30 days after hatching.	407.8^{a}	269.0^{bc}
Mean	456.4	282.4
LSD 1%	88.2	79.1
5%	64.1	57.4

Any two means followed by the same letter do not differ significantly at the 1% or 5% level by the least significant difference (LSD) test (Paterson,1939).

Table3. Estimates of oviposition and hatchability of eggs laid by mated females of *C. cephalonica* whose larvae were exposed/not exposed to the Turmeric volatiles for the selected tenure of their larval life. (data pooled from 5 females per tests)

Experimental regimen (larval exposure to volatiles)	Mean egg yield	Mean egg hatchability
(a) No exposure (Control)	427.8[a]	352.2[ab]
(b)For first 15 days after hatching.	412.8[a]	357.0[ab]
(c) For 15 days from the 16 day after hatching.	358.6[a]	313.4[a]
(d) For 30 days after hatching.	436.4[a]	391.6[b]
Mean	408.9	353.5
LSD 1%	114.5	102.8
5%	83.2	74.6

Any two means followed by the same letter do not differ significantly at the 1% or 5% level by the least significant difference (LSD) test (Paterson,1939).