

EFFECT OF HORIZONTAL CENTRIFUGATION ON REPRODUCTIVE BIOLOGY *CALLOSOBRUCHUS MACULATUS* (FABRICIUS)

(Coleoptera : Bruchidae)

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ABSTRACT During centrifugation for 3 hours at speeds of 185 rpm and 370 rpm, adult *Callosobruchus maculatus* laid eggs at regular intervals on host seeds. The centrifugation caused no significant change in the number of eggs laid, number of viable eggs, developmental period from egg to adult and longevity of adult.

Centrifugation at speeds of 660 rpm, 1000 rpm and 3000 rpm brought about a significant drop in the total number of eggs laid and the number of viable eggs also was reduced.

When centrifuged at 4000 rpm and 5000 rpm, the weevil ejected the eggs in a heap on the glass surface of the container and subsequently the female died. There was a highly significant drop in the number of eggs laid and viable eggs.

It appears that centrifugation of *Callosobruchus maculatus* at lower speeds does not cause any harm, but centrifugation at higher speeds affects both the egg laying capacity and the viability of eggs.

Introduction

The cowpea weevil, *Callosobruchus maculatus* is an important pest of various pulse crops in Africa, India, the middle and Far East (Hill, 1975). It inflicts considerable damage to cowpea seed. Infestation which commences on mature pods and seeds in the field, persists and increases during storage (Osuji, 1982). Female lays her eggs on the surface of the cowpea and the newly hatched larvae tunnel directly into the kernal, ultimately the interior of the cowpea seed is virtually destroyed by the feeding activity of the developing larvae (Storey, 1978).

The principal method of controlling this pest is fumigation with methyl bromide in the stores (Metcalf and Flint, 1979). An alternative method of effective control other than fumigation would be desirable.

An attempt has been made in this study to determine the effect of horizontal centrifugation at different speeds on number of eggs laid, viability of eggs, developmental period from egg to adult and longevity of adult of *Callosobruchus maculatus*.

Materials and Methods

A mass culture of *Callosobruchus maculatus* was maintained under laboratory conditions on cowpea seeds which were previously heated to 140°F for four hours and cooled thereafter. *C. maculatus* was introduced into the jar. The adults that just emerged from these culture were used for experimental purposes.

In the experimental set-up, newly emerged adult *C. maculatus* (one female and two males) were allowed to mate and were introduced into a test tube (60 ml) containing 5g of cowpea seeds covered with fine gauze for ventilation. These test tubes were kept in each of the centrifuge tubes which was left open in order to facilitate ventilation. The weevils were centrifuged for three hours. After centrifugation the test tubes were removed and observations were made until the weevils die.

Control experiments were conducted concurrently with the same number of weevils which were kept in comparable test tubes and observations recorded until death of the weevils under similar conditions (87.8°F and 78%RH) but without centrifugation.

Results

1) Number of eggs laid

Egg laying started during the period of three hours of centrifugation, and continued after removal from the container. The mean number of eggs laid per single adult on host seeds was 100.8 and 96.6 at speeds of 185 rpm and 370 rpm respectively. In comparison with the weevils of the control experiments, the centrifugation at this speeds caused no significant change in the number of eggs laid.

When centrifuged at 660 rpm, 1000 rpm and 3000 rpm, the eggs were not laid during centrifugation but laid after centrifugation. However the centrifugation at these speeds brought about a significant drop in the total number of eggs laid.

When centrifuged at 4000 rpm and 5000 rpm, most of the weevils (60%) ejected the eggs in a heap on the glass surface of the container and subsequently the weevils died. There was a highly significant drop in the number of eggs laid by the surviving weevils in comparison with that of the normal weevils. Most of the males were alive even after centrifugation at these speeds (Table I (a)).

2) Number of viable eggs

There was no significant change in the number of eggs hatched after centrifugation at 185 rpm and 370 rpm, when compared with the normal weevils.

Among the eggs that were laid by the weevils centrifuged at 660, 1000, 3000, 4000, & 5000 rpm, a significantly smaller number hatched out than those from the control experiment (Table I (b)).

3) Developmental period from egg to adult and longevity of the adult.

There was no significant difference in the developmental period (around 23 days) from egg to adult by centrifugation. But the longevity of adults at 4000 rpm and 5000 rpm, was reduced to 3.6 days and 3.4 days from 6.8 and 6.6 respectively (Table I (c)).

Discussion

The control of insect pests by horizontal centrifugation has not been attempted before. It appears that centrifugation affects most of the systems of insects, causing death. The effect of centrifugation on *C. maculatus* was experimented in this study.

It was found in this study that centrifugation of the weevils at lower speeds (185—370 rpm) has not affected the number of eggs laid, the number of viable eggs, developmental period and longevity. It appears that the weevil could withstand such centrifugation. However, the centrifugation at higher speeds

Table I : Effect of centrifugation on (a) Number of eggs (b) Number of viable eggs (c) Longevity (days), of *C. maculatus*. (rpm = Speed of centrifuge)
*Significant (P=0.05)

rpm	Control			Centrifuged weevils			Difference		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
185	105.5	62.8	6.9	100.8	60.2	6.7	4.7	2.6	0.2
370	101.8	56.5	6.5	96.6	51.5	6.5	5.2	4.0	0.0
660	98.3	59.2	6.8	70.0	47.0	6.3	*28.3	*12.2	0.5
1000	93.5	58.0	6.1	59.0	33.0	6.0	*34.5	*25.0	0.1
3000	100.1	61.4	6.5	59.3	32.0	5.4	*40.8	*29.4	*1.1
4000	91.0	57.0	6.8	32.0	15.0	3.6	*59.0	*42.0	*3.2
5000	95.0	58.5	6.6	15.0	10.0	3.4	*80.0	*48.5	*3.2

(660—3000 rpm) caused significant drop in the total number of eggs laid and the number of viable eggs. Obviously, the centrifugation at these speeds has affected the fecundity. This was probably due to physiological disturbances caused in the developmental stages of the oocytes. Such centrifugation did not cause considerable change either in developmental period of the larva or longevity of adult.

When centrifuged at still higher speeds (4000—5000 rpm), most of the female weevils ejected the eggs which did not develop at all. Centrifugation at these speeds too caused a drop in the number of eggs laid, the number of viable eggs, and reduced the longevity and the adult weevils. It appears that these speed caused mortality in this insect. Females were more affected than males by centrifugation at (4000 — 5000 rpm). Most of the males were alive after centrifugation at high speed. Therefore it is concluded that females are more susceptible to centrifugation than males.

Although fumigation has been the method of control of the pest the centrifugation method gives an effective control of females and reduces the possibility of development of eggs of the weevils. This method of control is promising if chemical treatment had to be avoided for very specific reasons. Besides it gives some indication on the effect of gravitational force on egg development which may have morphogenetic significance related to polarity and development of physiological gradients during egg development.

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References

- Hills, S. (1975) Agriculture insect pests of the Tropics and their control. Cambridge University Press, London. 516 pp.
- Metcalf, C. L. and Flint, W. P. (1979). Destructive and useful insects. Tata Mc Graw - Hill publishing company Ltd. New Delhi, 1087 pp.
- Osuji, C. N. (1981). Radiographic studies of the development of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) in cowpea seeds. *J. stored Prod. Res.* 18(1) 1-8.
- Sakunthaladevi Ambikaipakan and Ganesalingam, V. K. (1985). Effect of horizontal centrifugation on egg laying capacity and survival of *Callosobruchus maculatus* (Fabricus) Coleoptera : Bruchidae). *Proc. Sri Lanka Assoc. Advmt. Sci.* 41 (1) : 81
- Storey, C. L. (1978). Mortality of cowpea weevil in a low oxygen atmosphere. *J. Econ. Ent.* 71. 833-834.

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