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Laboratory Investigations on the Repellent and Narcotic Properties of Steam Distillates of Local Plant Extracts to *Sitotroga cerealella* (Olivier)

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Abstract ; The study was undertaken to determine suitable local plant extracts to be used against *Sitotroga cerealella*, an important pest of paddy in Sri Lanka.

A 'Y' shaped insect olfactometer was used to determine the behaviour of the moths towards the materials used. Additional experiments were conducted in large petridishes to find the toxic effect of the vapor of these materials. Several replicates were taken in each case.

Statistical analysis of the data obtained in the experiments showed that among the materials used, the steam volatile constituents of *Vitex negundo* appeared to be a promising repellent and the vapour of citronella oil was toxic to *Sitotroga cerealella*.

1. Introduction

Effective natural enemies are not available for *Sitotroga cerealella*, an important pest of paddy in Sri Lanka. The use of chemicals to control it may not be advisable due to their residual effect. Although maintenance of a certain standard of cleanliness in storing paddy may reduce infestation[1] it is not possible to reduce infestation appreciably by this method. Therefore, the feasibility of using a suiatable local repellent was investigated in the laboratory.

This study was undertaken to find suitable plant extracts that could be used against the pest in stored paddy. It was thought that the use of local resources as repellents would be of economic value for controlling the pest.

2. Materials and Methods

The moths were reared on paddy under laboratory conditions in bottles (375 c. c.) covered with perforated plastic caps for ventilation. Each newly emerged female was introduced into a bottle containing newly emerged males. Immediately after copulation the female was collected in separate bottles containing paddy sterilised at 80° C for twenty minutes. The 1st generation moths emerged after about a month. One-day-old moths, both females and males in equal number were collected by means of an aspirator and used in these experiments.

A simple 'Y' shaped insect olfactometer similar to that used by Hershberger and Smith[2] was used in this experiment with an additional syringe to push the experimental specimens from the main chamber to the 'Y' tube (Figure 1). A current of air was drawn by a suction pump along both arms of the olfactometer simultaneously and passed out through the outlet of the main stem. The material under investigation was placed in a small bottle, through which air was passed so that its vapour passed into one arm of the olfactometer, while the

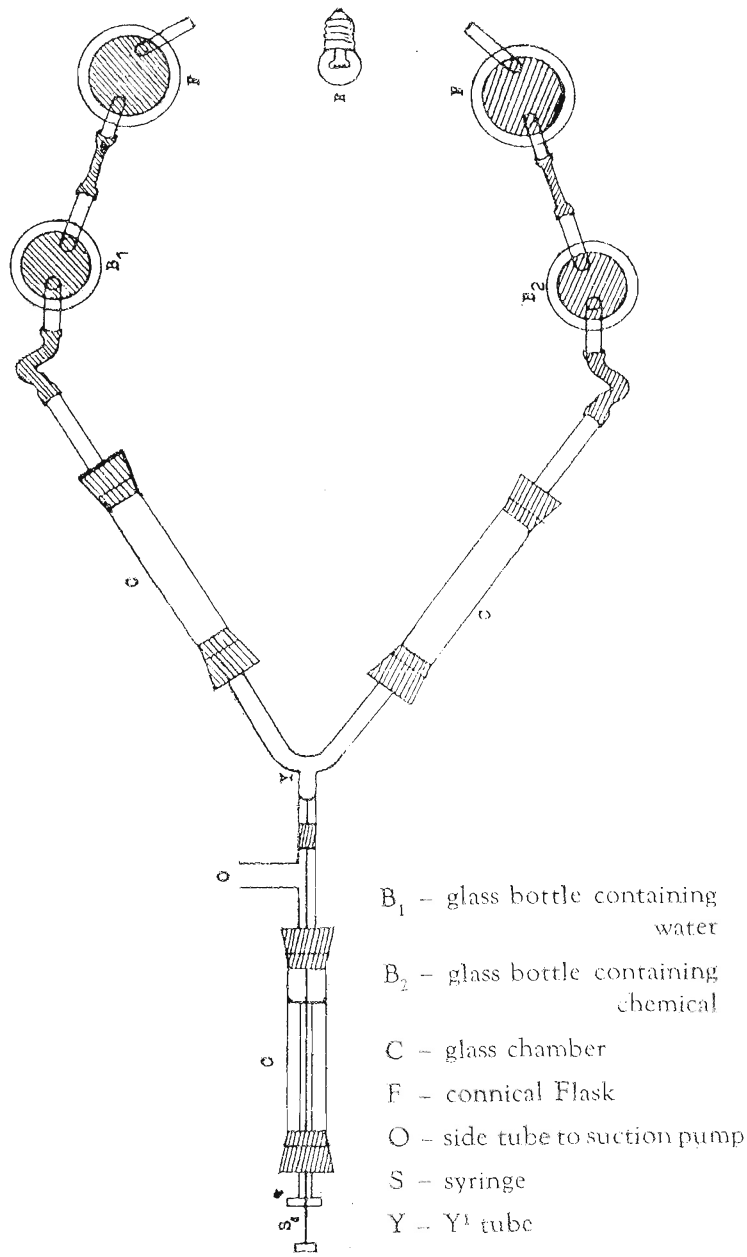

Figure 1 - 'Y' shaped insect olfactometer.

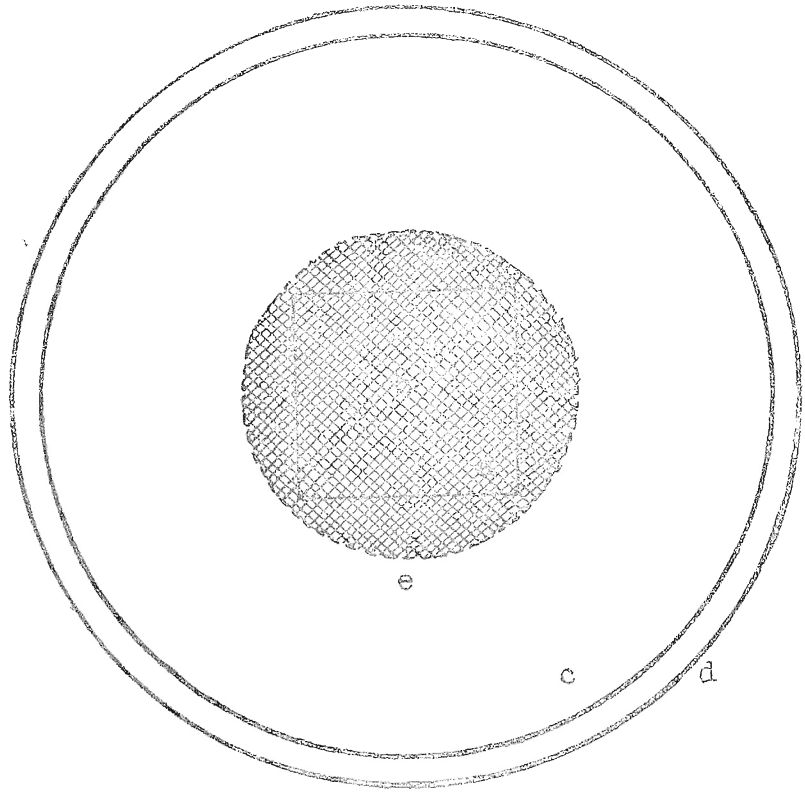

Figure 2 A

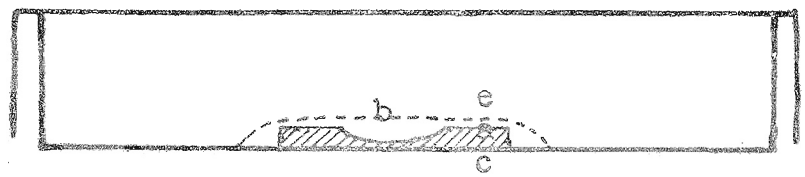

Figure 2 B

Figure – 2 Apparatus used to determine the time taken for the moths to die due to the vapour of the plant extracts.

A. Top view.
B. Side view

a. cavity side
b. plant extract
c. petridish
d. cover
e. mesh

other arm carried air which has passed over water. The moths were introduced in groups into the main stem and as they proceeded into the 'Y' shaped tube, they encountered two air currents of the same speed containing different odours, and as such they would move away from the one carrying a repellent. Subsequently, they would reach the respective large glass tubes. Using this technique eleven replicates were taken with various numbers (2-6) of moths in almost the same sex ratio. (The time allowed was 11 minutes in each case). The experiments using 'Y' shaped olfactometer were conducted in a dark room.

Additional experiments were conducted using large petridishes (diameter 9cm; volume 100 cc), keeping the material under investigation on a cavity slide and covering it with another petridish (Figure 2). The moth was introduced into a large petridish and the time taken for it to die due to the vapour of the materials used was determined. Several replicates were taken. In this way different materials were used to find their toxic effect on the moth concerned.

The plant extracts used in this study were either prepared in our laboratory or obtained from the Ceylon Institute of Scientific and Industrial Research, Colombo.

The extracts in our laboratory were prepared by steam distillation of the leaves, followed by other extraction. The temperature of the laboratory during the experimental period was $30° \pm 2°$ C and the relative humidity $80 \pm 4\%$

3. Results

Statistical analysis using analysis of variance[3] for the data obtained in the experiments using the 'Y' shaped insect olfactometer, showed that the data obtained with the extract of *Vitex negundo* was significantly different from those obtained using other extracts (d. f = 9/100, F = 1·682 significant at 10% level). Analysing the results using t - test, pair by pair shows that the data obtained for the extract of *Vitex negundo* is significantly different from those obtained using other extracts. The "Chi" square test applied to the data obtained using the extract of *Vitex negundo* showed that there is a significant difference between the number of moths moving into the arm ($X^2 = 12 \cdot 736$, $P < 0 \cdot 005$). The number moving into the arm containing the extract of *Vitex negundo* was significantly less than the number moving into the other arm - (Table 1).

With regard to the time taken for the moths to die due to vapour toxicity of the materials used, it was found that among the materials used, Citronella oil vapour, killed within the shortest time (14 minutes an average of 11 readings taken in each case - Table 2).

Table 1 – The direction of movements of *Sitotroga cerealella* in the 'Y' shaped olfactometer when given a choice between the plant extracts (oil) and water. (* significantly different).

Materials	Total No. of Insects	No. of insects moved into the arm containing plant extract	No. of insects moved into the arm containing water	Non-response	X2	P
Citronella oil	50	12	28	10	6·4	*<0·025
Clove oil	53	17	14	22	0·029	<0·900
Margosa oil	56	20	22	14	0·095	<0·900
Cinnamon leaf oil	47	13	21	13	1·82	<0·250
Eucalyptus oil	46	9	18	19	3·00	<0·050
Lime leaf oil	42	21	15	6	0·111	<0·750
Vitex oil	43	8	30	5	12·736	*<0·005
Camphorated margosa oil	54	18	31	5	3·447	<0·050
Lemon grass oil	64	13	13	38	0·000	<0·095
Ocimum extract	39	10	16	13	1·384	<0·250

Table 2 – The time taken for the moths to die due to the toxic effect of the vapour of the materials used. (Average of 11 readings in each case).

Materials	Average time taken for death (mins.)
Citronella oil ..	14
Clove oil ..	16·5
Vitex oil ..	18
Cinnamon leaf oil ..	18
Lemon grass oil ..	19
Margosa oil ..	> 30
Eucalyptus oil ..	> 30
Lime leaf oil ..	> 30
Camphorated Margosa oil ..	> 30
Ocimum extract ..	> 30

4. Discussion

The study revealed that of all the plant extracts tested for potent repellency against *Sitotroga cerealella*, the extract of *Vitex negundo* could be considered as a promising repellent. The other materials were unsuitable for this purpose. The odour of the extract of *Vitex negundo* seems to be intolerable, as it is to some animals and to man. It is probable that the olfactory organs of the moth are extra sensitive to the odour of the extract of *Vitex negundo*.

From the present study one could conclude that the oil of Citronella (*Andropogon nardus* – Lenabatu type) is the most toxic material used in these experiments, as it takes the shortest time to kill the pest. Although Citronella (Lenabatu type) seems to have a repellent property to mosquito species as reviewed by Wijesekera,[5] how it causes death in *Sitotroga cerealella* is not known.

The extract of Black pepper, *Piper nigrum* (L) has been used against rice weevil, *Sitophilus oryzae* (L), and cowpea weevil, *Callosobruchus maculatus* (F).[4] In similar manner, *Vitex negundo* could be made use of as repellent and poison against *Sitotroga cerealella*.

The toxicity of Black pepper was not attributed to the presence of piperine alone. Several other chemical components of Black pepper may be ascribed for its toxicity in conjunction or in synergism with piperine.[4] Likewise, *Andropogon nardus* contains about 47 constituents[5] but the components with toxic or repellent qualities have not been identified. In the case of *Vitex negundo*, even the chemical consitituents have not been investigated.

Further investigations on the chemical constituents and their effects individually, or in conjunction with others, so as to determine the most promising composition, for repellency or toxicity are necessary.

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