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Editor

David McDonald B.Sc.

Assistant Editor

Margaret Street

Technical Consultants

T.F. West

M.Sc., Ph.D., D.Sc., F.R.S.C.

T. Mabbett

B.Sc., M.Sc., Ph.D.

Publisher

J. Kumar Patel

Advertisement Manager

Julie Saunders

5 Teal Close

Longridge

Colchester

Essex CO4 3GF

United Kingdom

Tel: 01206 795866

Fax: 01206 794197

Subscription Manager

Richard Wood

Publishing Offices:

McDonald Publications
of London Ltd

222 Maylands Avenue

Hemel Hempstead

Hertfordshire HP2 7TD

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FRONT COVER

A riot of colour — a Micron Ulvafan Mark 2 sprayer being used to spray glasshouse chrysanthemums in the UK. (Photograph courtesy Micron Sprayers Ltd)

Table 1: Effects of clove extracts on larvae of *T. castaneum*

Concentration (g ml ⁻¹)	% Corrected mortality [Mean \pm s.e. (n)]		
	10-day old larvae	14-day old larvae	16-day old larvae
0.4	6.83 \pm 1.60 (7)	0.71 \pm 0.57 (9)	0.44 \pm 0.29 (6)
0.8	8.50 \pm 0.62 (7)	3.86 \pm 1.79 (9)	0.28 \pm 0.15 (6)
1.0	6.83 \pm 0.79 (7)	2.71 \pm 1.32 (9)	2.33 \pm 0.69 (6)

Table 2: Effect of clove extracts on oviposition by adult *T. castaneum* (24h after introduction on filter papers)

Treatment	No. of eggs laid) (Mean \pm s.e.)
Control	0.25 \pm 0.50
0.93 g ml ⁻¹	0.75 \pm 0.96

in the treated medium but they died before hatching.

Discussion

The younger larval stages of *T. castaneum* were more susceptible than the older ones to non-polar clove extracts. The susceptibility of *T. castaneum* eggs to clove extracts was the highest of all the life stages studied. This observation is contrary to other studies where insect eggs are more tolerant than larval stages to contact insecticides (Busvine 1971), carbon dioxide (Leong and Ho, 1993) and phosphine (Howe, 1973). It is possible that clove has ovicidal activity against *T. castaneum* eggs. The potential ovicidal effect of cloves is thus worth exploring further.

Although low mortality was observed in larvae aged 10 days and older, it is expected that larvae younger than 10 days would be more susceptible, as susceptibility tended to decrease with age. Interestingly, moulting occurred in more individuals at higher extract concentrations for 10-day, 14-day and 16-day old larvae. It is not certain why this occurred but this phenomenon could be a means of increasing chances of survival for the larvae by removing the toxin via the exuviae.

The clove extracts were also very effective against the progeny production of *T. castaneum*, confirming earlier results (Ho *et al.*, 1994). The earlier suspicion that the repellent effect of cloves against adult *T. castaneum* (Sighamony *et al.*, 1984) might have prevented oviposition can now be dismissed. This study shows that eggs were laid by adults in the treated media but were soon killed by the extracts. Thus no F₁ adults emerged.

Although clove extracts appeared to be non-toxic to *T. castaneum* adults (Ho *et al.*, 1994), they were effective against the eggs and young larvae. Hence, clove extracts can be used safely and effectively on grain against *T. castaneum*. However, field trials should be conducted before these extracts are used in grain storages.

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Successful and simple artificial medium for rearing three noctuid species

M. Ragaei* and A. Shams El-Dint

* National Research Centre, Pests and Plant Protection Department, Dokki, Cairo, Egypt.

† Zagazig University, Faculty of Agriculture, Plant Protection Department, Moshtohor, Egypt.

A practical diet containing the commercial feeding stimulant COAX (cottonseed flour, cottonseed oil and carbohydrate) has been developed to facilitate the mass rearing of three noctuid species, with a minimum of time and cost. The medium is composed of COAX, agar, water and mould inhibitors.

Development times for larvae of the spiny bollworm (*Earias insulana*), the pink bollworm (*Pectinophora gossypiella*) and the almond moth (*Ephestia cautella*) were as follows:

E. insulana: mean development period from larva to adult, 27 days;

P. gossypiella: mean development period from larva to adult, 40 days;

E. cautella: mean development period from larva to adult, 23 days.

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COAX was kindly supplied by Lobel Chemical Corporation, 100 Church Street, New York, N.Y. 10007-2682, USA.

