INTERNATIONAL PEST CONTROL
CROP & STOCK PROTECTION
PUBLIC HEALTH, WOOD PRESERVATION

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

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 clove 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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References

**Successful and simple artificial medium for rearing three noctuid species**

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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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