J. Aust. ent. Soc., 1974, **13**: 267-270

THE RESPONSES OF FRUIT FLY SPECIES (DIPTERA: TEPHRITIDAE) IN THE SOUTH PACIFIC AREA TO MALE ATTRACTANTS

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Abstract

Specimens of Dacini were collected in traps containing male attractants in north-east Australia and 26 islands of the South Pacific area. The resulting species-attractant records are given for 79 species, which fit into 2 groups on the basis of their response to attractants: (1) species attracted to the cue-lure type of attractant (cue-lure and Willison's lure); (2) species attracted to methyl eugenol. No species was attracted to both types of attractants. Species of the genus *Callantra* and of both the *Strumeta* and *Dacus* groups of subgenera of the genus *Dacus* were attracted to the cue-lure type of attractant. Only species of the *Strumeta* group of subgenera were attracted to methyl eugenol.

Introduction

The attraction of species of Dacini to lures has long been recognised by Australian workers. Jarvis (1931) recorded that Froggatt collected males of the oriental fruit fly, *Dacus (Strumeta) dorsalis* Hendel, in India in 1909, using citronella oil. Jarvis (1931) also noted that in Queensland in 1914, Harvey's lure (an unknown mixture) was used to collect males of the Queensland fruit fly, *Dacus (Strumeta) tryoni* (Froggatt). In 1928, Jarvis collected both sexes of 4 species of Queensland Dacini with a mixture of vanilla essence, ammonia and water (Jarvis, 1931). Perkins and Hines (1934) showed that both sexes of *D. tryoni* were attracted to ammonia and as a result Robinson's lure (containing ammonia, orris root, molasses and vanilla essence) was developed. Caldwell and May (1943) tested approximately 300 lures and recommended 5 formulae based on various combinations of ammonia, ammonium carbonate, maize meal, orange rind, pollard and yeast for use by commercial fruit growers in population detection and control programmes. May (1958) developed a lure containing pulped orange, ammonium carbonate and water. He carried out an extensive collecting programme throughout Queensland using his lure and although he collected both sexes of many Queensland species of Dacini (notes in DPI* fruit fly collection) no species-attractant records are available. In 1959, a male attractant, 1-(p-hydroxyphenyl)-butan-3-one (Willison's lure), was developed in Australia and shown to be attractive to the males of *D. tryoni*. More recently, a mixture of Willison's lure and 1-(p-acetoxyphenyl)-butan-3-one, (cue-lure), an attractant used in the commercial "Dak Pot" traps, has been made available by Union Carbide Australia.

In the South Pacific area (including Australia), no attempt has been made to test the responses of fruit flies to the more recently developed fruit fly attractants and to assemble species-attractant records for species of Dacini.

Workers in Asia and the northern Pacific area (especially in Hawaii) have also developed attractants for species of Dacini. Howlett (1912, 1915) recorded the attraction of males of *Dacus diversus* Coquillett and *Dacus zonatus* Saunders to citronella oil, and the attraction of males of *D. zonatus* to methyl eugenol, *D. diversus* to iso-eugenol and *D. dorsalis* to both attractants. Following the discovery of *D. dorsalis* in Hawaii in 1946, Hawaiian entomologists tested citronella oil and methyl eugenol as attractants to be used in detecting and studying populations. Methyl eugenol was found to be the most attractive lure to this species (Steiner 1952). Steiner (1957) designed a cylindrical plastic fruit fly trap which proved to be very successful in trapping *Dacus cucurbitae* Coquillett and *D. dorsalis* when baited with appropriate attractants. Barthel *et al.* (1957) tested over 1000 compounds as attractants for *D. cucurbitae* and found that males of this species were attracted to a number of aromatic ketones, anisylacetone being the most effective. Anisylacetone only attracts sexually mature males of *D. cucurbitae*. Beroza *et al.* (1960) developed another attractant, cue-lure, which attracts both teneral and sexually mature male

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specimens of *D. cucurbitae* and in addition is a much more powerful attractant than anisylacetone, attracting larger numbers of specimens. Cue-lure was found to attract males of *Dacus ochrosiae* (Malloch) in the Mariana Islands.

The work in Hawaii has been concentrated on the development of effective male attractants for use in population studies and for the attempted control of pest species by killing males. There are few species-attractant records published for the Dacini of Asia and the northern Pacific area. The attractants are important when used to detect the presence of flies in an orchard. It would therefore be advantageous to know the species-attractant records so that specific lures could be used for detecting pest species.

Attractants are becoming increasingly important in fruit fly control, both in individual orchards and in suppression and eradication of populations over large areas. The basic value of attractants is their ability to draw fruit flies to insecticides thus eliminating the application of cover sprays over entire target areas. Notable examples are the eradication of *D. dorsalis* from the Mariana Islands by the use of methyl eugenol plus naled (Steiner *et al.* 1970); the reduction of populations of *D. cucurbitae* in Hawaii by more than 99% over plots of 518 ha by the use of cue-lure plus naled (Cunningham and Steiner 1972); the reduction of populations of *D. dorsalis* in Hawaii by 98% over plots of 2073 ha by the use of methyl eugenol plus naled (Cunningham *et al.* 1972).

Willison's lure, cue-lure, and anisylacetone are similar in molecular structure. It is thought that the acetoxy derivative (cue-lure) is not very stable and that most of it is transformed to the hydroxy derivative (Willison's lure) soon after exposure in the field (M. A. Bateman, personal communication).

The formula of methyl eugenol (an ether) is different from the above lures which are ketoesters.

Barthel *et al.* (1957) found that the introduction of another methoxyl group (CH_3O) on the benzene ring of anisylacetone gives a compound that is no longer attractive to *D. cucurbitae* but attractive to *D. dorsalis*. The formula of this compound is similar to that of methyl eugenol.

Methods and materials

Fruit fly specimens were collected on 26 South Pacific Islands and in north-east Australia (Drew, in press) by using male lure traps as described by Steiner (1957). The traps were assembled at the Brisbane laboratory and forwarded together with samples of attractants (methyl eugenol, cue-lure, Willison's lure) and dichlorvos insecticide to personnel in centres throughout the South Pacific area. Occasionally in Papua and New Guinea, the "Dak Pot" trap (containing a mixture of cue-lure and Willison's lure) was used. In order to obtain correct species-attractant records, a separate trap was used for each attractant.

The insects collected were forwarded to the laboratory, packed in cotton wool, in glass jars which contained thymol crystals. This ensured that the specimens were not damaged in transit or by bacterial or fungal growth.

All species identifications were made in the laboratory.

Results

Of the 79 species collected 56 responded to the cue-lure type of attractant (cue-lure, Willison's lure, or a mixture of both) and 23 to methyl eugenol. These are listed in Tables 1 and 2 respectively.

In both tables, members of the subgenus *Strumeta* are arranged in groups of closely related species, except for the final 20 in Table 1 and 18 in Table 2, which are alphabetical.

TABLE 1

SPECIES RESPONDING TO ATTRACTANTS OF THE CUE-LURE TYPE

Species	Attractant*
Genus *Callantra* Walker	
C. capillaris Drew	c
C. mayi Drew	c
C. smieroides Walker	c, c + h
C. solomonensis (Malloch)	c
Genus *Dacus* Fabricius	
Dacus group of subgenera	
Subgenus *Pacifodacus* Drew	
D. abdopallescens Drew	h
D. perpusillus Drew	c
D. strigifinis strigifinis Walker	c + h
D. triangularis (Drew)	c, c + h
D. univittatus Drew	c
Subgenus *Zeugodacus* Hendel	
D. abdoangustus Drew	c
D. amoenus Drew	c
D. brachus Drew	c
D. choristus (May)	c, h
D. cucurbitae Coquillett	c, c + h
D. curtus Drew	c
D. gracilis Drew	c
D. reflexus Drew	c, c + h
D. trichotus (May)	c
Strumeta group of subgenera	
Subgenus *Afrodacus* Bezzi	
D. minutus Drew	c
Subgenus *Strumeta* Walker	
D. amplus Drew	c, c + h
D. decumanus Drew	c
D. anomalus Drew	c
D. distinctus Malloch	c
D. pseudodistinctus Drew	c, c + h
Subgenus *Strumeta* Walker (con.)	
D. anthracinus Drew	c
D. aterrimus Drew	c
D. simulatus Malloch	c
D. bryoniae (Tryon)	c, h, c + h
D. phaeus Drew	c, c + h
D. enochrus Drew	c
D. trifarius Drew	c
D. frauenfeldi Schiner	c, h, c + h
D. triseriatus Drew	c
D. indecorus Drew	c, c + h
D. trivialis Drew	c, h, c + h
D. vulgaris Drew	c, h
D. abdonigellus Drew	c + h
D. alyxiae (May)	c, h
D. atramentatus (Hering)	c
D. brevistriatus (Drew)	h
D. curvipennis Froggatt	c
D. denigratus Drew	c
D. dyscritus Drew	c
D. facialis Coquillett	c
D. kirki Froggatt	c
D. lineatus (Perkins)	c
D. moluccensis (Perkins)	c
D. mucronis Drew	c
D. neohumeralis Hardy	c
D. nigrescentis Drew	c
D. obscurus Malloch	c
D. passiflorae Froggatt	c
D. psidii (Froggatt)	c
D. recurrens (Hering)	h
D. reduncus Drew	c
D. tryoni (Froggatt)	c

*c = cue-lure; h = Willison's lure; c+h = "Dak Pot", which is a mixture of cue-lure and Willison's lure.

TABLE 2

SPECIES RESPONDING TO METHYL EUGENOL

Genus *Dacus* Fabricius	*D. ebeneus* Drew
Strumeta group of subgenera	*D. froggatti* (Bezzi)
Subgenus *Daculus* Speiser	*D. fulvicaudus* (Perkins)
D. visendus Hardy	*D. lampabilis* Drew
Subgenus *Notodacus* Perkins	*D. melanotus* Coquillett
D. xanthodes (Broun)	*D. musae* (Tryon)
Subgenus *Strumeta* Walker	*D. nigellus* (Drew)
D. abdolonginquus Drew	*D. nigritus* Drew
D. endiandrae (Perkins and May)	*D. ochromarginis* Drew
D. nigrescens (Drew)	*D. pepisalae* Froggatt
D. biarcuatus Walker	*D. piceus* Drew
D. cheesemani (Perkins)	*D. seguyi* (Hering)
D. confluens Drew	*D. umbrosus* Fabricius
D. curvifer Walker	*D. unistriatus* Drew

Discussion

The species are specific in their response to the types of attractants, no species being collected at both the cue-lure type and methyl eugenol. Drew (1971) recorded the following species as being collected at both types of attractants: *D. minutus, D. abdolonginquus, D. anomalus, D. ebeneus, D. mucronis, D. reduncus, D. triseriatus.* Subsequent correspondence with the collectors has revealed that some records for these species are doubtful and as a result they have been arranged in the above tables under the attractants that could be confirmed. This record of response of species to attractants is of considerable importance in monitoring populations of pest species for quarantine and control procedures and for applying certain fruit fly control methods.

The Tribe Dacini has been divided into two genera, viz., *Callantra* and *Dacus,* and genus *Dacus* has been divided into two groups of subgenera, viz., the *Dacus* group of subgenera and the *Strumeta* group of subgenera (Drew 1972a). Attractants of the cue-lure type (ct) attracted species of the two genera and both groups of subgenera, while methyl eugenol (m) only attracted species of the *Strumeta* group of subgenera. Within all groups of morphologically similar species of subgenus *Strumeta,* most species are attracted to the one type of attractant. There are some exceptions within some of these groups, viz., *D. atramentatus* is attracted to ct while *D. piceus* is attracted to m; *D. brevistriatus* is attracted to ct—*D. musae* is attracted to m; *D. indecorus, D. trivialis, D. vulgaris* are attracted to ct—*D. abdolonginquus, D. endiandrae, D. nigrescens* are attracted to m; *D. anthracinus, D. aterrimus, D. simulatus* are attracted to ct—*D. nigellus* is attracted to m. The responses to attractants, recorded in this paper, partly conform with taxonomic divisions. This is an indication that such responses may have use as taxonomic characters.

Acknowledgments

I am indebted to many people who have organised trapping in various centres in the South Pacific area. These are listed in a previous paper (Drew 1972b).

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[*Manuscript received May* 22, 1974].