Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 6 (1): 181-183, 2007
ISSN 1682-3974

Male Fruit Fly, *Bactrocera tau* (Diptera; Tephritidae) Attractants from *Elsholtzia pubescens* Bth

[1]A. Hasyim, [1]Muryati, [1]Mizu Istianto and [2]W.J. de Kogel
[1]Balai Penelitian Tanaman Buah Jl. Raya Solok Aripan, KM 8, P.O. Box 5. Solok 27301, Indonesia
[2]Plant Research International B.V. P.O. Box 16, 6700 AA Wageningen, The Netherlands

Abstract: Studies on the ability of different plant extracts to attract male fruit flies indicated that an extract of *Elsholtzia pubescens* attracted male *Bactrocera tau* fruit flies in Passion fruit orchards in West Sumatra, Indonesia. Analyses of the plant extract showed that the major compound present was Camphor. Both the complete plant extract and its major compound Camphor were at least as efficient as the standard cue-lure in trapping male *B. tau* in trapping experiments in Passion fruit orchards.

Key words: Fruit flies, semiochemicals, attractant, trapping, male annihilation

INTRODUCTION

The damage to crops caused by fruit flies can be either direct, through oviposition in fruit and tissues of vegetative parts of plants and feeding by the larvae, or indirect, through decomposition of plant tissues by invading micro organisms (Daini *et al*., 1983; Kalshoven 1981; Manoto 1991; Iwashi *et al*., 1996; Kaneshiro, 1989; Koyama *et al*., 1984). The losses caused in fruit crops by insect pests particularly by fruit fly, *Bactrocera tau* has been estimated to be as high as 40% of the production (Hasyim *et al*., 2004). The extend of losses varies between 30-100% depending on the fruit species and season (Dillon *et al*., 2005).

The predominant method of insect pest control has been through the use of conventional pesticides. They have been very effectively used over long time and have ensured yields and benefits to the growers. The continued use of such products has however been questioned in amount of pesticides that is being used to control pests. In many agricultural crops, the concept of Integrated Pest Management (IPM) has been developed as a means of rationalizing the use of pesticides. IPM has been defined by the International Organization of Biological Control (IOBC) as a pest management strategy employing all methods consistent with economic, ecological and toxicological requirements to maintain pests below economic threshold while giving priority to sustainable crop protection. Technologies and techniques which have found a useful role in IPM strategies include; the use of resistant plants varieties, cultural practices, the use of predators and parasites, microbial pesticides (entomopathogenic bacteria, viruses and fungi), botanical insecticides, insect growth regulators and semiochemicals.

Semiochemicals are defined as substances which transmit messages between living organisms, both plant and animals. These include insect pheromones but also plant produced attractants and repellents. For several species of fruit flies sex pheromone compounds have been identified e.g., for *Bactrocera oleae* (Baker *et al*., 1980).

Two compounds play significant roles as attractants for male Tephritid fruit flies: Methyl eugenol and cue-lure (Metcalf, 1990). These chemicals are distinctively plant-related products derived from phenylpropanoid and related compounds. Methyl eugenol [allyl-3, 4-dimethyoxybenzene], occurring widely as a natural product in the plant kingdom, is a highly potent attractant for the male fruit flies of several species e.g., *B. dorsalis*. Due to its availability and strong attractant properties, it has been used both as a trapping agent in capturing native male fruit flies for population estimation and for pest control. Cue-lure on the other hand has not been isolated directly as a natural product (except as the hydrolysed derivative) and is a potent male attractant to another group of fruit flies e.g., *Bactrocera cucurbitae* (Yong, 1990).

Preliminary studies on the ability of different plant extracts to attract male fruit flies indicated that an extract of *Elsholtzia pubescens* attracted male *Bactrocera tau*

Corresponding Author: A. Hasyim, Balai Penelitian Tanaman Buah Jl. Raya Solok-Aripan, KM 8, P.O. Box 5. Solok 27301, Indonesia Tel: + 6275520137 Fax: 62 755 20592

fruit flies in passion fruit orchards in West Sumatra, Indonesia. *Elsholtzia pubescens* (local name: Salasih gunung) is a Lamiaceae herbaceous plant occurring throughout tropical Asia including West Sumatra, Indonesia. *Elsholtzia* spp. have been studied mainly because of their medicinal values, perfume components and antibacterial activity (Peng and Yang, 2005; Zue *et al*., 1992). In the present study steam distillates of *E. pubescens* were made and analysed and tested for attractivity to male *B. tau* fruit flies in passion fruit orchard in West Sumatra to see if they could serve as a source of new effective attractants. The attractivity was compared with standard cue-lure.

MATERIALS AND METHODS

Plant material: *Elsholtzia pubescens* leaves were collected in August and September 2005 from Alahan Panjang, West Sumatra and transported in plastic bags to the laboratory where they were put to dry at room temperature (approx. 28°C) the same day. After 4 days the leaves were chopped before extraction. The plant was identified and authenticated by a plant taxonomist. A voucher specimen was lodged at Herbarium of Biology Department, University of Andalas, Padang.

Plant extraction: A simple laboratory quick fit apparatus with 2000 mL steam generator flask, a distilling flask a condenser and a receiving vessel, was used for steam distillation. The flask was heated with a gas burner. A hundred gram air dried and chopped leaves of *Elsholtzia* plants were subjected to steam distillation.

Coupled gas chromatography mass spectrometry (GC-MS): GC-MS was performed on a Hewlett Packard 5973 mass selective detector (70 eV), coupled to a Hewlett Packard gas chromatograph equipped with a split/splitless Programmed Temperature Vaporization (PTV) injection system (CIS 4; Gerstel, Mülheim an der Ruhr, Germany) Injections were done in split mode only (1 μL). The column was an 30 m EC-5 fused silica column, 0.25 mm ID and 0.25 μm film thickness (Alltech/Applied Science BV., Breda, The Netherlands) Conditions were: carrier gas, helium, constant head pressure at 0.6 bar; temperature programming, 50°C (2 min hold) to 300°C (5 min hold) at 8°C/min; injector temperature, 250°C; transfer line temperature, 300°C.

Bioassay: Field trapping of fruit flies was done using modified clear traps (Steiner *et al*., 1965) made from mineral water bottles baited with *Elsholtzia* extract, cue lure (Bedoukian, purity>97%) or (±) camphor (Sigma, purity>95%). Each trap was baited with 0.25 g *Elsholtzia* extract, 0.5 mL cue lure or 0.25 g camphor. Experiments were performed in a passion fruit orchard of approximately 1 h. Per experiment, six traps per treatment were distributed randomly in the passion fruit orchard at 1.5 m from the ground level. Traps were placed at least 10 m apart from each other. Trapping experiments were conducted between 8.00 and 11.00 am. The experiment was repeated 10 times on ten different days. Trap data (number of flies per trap) were analyzed analyses of variance followed by Tukey-Kramer multiple range test.

RESULTS AND DISCUSSION

Analyses of the steam distillate of *E. pubescens* leafs showed that the major chemical compounds were Camphor, Camphene and Alpha pinene (Fig. 1). During the drying procedure of the plants and because of the simple distillation technique used, probably only part of the compounds present in the leaves were recovered. It is however a technique that could be used locally at low cost to extract attractants for fruitflies.

From literature, the chemical composition of several other *Elsholtzia* species is known and appears to be quite different. For example, the main components of *Elsholtzia ciliate* were found to be perillene (2.1-3.9%), Elsholtzia ketone (3.3-19.3%), α dehydro-elsholtzione (2.0-5.7%), dehydro-Elsholtzia ketone (66-72.4%) and humulene (1.5-3.8%) (*Elena et al*., 2002). Ahmad *et al*. (1988) analyzed that the major constituents of *Elsholtzia polystachya* were 1,4-cineole (20.04%), 1,8-cineole (26.11%), perillaldehyde (7.24%), neryl acetate (10.12%), geranyl acetate (2.14%) and β caryophyllene (2.56%).

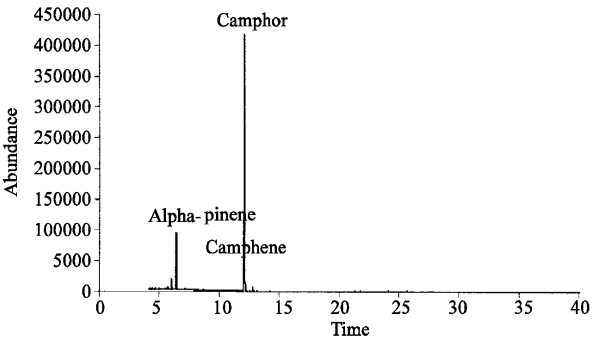

Fig. 1: GC-trace of *Elsholtzia pubescens*

Table 1: Mean±SD of male *B. tau* fruit flies captured in traps baited with different lures

Chemical compound	No. flies captured
Cue lure	34.33±3.57a
Elsholtzia extract	40.83±3.92a
Camphor	36.33±3.70a

Means in the same column followed by the same letter are not significantly different, $p<0.05$

Field tests showed that a steam distillate of *E. pubescens* was able to attract male *B. tau* fruit flies at least as efficient as a standard lure cue-lure. Furthermore the main compound of the extract (Camphor) also attracted the flies at the same rate (Table 1).

Further studies will focus on improvement of the attractivity and study the effect of these compounds on other fruit fly species. In the future alternative lures, useful for fruit fly control, may be the result from these investigations.

ACKNOWLEDGMENTS

We thank the Ministry of Agriculture, Indonesia and the Ministry of Agriculture, Nature and Food Quality, the Netherlands, for funding this research through the HORTIN programme.

REFERENCES

Ahmad, A., M.S. Siddiqui and L.N. Misra, 1988. Composition of *Elsholtzia polystacya* leaf essential oil. Pergomon J., 27: 1065-1067.

Baker, R., R.H. Herber, P.E. Howse, O.T. Jones, W. Franke and W. Reith, 1980. Identification and synthesis of the major sex pheromone of the olive fly (*Dacus oleae*). J. Chem. Soc. Chem. Commun. No., 1106: 52-53.

Daini, S., Z. Zulfiar and S. Isnadi, 1983. Inventory of fruit flies *Dacus* sp. Second Congress of Entomology. Jakarta, Indonesia.

Dillon, M.K., M. Sign, J.S. Naresh and H.C. Sharma, 2005. The melon fruit fly. *Bactrocera cucurbitaceae*: A review of its biology and management. J. Insect Sci., 1: 30.

Elena, A.K., W. Konig and A.V. Tkachev, 2002. Composition of leaf essential oil of *Elsholtzia ciliate* (Thunb) Hyl. From the novosibirk region, Rusia. Russian. J., pp: 31-36.

Hasyim, A., Muryati, M. Khairul, Riska and W.J. de Kogel, 2004. Fruit fly control in Indonesia. Annual Report. Research Institute of Fruit Solok. Unpublished Report (In Bahasa Indonesia).

Iwashi O., T.S.S. Subazar and S. Sastrodihardjo, 1996. Attractiveness of methyl eugenol to fruit fly *Bactrocera carambolae* (Diptera: Tephtritidae) in Indonesia. Ann. Entomol. Soc. Am., 89: 653-660.

Kalshoven, L.G.E., 1981. Pest of Crops in Indonesia. P.T. Ikhtiar Baru, Van Houve, Jakarta. Indonesia.

Kaneshiro, K.Y., 1989. The Dynamics of Sexual Selection and Founder Effects in Species Formation. In Genetics, speciation and Founder Principle. L.V. Giddings. Oxpord University Press.

Koyama, J., T. Teruya and K. Tanaka, 1984. Eradication of the oriental fruit fly (Diptera:Tephritidae) from Okinawa islands by male annihilation method. J. Econ. Entomol., 77: 469-472.

Manoto, E.C., 1991. Status of the Fruit fly control program in the Philippines. Proceeding of the International Symposium the Biology and Control of Fruit flies. Jointly organized by the Food and Fertilizer of Technology Center The University of The Ryukyus. The Okinawa Prepectural Government. Held at Ginowan, Okinawa, Japan, pp: 85-92.

Metcalf, R.L., 1990. Chemical ecology of Dacinae fruit flies (Diptera: Tephritidae). Ent. Soc. Am., 83: 1017-1030.

Peng, H. and X. Yang, 2005. Volatile constituens in the flower of *Elsholtzia argyi* and their variation: A possible utilization of plant resources after phytoremediation. J. Zhejiang Univ., SCI 6B: 91-95.

Steiner, L.F., F.J. Harris, W.C. Mitchell, M.S. Fujimoto and I.D. Christenson, 1965. Melon fly eradication by over flooding with sterile flies. J. Econ. Entomol., 58: 519-523.

Yong, H.S., 1990. Flower of *Dendrobium anosmum* (Orchidaceae): A male fruit-fly attractant of the cue lure group. Nature Malaysiana, 15: 112-115.

Zue, G.P., X. Feng and J.L. Shi, 1992. Studies on the components of essential oils from *Elsholtzia argyi*. J. Traditional Medical Colage of Beijing, 15: 57-59.