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IDENTIFICATION OF FRUIT FLY (DIPTERA: TEPHRITIDAE) IN SEVERAL DISTRICTS IN NORTH SUMATERA

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Abstract

Humayra Windayani Rangkuti, Identification of Fruit Flies (Diptera: Tephritidae) in Several Districts in North Sumatra Province. Supervised by Prof. Dr. Ir. Nur Hayati, MP and Dr. Ir. Rahmad Setia Budi, M.Sc. Fruit flies (Diptera: Tephritidae) are one of the economically important pests that attract world attention. Fruit flies are generally polyphagous with a wide host range. The presence of fruit flies is a limiting factor for the export of agricultural products, especially fruits and vegetables. Fruits infested with fruit flies will rot and their growth will become abnormal. The damage caused can reach 90%-100%. Sampling of fruit flies using the collection method of trapping using a lure or attractant Methyl eugenol (ME). The study was conducted in several districts in the North Sumatra Region. Fruit flies were identified at the Integrated Laboratory of the North Sumatra Animal, Fish, and Plant Quarantine Center (BBKHIT Sumut). The research was conducted from May to December 2024. The results of the trap installation found 8 species of fruit flies of the genus Bactrocera, subgenus Bactrocera and Zeugodacus with the names of the species found being B. carambolae, B. dorsalis, B. albistrigata, B. (Zeugodacus) tau, B. umbrosa, B. (Z.) caudata, B. raiensis, B. verbasifolie, B. (Z.) cucurbitae. Information on species and status of fruit flies in North Sumatra can be used as a reference in anticipating the spread of fruit flies and how to control them on agricultural products with high economic value. Making a list of pest species (pest list) and description of morphological characteristics of OPT, especially fruit flies, is important in trade negotiations. One of the important roles of quarantine is to prevent the entry and exit of OPT/OPTK including fruit flies from one country to another or from one area to another within the country, or out of the territory of the Republic of Indonesia through local and international trade activities.

Keywords: ***identification, fruit flies, methyl eugenol.***

INTRODUCTION

Fruit flies (Diptera: Tephritidae) are one of the economically important pests that attract world attention. Fruit flies are generally polyphagous with a wide host range. The presence of fruit flies is a limiting factor for the export of agricultural products, especially fruits and vegetables. Fruits infested with fruit flies will rot and their growth will become abnormal. The damage caused can reach 90%-100%. The number of fruit flies worldwide is around 4000 species, and 35% of them attack soft and thin-skinned fruits, including profitable commercial fruits. Fruit flies also live and develop on the flowers of plants in the Asteraceae (Compositae) family around 40%, and the rest become miners on leaves, stems, or root tissues of other plants. Fruit flies are included in the Tephritidae family which has several subfamilies. Species known as pests from the subfamily are Dacinae and Trypetinae. The genera Dacus (Fabricus) and Bactrocera (Macquart) are included in this subfamily (White & Harris 1992) Siwi & Hidayat 2004 stated that fruit flies from this family are distributed throughout the world with around 4000 species in 500 genera. This number includes types of insects that are very important economically. A total of 63 species of fruit flies have been found in Indonesia (AQIS 2008). Much research has been conducted and reported on fruit flies. In Asia there are 180 species and in the Indo-Pacific region there are 90 species of fruit flies.

Drew and Romig (2012a) reported that there are 122 species of fruit flies in Indonesia, but only 11 species act as pests. In western Indonesia there are 89 species of fruit flies including local (indiginous) types but only eight species are important pests including: Bactrocera albistrigata (Meijere), Bactrocera dorsalis Hendel, Bactrocera carambolae Drew and Hancock, Bactrocera papayae Drew and Hancock, Bactrocera umbrosa (Fabricius),

Bactrocera caudata (Fabricius), Bactrocera tau (Walker), Bactrocera cucurbitae (Conquillet), and Dacus (Callantra) longicornis (Wiedemann) (Sunarno and Popoko 2013).

Information on species and status of fruit flies in North Sumatra can be used as a reference in anticipating the spread of fruit flies and how to control them on agricultural products with high economic value. Making a list of pest species (pest list) and description of morphological characteristics of OPT, especially fruit flies, is important in trade negotiations. One of the important roles of quarantine is to prevent the entry and exit of OPT/OPTK including fruit flies from one country to another or from one area to another within the country, or out of the territory of the Republic of Indonesia through local and international trade activities.

LITERATURE REVIEW

2.1. Taxonomy of Fruit Flies (Diptera: Tephritidae)

Fruit flies are included in the Animalia Kingdom, Arthropoda Phylum, Insecta Class, Diptera Order, Brachycera Suborder, Tephritidae Family (Hardy 1969; Drew 1989; Ibrahim & Ibrahim 1990; White & Harris 1994; Aluja & Norrbom 1999). According to White and Harris (1994), the Tephritidae Family consists of 3 Subfamilies, namely Dacinae, Trypetinae, and Tephritinae. The Dacinae Subfamily consists of the Ceratitini and Dacini Tribes. The Trypetinae Subfamily consists of the Acanthonevrini, Adramini, Eupharantini, Phytalmiini, Rivelliomimini, Toxotrypanini, and Trypetini Tribes. The Tephritinae Subfamily consists of the Myopitini, Tephrellini, Terelliini, and Tephritini Tribes. The Tephritidae family consists of 7 genera, namely Ceratitis, Anastrepha, Bactrocera, Rhagoletis, Carpomya, Toxotrypana and Dacus. The genus Ceratitis consists of the subgenus Cerattis, Ceratalaspis, Pardalaspis, and Pterandus. This taxonomic revision states that B. dorsalis (Hendel) is a senior synonym of B. papayae (Drew & Hancock) syn.n. and B. (Bactrocera) invadens (Drew, Tsuruta & White) syn.n. B. carambolae (Drew & Hancock) remains a separate taxon. This taxonomic change has implications for crop protection, pest control, quarantine, international trade, post-harvest management, and basic research.

2.2. Morphology

The body of the fruit fly imago is elongated like a tube and bilateral. The average imago size is 0.7 mm × 0.3 mm. The imago has three main parts, namely the head, thorax, and abdomen. The head has main parts as important characteristics in identification, namely the eyes, antennae, mouth, and facial spots. The antennae of the fruit fly are aristate type. The face has colors and patterns with various shapes and sizes (Figure 2.1) (White & Harris 1994).

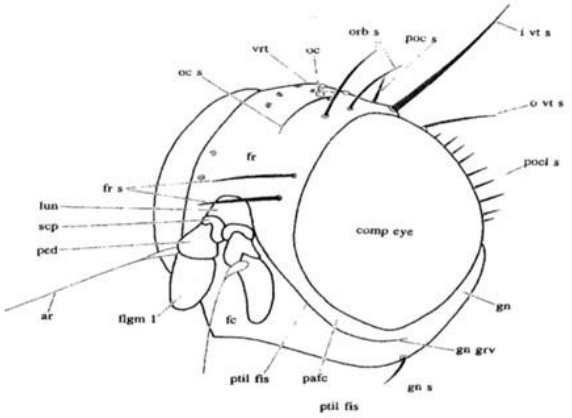

Figure 2.1. Morphological characteristics of fruit fly heads (White & Harris 1994)

Description: ar – arista, comp eye – compound eye, fc – face, flgm 1 – 1st flagellomere, fr – frons, fr s – frontal setae, gn – gena (plural: genae), gn grv – genal groove, g ns – genal seta, i vt s – inner vertical seta, lun – lunule, oc – ocellus, oc s – ocellar seta, o vt s – outer vertical seta, orb s – orbital setae, pafc – parafacial region, ped – pedicel, poc s – postocellar seta, pocl s – postcular setae, ptil fis – ptilinal fissure, scp – scape, vrt – vertex

The thorax consists of three segments, namely the anterior part of the prothorax, mesothorax, and the posterior part of the metathorax. The thorax contains bristles, lateral postsutural vittae, medial postsutural vittae, wings, and legs. The mesothorax has a pair of wings, the metathorax has a pair of halteres. The thorax is orange, reddish brown, brown, or black. The thorax consists of two important parts called the scutum or mesonotum (upper thoracic

dorsum) and the scutelum (lower thoracic dorsum). Bristles on the thorax are limited in number (Figure 2.2) (Drew 1989; Ibrahim & Ibrahim 1990; Drew & Hancock 1994; White & Harris 1994; Drew et al. 1998; AQIS 2008; Drew et al. 2011; Drew & Romig 2012a).

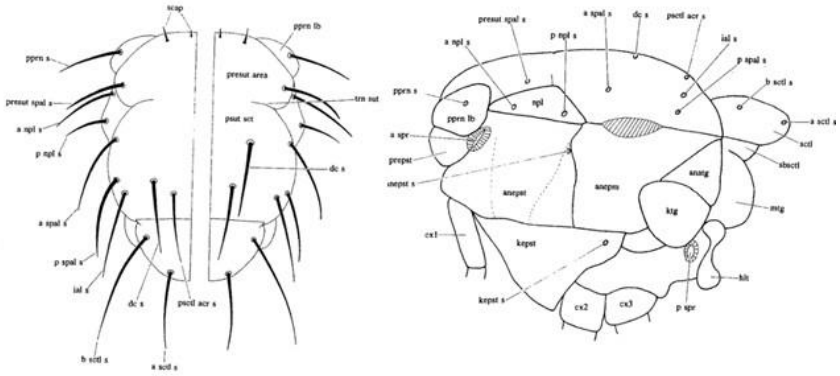

Figure 2.2. Morphological characteristics of the fruit fly thorax in dorsal section (a) and lateral section (b) (White & Harris 1994)

Description: : a npl s – anterior notopleural seta, a sctl s – apical scutellar seta, a spal s – anterior supra-alar seta, a spr – anterior spiracle, anatg – anatergite, anepm – anepimeron, anepst – anepisternum, anepst – anepisternum, anepst s – upper anepisternal seta, b sctl s – basal scutellar seta, cx – coxa, dc s – dorsocentral seta, hlt – halter or haltere, ial s – intra-alar seta, kepst – catepisternum, kepst s – catepisternal seta, ktg – catatergite, npl – notopleuron, p npl s – posterior notopleural seta, p spal s – posterior supra-alar seta, p spr – posterior spiracle, pprn lb – postpronotal lobe, pprn s – postporontal seta, prepst – propisternum, presut region – presutural region, presut spal s –preutural supraalar seta, psctl acr s –prescutellar acrostichal seta, psut sct – postcutural scutum, sbsctl – subscutellum, scape – scapula setae, sctl – scutellum, trn sut – transverse scuture

Wings have characteristics of wing vein patterns, namely costal (anterior wing vein), subcostal, anal (posterior wing vein), cubitus (main wing vein), median (middle wing vein), radius (radius wing vein), and transverse wing vein. Several species of fruit flies are known to have different patterns on their wings. Wing venation is sometimes not clearly visible due to the fusion of several veins (Figure 2.3) (Drew 1989; Ibrahim & Ibrahim 1990; White & Harris 1994; AQIS 2008).

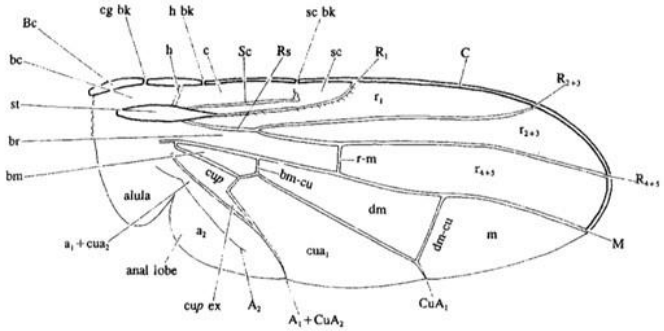

Figure 2.3. Morphological characteristics and structure of fruit fly wing venation (White & Harris 1994).

Description: Bc - basal cell, cg bk - costagial break, h bk - humeral break, bm - medial basal, bc - costal basal, C - costal, Sc - sub costal, st - stem vein, h - humeral, R - radius

Morphological characteristics of the abdomen of the Bactrocera genus have terga I and II fused abdominal segments, terga III-V are separate. The Dacus genus has fused abdominal segments and has a slender waist (petiole) so that it resembles a wasp. The abdomen generally has two transverse bands and one longitudinal band in black or a 'T' shape which is sometimes unclear. The abdomen has ceromae, ovipositor in female insects, aculeus at the tip of the ovipositor. The abdomen has a longitudinal medial line on terga III-V and is black on the lateral side. Terga III on both lateral sides of the abdomen has pecten (Figure 4) (Drew 1989; Ibrahim & Ibrahim 1990; White & Harris 1994; Drew et al. 1998; AQIS 2008).

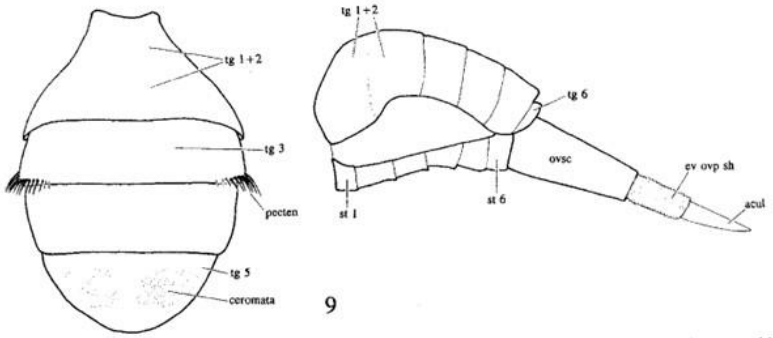

Figure 2.4. Morphological characteristics of the fruit fly abdomen in the male abdomen (a) and female abdomen (b) (White & Harris 1994)

Description: acul – aculeus, ev ovp sh – eversible ovipositor sheath, ovsc – oviscape, st – sternites, tg – tergites

2.3. Symptoms of Attack

Fruit flies lay eggs on the fruit tissue. The egg-laying site is marked by the presence of small black spots/dots that are not very clear. These small spots from ovipositor punctures are early symptoms of fruit fly attacks. These ovipositor punctures will be followed by the appearance of necrosis around the punctures. The eggs then hatch and the larvae eat the fruit flesh causing the small spots to develop into brown spots, then the larvae will damage the fruit flesh so that the fruit rots and falls before reaching the desired ripeness. If this fallen fruit is not immediately collected and destroyed, it will become a source of infestation for the next generation of fruit flies.

2.4. Distribution of Fruit Flies

Fruit flies are grouped into five genera in the Tephritidae family, namely the genera Anastrepha, Bactrocera, Ceratitis, Dacus, and Rhagoletis (White and Harris 1992). The genus Anastrepha is a major pest, most of which are endemic species in tropical South America (AQIS 2012). Bactrocera has a wider distribution area, from Southeast Asia to the North Pacific. Bactrocera is a pest of tropical and subtropical fruits in tropical rainforest habitats (AQIS 2012).

2.5. Bactrocera (B.) dorsalis syn. n Bactrocera (B.) papayae

B. papayae Drew & Hancock, B. philippinensis Drew & Hancock, B. carambolae Drew & Hancock, and B. invadens Drew, Tsuruta & White are four species of fruit flies that are pests of horticultural crops that are morphologically and genetically very similar to B. dorsalis (Hendel) (Schutze et al. 2015). Several distinct characters have been found in B. carambolae that are used to differentiate it from B. dorsalis, B. invadens and B. papayae compared to the characters used to differentiate the three morphologically or genetically similar species B. dorsalis, B. invadens and B. papayae. B. philippinensis is currently a synonym of B. papayae, while B. carambolae is a species that is in accordance with taxonomy and taxonomically B. dorsalis, B. invadens and B. papayae are the same species.

2.6. Methyl eugenol attractant and Cue lure

Fruit host plants are naturally the main attractants for fruit fly adults (Drew 1987). There are several hypotheses that fruit host plants are sexual attractants for male adults and food attractants for female adults. Methyl eugenol (ME) can be found in nature in several plant species and fruits such as bananas, oranges, mangoes, and apples, while cue lure (CL) is produced by ripe fruits and several bacteria from the Enterobacteriaceae family (Drew 1987).

2.7. Geographical Conditions and Natural Conditions of North Sumatra

North Sumatra Province is located between 10 -40 North Latitude and 980 -1000 East Longitude. The area of North Sumatra Province reaches 71,680.68 km2 or 3.72% of the area of the Republic of Indonesia. North Sumatra Province has 162 islands, namely 6 islands on the East Coast and 156 islands on the West Coast. The boundaries of North Sumatra Province include Aceh Province to the North, Riau Province and West Sumatra to the South, the Indian Ocean to the West, and the Strait of Malacca to the East. The geographical location of North Sumatra Province is on the strategic international shipping route of the Strait of Malacca which is close to Singapore, Malaysia, and Thailand.

METHOD

3.1. Time and Place

Sampling of fruit flies using the observation and trapping method was carried out in 15 districts in the North Sumatra Region, namely Dairi Regency, Humbang Hasundutan Regency, West Pakpak Regency, Mandailing Natal Regency, Samosir Regency, Simalungun Regency, Pematang Siantar City, South Tapanuli Regency, Padang Lawas Regency, North Padang Lawas Regency, North Tapanuli Regency, Toba Samosir Regency, Gunung Sitoli Regency, West Nias Regency, North Nias Regency and Central Tapanuli Regency.

3.2. Tools and Materials

Attractant (Methyl Eugenol, Cue Lure), 70% alcohol, insecticide (Malathion), thymol, naphthalene (camphor), silica gel, tissue paper, cotton, fine sand, granulated sugar, glue, distilled water, tweezers trap, forceps, insect brush, pipette (volumetric, dropper), vial, plastic box (gauze lid), collection box, sprayer, loupe, GPS, stationery, scissors, knife, insect pin, styrofoam, camera, survey bag, label, data sheet

3.3. Research Methods

The surveillance methods used refer to the ISPM and ACIAR standard methods (BKP 2007b; Hamzah 2004).

3.3.1. Making and Placing Traps

The trap is made from a cylindrical plastic container with a diameter of 10 cm and a height of 15 cm (Figure 3.1a). A hole with a diameter of 3 cm is made on the base and lid for the fruit fly to enter. On the top of the plastic container, an iron hook is installed to tie the trap to a plastic rope or wire and hang it on a tree branch. On the inside, a hook is installed to hang the cotton balls (Figure 3.1b).

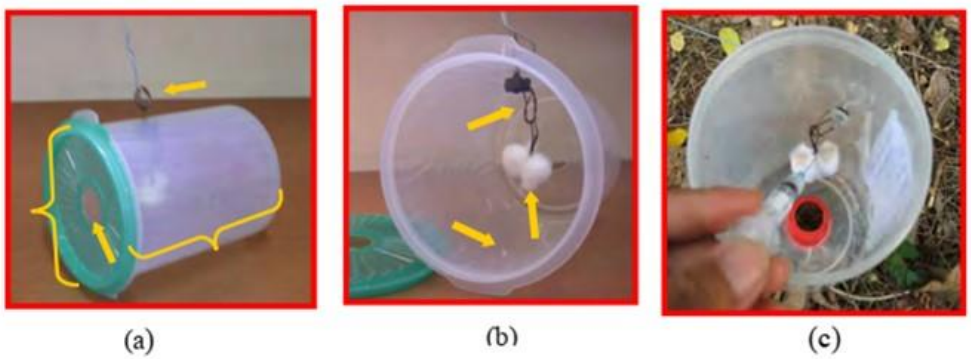

Figure 3.1. Fruit fly trap: exterior (a), interior (b), chemical application (c) (Ginting, 2009).

Small holes were made at the bottom of the plastic container as a place to drain water when water enters the container. The traps were given an identity label containing the type of attractant, trap number, research location, date of trap installation, and a warning sign (beware of poison). The bait used in the study was Methyl eugenol (ME). On the cotton inside the trap, one of the bait substances was dripped as much as 3-5 cc with a syringe and 3 drops of insecticide with the active ingredient malathion 1% with a dropper (Figure 3.1c).

The bait was repeated after the trapping results were collected for further installation. At each research location, fruit fly traps were installed randomly. At each sampling location, 1 Methyl eugenol trap was installed. The traps were hung on shaded tree branches at a height of no less than 2 m from the ground (Figure 3.2).

Figure 3.2. Placement of fruit fly traps at the research location (Ginting, 2009)

3.3.2. Collection of Trap Results

The trapped fruit flies were taken from the trap and then wrapped in tissue paper. The fruit flies were put into a 5.5 x 5.5 x 9 cm3 cardboard box (Figure 3.3). Thymol powder wrapped in tissue was also put into the cardboard box. The outside of the cardboard was marked with the sample number, location, type of attractant, date of installation, date of collection, and name of the collector. The samples were then taken to the laboratory for identification.

3.3.3. Sample Handling

Sample handling was carried out at the Entomology Laboratory of BBKHIT North Sumatra. The samples were air-dried on tissue before the identification process. Samples that were not immediately identified were stored in a small box given thymol powder.

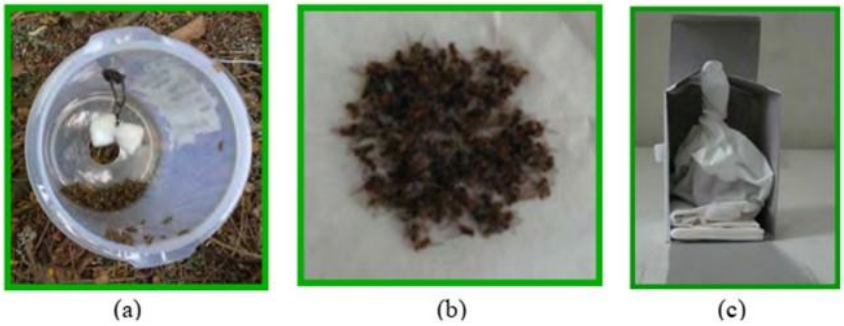

Figure 3.3. Collection of trap results: samples in traps (a), samples collected on tissue paper (b), cardboard box containing samples (c) (Ginting, 2009).

3.3.4. Collection, identification and variables of observed insects

Identification is done based on the morphological characteristics of the fruit fly on the head, thorax, wings, abdomen, and legs. The morphological characters or variables observed consist of several parts. On the head, the observed variables or morphological characters are the presence and shape of facial spots on the face.

Fruit fly identification was carried out under a Leica M80 stereo microscope and identification key (Drew 1989; Ibrahim & Ibrahim 1990; Drew & Hancock 1994; White & Harris 1994; ACIAR 1998; Drew et al. 1998; Siwi et al. 2006; Suputa & Taufiq 2006; AQIS 2008; Drew et al. 2011; PHA 2011; Drew & Romig 2012a; Larasati 2012). Each morphological character of the fruit fly was photographed using a LEICA M80 camera microscope to be used as documentation for identification tracing.

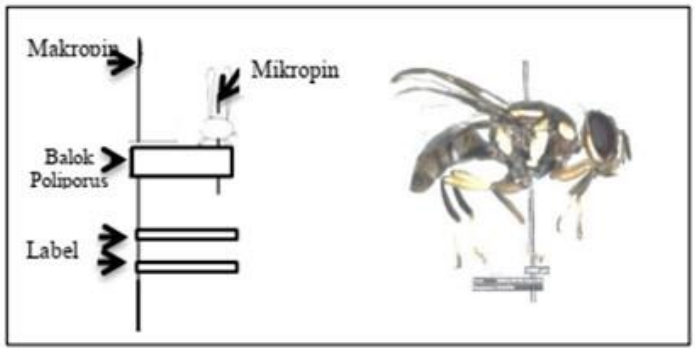

Figure 3.4. Collection of fruit fly specimens using double pinning (Khaeruddin, 2015)

RESULTS AND DISCUSSION

4.1. Species found

The results of trapping in 15 districts/cities in North Sumatra (Table 1) found 8 species of fruit flies of the genus Bactrocera, subgenus Bactrocera and Zeugodacus with the species names found being B. carambolae, B. dorsalis, B. albistrigata, B. (Zeugodacus) tau, B. umbrosa, B. (Z.) caudata, B. raiensis, B. verbasifolie, B. (Z.) cucurbitae.

Identification is done by the dichotomy method by looking at the morphological characters of each individual fruit fly. This method allows users to select certain characters that match the specimen being identified. Elimination of unselected characters will bring the sample closer to a particular species name, the key is made with a written description or picture of a character. Each species has a variety of colors and sizes, but in some cases in some species morphologically appear similar or only differ in certain structural details that are difficult to distinguish. Identification of fruit flies is generally for the imago stage (Quicke 1993; AQIS 2008; Ubaidillah & Sutrisno 2009).

Table 4.1. Location and number of fruit fly individuals found

Lokasi (Kabupaten/Kota)	Jumlah individu lalat buah									Total spesies
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	
Simalungun	156	3	-	71	-	-	3	2	4	**6**
Tapanuli Utara	57	-	-	58	-	-	2	-	3	**4**
Humbang Hasundutan	34	-	-	63	-	1	3	2	4	**6**
Tapanuli Selatan	23	-	-	40	2	-	-	-	3	**4**
Toba	54	-	-	30	-	-	-	-	3	**3**
Mandailing Natal	32	10	1	49	-	-	-	-	3	**5**
Nias Selatan	30	-	-	25	4	-	2	-	-	**4**
Nias Utara	22	-	-	11	-	-	-	-	-	**2**
Gunung Sitoli	36	1	-	18	4	-	1	-	1	**6**
Samosir	50	-	2	39	-	2	-	-	3	**5**
Pakpak Barat	42	-	-	35	-	-	-	-	2	**3**
Dairi	35	-	-	34	1	-	2	-	3	**5**
Tapanuli Tengah	5	-	-	5	-	-	-	-	-	**2**
Padang Lawas Utara	-	-	-	5	-	-	-	-	-	**1**
Padang Lawas	7	-	-	8	-	-	-	-	-	**2**
Pematang Siantar	10	-	-	8	-	-	-	-	-	**2**
Total individu	**593**	**14**	**3**	**499**	**11**	**3**	**13**	**4**	**29**	

A: Bactrocera carambolae; B: B. albistrigata; C: B. caudata; D: B. dorsalis; E: B. umbrosa;F: B. cucurbitae;G: B. raiensis;H: B. verbasifolia;I: B. tau

The largest number of species found in Simalungun Humbang Hasundutan and Gunung Sitoli districts, namely 6 species of fruit flies. In Mandailing Natal, Dairi and Samosir districts, 5 species were found, North Tapanuli, South Tapanuli and South Nias 4 species, West Pakphak 3 species, North Nias, Padang Lawas and Pematang Siantar City 2 species. While in North Padang Lawas only one species was found, namely B. dorsalis.

4.2. Fruit Fly Dominance and Factors Influencing It

Falcoa (2012) stated that a species of fruit fly is dominant or non-dominant if the F value (relative frequency) > 0.028 (D value) then the species is declared dominant and vice versa, if the F value <0.028 then the species is declared non-dominant. The F value is obtained by dividing N (the total individuals of each species found) by the total number of individuals found and the D value is a value that has been set as a comparison in determining the dominance of fruit fly species.

Table 4.2. Number of fruit fly individuals and dominance categories of fruit fly species.

No	Fruit Fly Species	N	F	Grade D	D
1	*B. carambolae*	593	0.507	0.028	d
2	*B. albistrigata*	14	0.012	0.028	and
3	*B. caudate*	3	0.003	0.028	and
4	*B. papaya*	499	0.427	0.028	d
5	*B. umbrosa*	11	0.009	0.028	and
6	*B. cucurbitae*	3	0.003	0.028	and
7	*B. raiensis*	13	0.011	0.028	and
8	*B. verbasifolia*	4	0.003	0.028	and
9	*B. know*	29	0.025	0.028	and
	Total	1169			

N: total individuals; F: relative frequency; ; D: Dominance; F: N/total individuals; F>D (d: dominant); F<D (nd: non dominant) (Falcao, 2012 #120)

In addition, competition between fruit fly species causes the population of a species to be limited. The existence of a group of dominant species can suppress the percentage of non-dominant species so that these species cannot develop due to selection pressure (Hudiwaku et al., 2022). The abundance of fruit fly species is also influenced by several factors such as season, environmental balance, host diversity, competition, and other complex factors (Arimbi et al., 2023).

4.3. Distribution of Fruit Flies and their status in the field

B. carambolae and B. dorsalis are species that are evenly distributed throughout the observed districts. Both species are recorded to have various host plants. According to White and Hancock (1997) and CABI (2007), the host plants of B. carambolae are starfruit, starfruit, water apple, guava, tomato, chili, jackfruit, cempedak, breadfruit, lemon, sapodilla, mangosteen, mango, aren, ketapang and others. The host plants of B. dorsalis include banana, papaya, guava, guava bol, sweet orange, sapodilla, starfruit, soursop, mangosteen, rambutan, jackfruit, mango, langsat, rambai, sugar palm, chili, eggplant, passion fruit and others. B. carambolae and B. dorsalis are polyphagous fruit fly species that can utilize various types of fruit and vegetable plants as hosts and are abundantly available at all times (Badriasih et al., 2019).

4.4. Effect of ME attractant on fruit flies

Fruit fly traps with ME attractants are often used in fruit fly monitoring activities because they can attract fruit flies with a fairly wide range of species. According to Sarjan et al. (2010), the attraction of these species to ME is due to the similarity of the content of a compound produced by a plant around the location where the trap is installed with ME. Shelly et al. (2014) stated that ME is obtained from the extraction of around 450 plant species consisting of 80 families, this vegetable oil is obtained from flowers, leaves, roots, stems or extracts of the whole plant. According to Aluja and Norrbom (1999), ME is a compound derived from the extraction of cycads (Cololasia antiquarium), mango, papaya, Cassia fistula or Pelea anisata leaves, Ziera sumithui, several essential oils, including lemongrass (Cymbopogon spp.), Basil (Ocimum spp.), Laurus nobilis, and Melaleuca spp. Methyl

eugenol is also contained in fruits such as oranges, bananas, and several forest fruits. According to Shelly et al. (2014), ME is the strongest attractant to attract male fruit flies because the nature of this attractant is the same as a type of distinctive fragrance released by female fruit flies when they are in heat, which attracts male fruit flies.

4.5. Morphological Description of Fruit Fly Species

The identification results derived from the trap installation found 9 species of fruit flies with the genus Bactrocera consisting of 2 subgenera, namely Bactrocera and Zeugodacus. The difference between the two subgenera is the absence of medial postsutural yellow vittae and scuttelar bristles in the scutellum totaling two in the subgenus Bactrocera, while the subgenus Zeugodacus found medial postsutural yellow vittae and scuttelar bristles in the scutellum totaling four except for B. (Z.) cucurbitae males only have two scuttelar bristles.

1. **Bactrocera (Bactrocera) carambolae Drew and Hancock**

This species has a pale yellow face and a pair of medium-sized black oval facial spots. The scutum is predominantly black with brown spots on the posterior lateral postsutural vittae, around the mesonotal suture and within the postpronotal lobes.

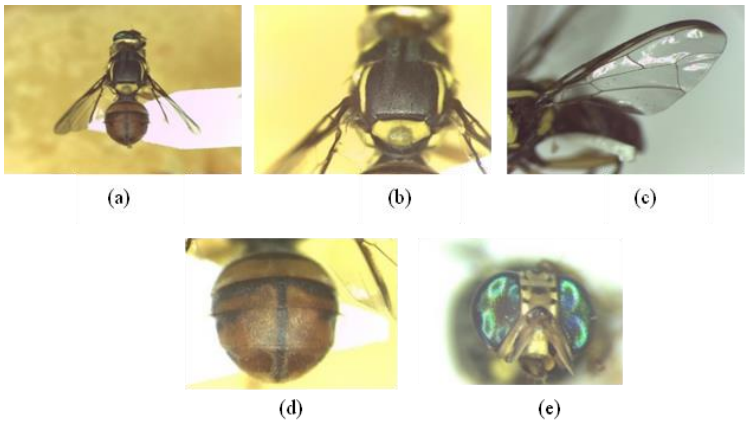

Figure 4.1. Drew and Hancock's Bactrocera carambolae species: (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

There are lateral postsutural vittae with parallel to sub parallel type of medium to wide size. Scutum is dominated by black color and brown color on the back of lateral postsutural vittae. Costal band on wings overlaps to R2+3. There is a “T” pattern on abdomen with widening medial longitudinal dark band. Anterolateral angle on terga IV is square. There is a pair of ceromae with bright color

2. **Bactrocera (Bactrocera) dorsalis Hendel**

Synonyms: B. philippinensis; B. invadens, B. papayae

This species has a yellow face with a pair of black oval markings. The scutum is predominantly black with dark brown on the posterior lateral postsutural vittae. The postpronotal lobes and notopleura are yellow.

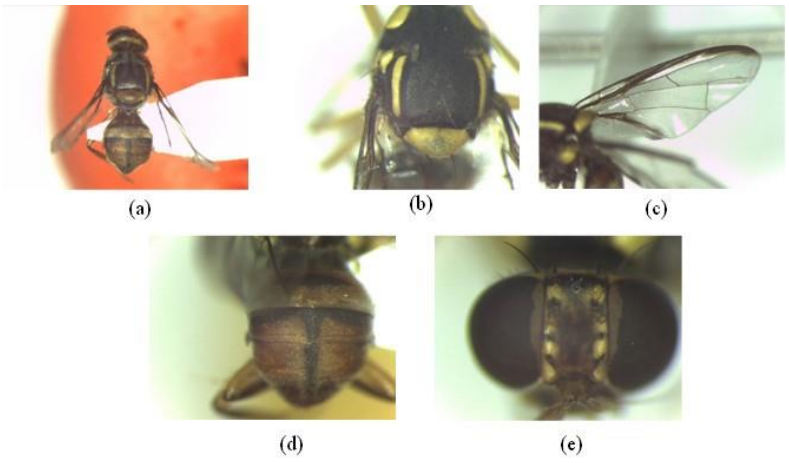

Figure 4.2. Bactrocera dorsalis species (Hendel): (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

Lateral postsutural vittae are parallel or subparallel and stop right at the intra-alar setae, lacking medial postsutural yellow vittae. The scutellum is yellow with two scuttelar bristles. The costal band on the wing does not pass through R2+3 and does not widen at the wingtip. There is a T pattern on the abdomen and a narrowed medial longitudinal dark band. It has an anterolateral angle on terga IV that looks like a triangle.

3. Bactrocera (Bactrocera) umbrosa Fabricius

This species is a large fruit fly species. The face is pale yellow with a pair of medium-sized round spots. The scutum is predominantly black, except for the area along the lateral edge and mesonotal suture which is brown.

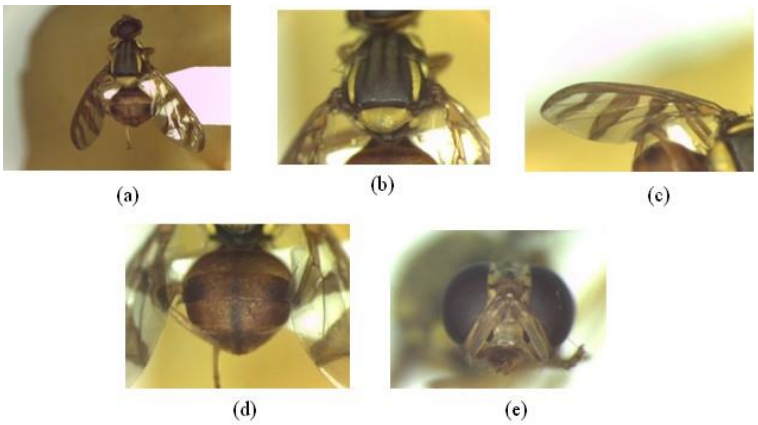

Figure 4.3. Species Bactrocera umbrosa (Fabricius): (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

There are wide and elongated lateral postsutural vittae that reach or pass the intra alar seta. The scutellum is yellow. The color of the legs is dominated by pale yellow. The costal band on the wings is parallel to R4+5, accompanied by 3 additional bands that run across from the wing costal to the underside of the wings. The abdomen is brown-orange and there is a medial longitudinal dark band that stretches from terga III to terga V. On terga V, there is a pair of bright brown-orange ceromae.

4. Bactrocera (Bactrocera) albistrigata de Meijere

This species is a medium-sized fruit fly species. The face is pale yellow, with a pair of black round or oval spots. The scutum is dominated by black. The postpronotal lobes and notopleura are yellow. There are lateral postsutural vittae with a tapered type. The scutellum is yellow. The costal band on the wings is very pale. There are 2 additional bands that run across the wing costal towards the underside of the wings. There is a medial longitudinal dark band that extends from terga III to terga V. The lateral dark markings on the lateral abdomen are very thick. The legs are dominated by pale yellow.

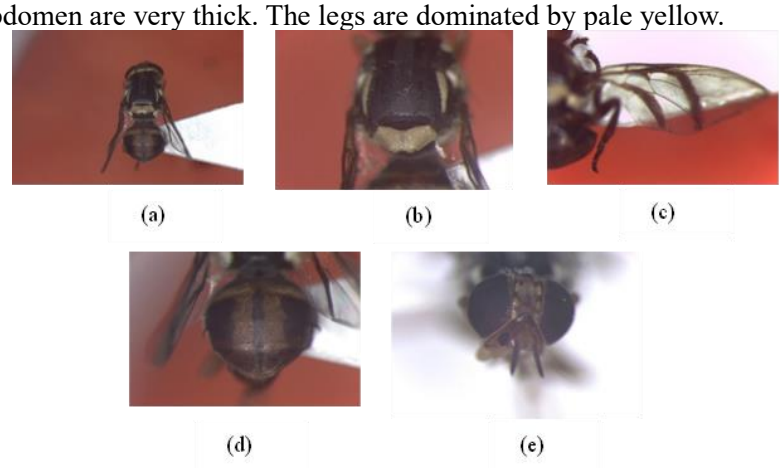

Figure 4.4. Species Bactrocera albistrigata de Meijere: (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

5. Bactrocera (Zeugodacus) caudata Fabricius

This species has a yellow face with black markings in the form of lines. The scutum is dominated by black. The postpronotal lobes and notopleura are yellow. Lateral postsutural vittae are parallel to sub-parallel and stop right at the intra-alar setae. Medial postsutural yellow vittae are found on the scutum. The scutellum is yellow and there are four scuttelar bristles on the scutellum. The wings do not have a specific pattern, the costal band is parallel to R2+3 and widens (resembling a spot on the wingtip) at the tip until it reaches R4+5. Abdomen terga III-V is brownish, with a T pattern, there is a transversal black band on terga III, and a medial longitudinal dark band on terga III-V. The anterolateral angles on terga IV and V are black. A pair of yellow ceromae on terga V.

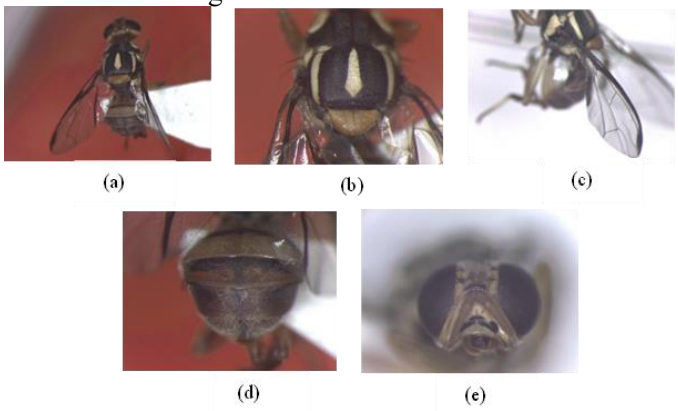

Figure 4.5. Bactrocera caudata Fabricius species: (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

6. Bactrocera (Zeugodacus) knows Walker

This species has a yellow face, equipped with a pair of black circular markings.

The scutum is black. The lateral postsutural vittae are parallel and stop right at the intra-alar setae. There are medial postsutural yellow vittae on the scutum. The scutum is yellow with four scuttelar bristles. The costal band on the wing passes through R2+3 and continues to the tip of the wing R4+5. The abdomen is yellow with a T pattern. The anterolateral angles on terga IV and V are black and wide. There is a pair of ceromae on terga V.

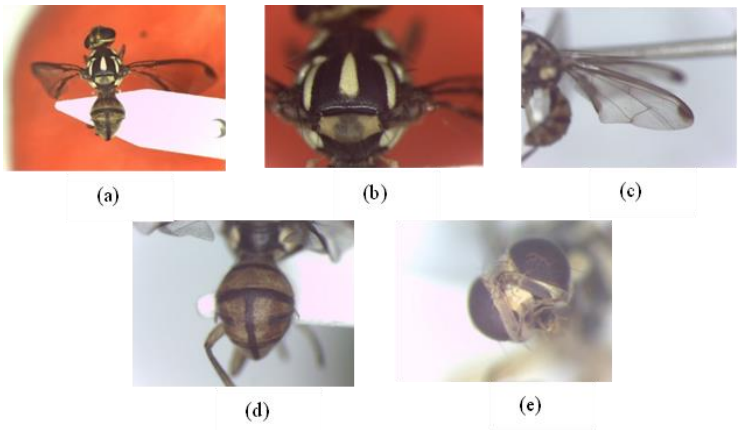

Figure 4.6. Bactrocera species or Walker: (a) whole specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

7. Bactrocera (Zeugodacus) cucurbitae Coquillett

This species is medium in size. The face is pale yellow with a large black circular spot. The scutum is reddish-brown. The lateral postsutural vittae are narrowed. There is a medial postutural vittae. The costal band on the wing becomes paler between R2+3 and R4+5, extending to meet the large spot at

the wingtip. There is a dark band extending from dm to cu. The cubital streak is wide and dark. The abdomen is orange-brown, with a "T" pattern. The medial longitudinal dark band is medium in size. The anterolateral angles of terga IV and V are dark. There is a pair of brightly colored ceromae on terga V. The sternal abdomen is dark.

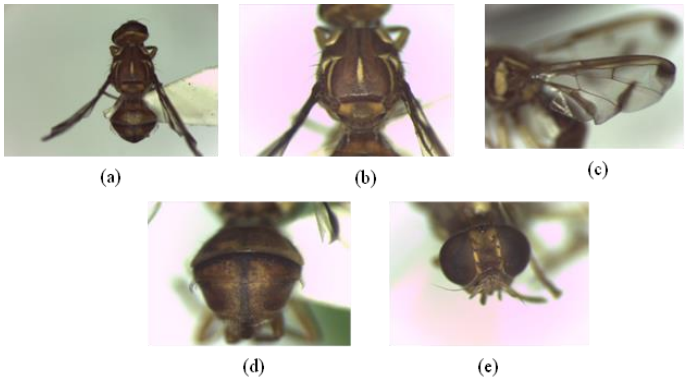

Figure 4.7. Bactrocera cucurbitae species Coquillett: (a) whole specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

8. Bactrocera raiensis

The specimen is small in size when compared to Bactrocera carambolae and Bactrocera pap ayae. The face is fulvous with large black spots and oval shape. The scutum is black, there are lateral postsutural vittae in sub-parallel shape that stop at or slightly behind the intra alar setae. There are no medial postsutural vittae. There are 2 prescutural bristles on the scutum and 2 scutural bristles on the scutellum which are yellow with a black base. The abdomen is brownish yellow with a wide black "T" pattern on the medial longitudinal part. There is a wide and thick black pattern (Lateral dark marking) on the lateral parts of tergum III-V and a pair of orange-brown ceromes on tergum V. Wings with colorless or very pale c and bc sells, mictroticia outside the corner of c sell only, narrow or thin costal band on the costa to the apex which is confluent or parallel to R2+3 and slightly widened at the apex of R4+5.

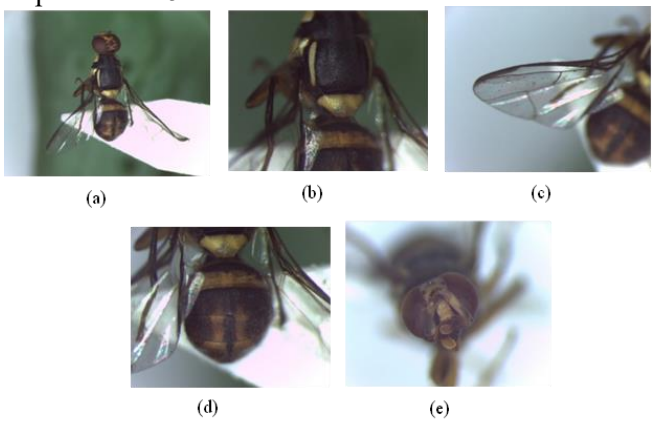

Figure 4.8. Bactrocera raiensis Coquillett species: (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

9. Bactrocera verbascifoliae Drew and Hancock

Small specimen. Face fulvous, there are a pair of large round black spots. Scutum is black, with parallel lateral postsutural vittae ending in intra alar setae. There are no medial postsutural vittae. There are 2 prescutural bristles on the scutum and 2 scutural bristles on the scutellum, yellow with a black base. Abdomen terga III-V is orange-brown with a dark band that passes through the anterior margin and widens to cover the lateral margin. There is a medial longitudinal band that passes through terga III-V and a pair of orange-brown ceromes on tergum V. Wings measure 5.32 mm (under 6 mm) with a costal band slightly overlapping R2+3 with a uniform width from the edge to the tip of the wing. Cells c and bc are colorless, mictroticia outside the angle of cell c only.

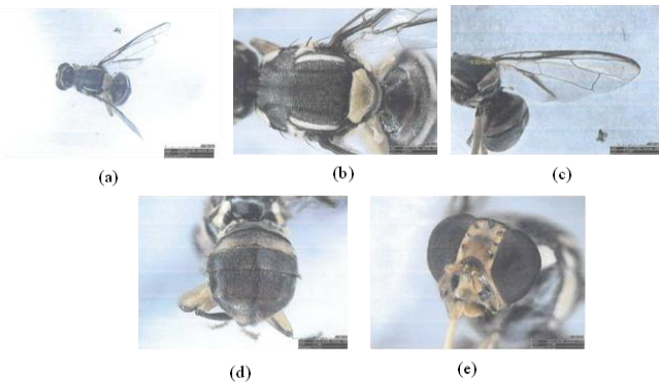

Figure 4.9. Drew and Hancock's Bactrocera verbascifoliae species: (a) intact specimen; (b) thorax; (c) wings; (d) abdomen; (e) head.

CONCLUSION

The number of fruit flies found in the research results was 8 species of flies. With a total number of fruit flies found of 1157 individual fruit flies. The eight species of fruit flies found came from the Genus Bactrocera with the subgenus Bactrocera and Zeugodacus with the names of the species found being B. carambolae, B. dorsalis, B. albistrigata, B. (Zeugodacus) tau, B. umbrosa, B. (Z.) caudata, B. raiensis, B. verbasifolie, B. (Z.) cucurbitae. The results of the identification of fruit flies show that Bactrocera carambolae and Bactrocera dorsalis are the dominant species of fruit flies. Both species of fruit flies are polyphagous and are found in every location where fruit fly traps are installed using the attractant Methyl eugenol.

Based on the species of fruit flies found, there are several species that act as pests, as many as 7 species, namely B. albistrigata, B. carambolae, B. dorsalis, B. caudata, B. cucurbitae, B. tau, B. umbrosa. However, it is still necessary to study the level of damage and economic losses caused.

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