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FLY POLLINATORS : ASSESSING THEIR VALUE IN BIODIVERSITY CONSERVATION AND FOOD SECURITY IN INDIA

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INTRODUCTION

Human beings depend on animal pollination directly or indirectly for about one third of the food they eat. Over 75 percent of the food and medicinal plants that benefit mankind and 90 percent of all flowering plants rely on pollination by animals to produce healthy seeds and fruits. Pollinators also provide an essential ecosystem service that contributes to the maintenance of biodiversity and ensures the survival of plant species including crop plants. Pollination is required for seed production, to improve seed quality, to create hybrid seeds and also to increase uniformity of crop ripening (Kearns *et al.*, 1998).

Flies (Diptera) are among the most common insects that visit flowers, and their association with flowers has a long history. Flies are also considered to be primitive pollinators of the earliest flowering plants with their suctorial or lapping mouthparts (Kevan and Baker, 1983). Fossil evidence shows that some of the important flower-visiting fly families-such as Syrphidae (flower flies), Bombyliidae (bee flies), Empididae (dance flies), Acroceridae (small-headed flies), Apioceridae (flower-loving flies) and Nemestrinidae (tangle-vein flies) were present as early as in the late Jurassic or early Cretaceous.

Diptera are probably the second most common order of flower visitors and pollinators today (after Hymenoptera). In tropical areas, the diversity of Diptera can rival or exceed that of Hymenoptera (Inouye, 2001). A preliminary estimate (Buchmann and Nabhan, 1996) indicates that 14, 126 species of Diptera are involved in the process of pollination in the tropical world.

Generally, agriculture occupies more than one third of the land in most countries of the world. It is widely believed that pollination is in such serious jeopardy from the view points of agricultural productivity and food security (Kevan *et al.*, 2001) that the Convention on Biological Diversity and the Food and Agricultural Organization of the United Nations have recently (1998–2000)

taken on leading roles internationally in this area. Nevertheless, little information is available on how pollination deficits affect the costs of food production.

Pollination by flies (myiophily) is economically important. In tropical areas flies are the primary pollinators of cacao and they also pollinate mango, cashew and tea like other cash crops. Roubik (1995), listed pollinators of 785 species of cultivated plants in the tropics, and 26–31 of these plants are apparently pollinated only by flies, 32 or 33 by flies as the primary pollinators, and 87–101 by flies as secondary pollinators.

Unfortunately, no such separate information of fly pollinators is available for India as a whole or in agricultural crops. Therefore, this is our first and foremost duty to prepare an inventory of dipteran species involved in the process of pollination of agricultural, horticultural and medicinal crop plants. In this context, we have tried to prepare a preliminary document on fly pollinators, their value and role in the field of agricultural, horticultural and on medicinal plants in India. We have made efforts to review the whole pollination by flies in India and also included our works on fly pollinators in the recent past.

A total of 42 families (Nematocera 12 & Brachycera 30) of Diptera are reported as flower visitors in the tropical world (Roubik, 1995), of them 38 families (Nematocera 12 & Brachycera 26) are present in India, The present communication reports 70 species of Diptera of 9 families which pollinate 63 species of crop plants of 29 families in India.

This communication presents lists of fly pollinators and their visited plant species (Table 1) and also agricultural, horticultural and medicinal plant species and their fly pollinators (Table 2), Both the lists have been prepared alphabet-wise and also incorporates the family name of each of the fly and plant species respectively. This will serve as a baseline data on fly pollinators of economic importance in India and will encourage the pollination scientists to make use of the fly species more and more in ensuring our food security and maintenance of biodiversity.

FLIES

The Diptera are minute to small soft-bodied insects, commonly known as (true) flies and include many familiar insects such as mosquitoes, black flies, midges, fruit flies, blowflies and houseflies. A highly mobile head with large compound eyes, antennae of variable size and structure; suctorial mouthparts; prothorax and metathorax small and fused with large mesothorax; wings present only on mesothorax. The major morphological feature which distinguishes flies from other insects is their reduced hind wings, termed halteres (small, club-like structures that function as balancing organs during flight), legs with 5-segmented tarsi; abdomen with variable number of visible segments, simple female genitalia and complex male genitalia in most species and presence of cerci.

VALUE

Flies have been systematically overlooked by pollination biologists. These tiny insects have generally been considered only a minor or secondary contributor to pollination of some plants, many of which are crops. In part, this attitude is due to lacking a number of characters in comparison to bees and wasps— (i) flies are more or less omnivorous, (ii) they do not nurse their brood, they take nectar for their own consumption and so they are not a busy collector, (iii) their pollinating activity is irregular, (iv) they are not having any specialized organ to carry the pollen (pollen basket in case of bees). But on the other hand flies may be the important pollinators under certain climatic conditions (cloudy weather, high wind speeds *etc*.). Moreover, majority of the flies are present in the field at all times of the year unlike the strictly periodic and more demanding bumble bees and honey bees.

A recent review (Larson *et al*., 2001, *unpub.manus.)* that details the pollen-carrying abilities, constancy, and effectiveness of fly pollinators indicates that flies may contribute significantly to the pollination process. The predominance of flies on certain arctic and alpine flowers makes their contributions particularly important in these environments (Downes 1965, Hocking 1968, Mani 1968, Kevan 1972, Pojar 1974, Arroyo *et al*., 1982, 1985, Primack 1983, Shaw and Taylor 1986, Inouye and Pyke 1988, Kearns and Inouye 1994, Elberling & Olesen 1999).

STUDIES ON MYIOPHILY IN INDIA

As far as knowledge goes studies of insect pollination for crop production in India began with launching of a crash programme for the development of sunflower cultivation in the country by the Government of India in the early 1960's (Veeresh, 1993). The two national and one International seminar held on pollination during 1983, 1990 and 1993 have helped to inculcate the awareness of the importance of insect pollinators in the conservation of plant species and enhancing crop production in India.

The literature on insect pollination in India is exceptionally rich but mostly concentrated on bees in comparison to other major insect pollinators. Mani and Sarvanan (1999) stated that, pollination studies in the recent past show a pronounced bias towards bee pollination. As may be expected, it also reflects in agriculture and horticultural fields in India. On the contrary, very little attention has been paid to the members of Diptera.

A perusal of literature reveals that the role of flies in the process of pollination, efficiency and importance to enhance the crop production in India, was said first by Kapil and Jain (1980). Some of the recent works on pollination of cauliflowers are contributed by a number of workers like Priti & Sihag (1997), Kakkar (1981), Sharma *et al.*, (1974), and Tewari and Singh (1983). All of these studies revealed that Diptera is one of the major pollinators of cauliflowers. Priti & Sihag (1998) reported 20 insect species of flower visitors of *Daucus carota*, of them 6 species are dipteran.

In another study Sihag (1986) observed that, among the insect visitors of carrot, flies are the second most efficient pollinator after bees. Goyal *et al.*, (1989) reported 71 insect species belonging to 31 families and 8 orders on carrot bloom in Himachal Pradesh.

During this study flies have also proved themselves as dominant pollinators after the bees. An enormous work has been done on crops of Himachal Pradesh. Misra and Kumar (1993) reported a number of dipteran species of the genus *Musca, Orthellia* (Family Muscidae); *Eristalis, Scaeva. Sphaerophoria, Episyrphus, Ischiodon. Melanostoma* (Family Syrphidae) are common visitors of mustard.

In a study of pollinator efficiency, flower visitors of onion revealed that, numerically the species strength of Diptera is more than Hymenoptera (Priti, 1998). Kumar *et al.*, (1985) stated that the Diptera are the predominant pollinators after Hymenoptera in onion at Himachal.

Reddi (1993) stated that cashew plantation in India are generally less attracted to honey bees because of the poor nectar yields. He showed that 37% of the insect visitors of the flowers of cashew were flies compared to 12% of bees. He also stated that, maintaining fly population in cashew orchards can lead to increase yields.

McGregor (1976), Free (1993), Bangyu *et al.*, (1997) and Batra (1997) reported the syrphids (Diptera) are one of the major insect pollinators of the apple trees. Dhara and Tandon (1993) observed that among the 5 major pollinator species of *Zizyphus mauritiana* (ber), 60 percent species are Diptera. Mitra *et al.*, (2002) also reported 2 species of fly flower visitors/pollinators of *Zizyphus mauritiana* from Gujarat. In Indian perspective very little effort has been given to study the role of fly pollinators to increase the crop productivity. Sharma *et al.*, (1998) had shown an easy and quick method of breeding flies for pollination of mango blossoms. This study may be the first in the field of applied pollination by flies in India.

In the recent past, medicinal plants constitute a group of industrialy important crops, which are of great value for domestic use and for export. In contrast to the large number of publications on the general problems of pollination and outstanding specialization in certain groups such as orchids, orchard trees, garden plants, oilseeds and other selected economically important species, very little attention seems to have been paid to the medicinal plants.

Recently Mitra *et al.*, (2002, 2003, 2004 & 2005) reported 38 dipteran pollinator species of medicinal plants from India (Table 1).

THREATS AND CONSERVATION

Pollinators face a large variety of threats of anthropogenic origin, including habitat fragmentation, a variety of effects of agriculture, pesticides, herbicides, and the introduction of both exotic pollinators and plants (Inouye, 2001).

The recent global concern over conservation and management of such a paradise of diversity has necessitated an immediate and thorough understanding of the factors contributing to their stability and maintenance. Pollination, a crucial link in the survival of ecosystems, is one such factor that needs to be well understood to develop appropriate strategies for conservation of the Indian biodiversity. Flies may never have the charisma of birds and mammals, but habitat conservation and urban planning can help maintain an interesting and diverse group of fly pollinators who render the free services to the human beings for their food security.

DISCUSSION

The role of pollinators in agriculture and horticulture has been acknowledged by workers in developed countries way back in the 1960's. The stress to identify alternatives to bee-pollination began during a 'pollinator-crisis' in the USA, after several local population of bees were wiped out, as a long term effect of introduction of African bees as pollinators, leading to a severe loss of productivity. In India, however, harnessing natural pollinators to increase productivity has been initiated with the launching of a crash programme for development of sunflower cultivation in the country. Like elsewhere in the world, the process has been largely bee-biased and stray reports on dipteran pollinators have come up from the study aimed mainly at bee-pollination.

Majority of the flies are enemies (as carriers of diseases) and causing harm (as crop pests) to the human beings. But there is another dimension to these tiny insects, where they play an important role to maintain the ecosystem healthy by their friendly activities to the human beings. However, in the recent past the importance of flies as pollinators in India have been acknowledged and as many as 38 families of Diptera have been clearly identified as pollinators. The present review is a short communication of the available literature and our preliminary findings of a continuing study on dipteran pollinators. This is the first step in the long process of inventorisation of the fly pollinators (from India) and discerning their importance in providing food security and in maintenance of biodiversity.

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Table 1. : List of Fly pollinators and their visited plant species in India

	NAME	FAMILY	PLANT SPECIES
1.	***Adoxomyia heminopla*** Wiedmann	STRATIOMYIDAE	*Nerium indicum*, *Zizyphus* sp.
2.	***Argyramoeba duvaucelli*** (Macquart)	BOMBYLIIDAE	*Cassia tora*
3.	***Asarkina (Asarkina) ericetorum*** (Fabricius)	SYRPHIDAE	*Amaranthus spinosus, Sida acuta, Polygonum chinensis, Cassia tora, Solanum nigrum*
4.	***Bactrocera (Zeugodacus) cucurbitae*** Coquilett	TEPHRITIDAE	*Cucurbita maxima*
5.	***Bombylius maculatus*** (Fabricius)	BOMBYLIIDAE	*Sorghum vulgare*
6.	***Campiglossa cribellata*** Bezzi	TEPHRITIDAE	*Polygonum chinensis*
7.	***Chrysotoxum baphyrus*** (Walker)	SYRPHIDAE	*Ipomea* sp.
8.	***Chrysops dispar*** (Fabricius)	TABANIDAE	*Allium cepa, Daucus carota*
9.	***Chrysomya megacephala*** (Fabricius)	CALLIPHORIDAE	*Zizyphus mauritiana, Althaea rosea, Holarrhena antidysenterica*
10.	***Chrysomya bezziana*** Villeneuve	CALLIPHORIDAE	*Allium cepa, Daucus carota*
11.	***Culex sp.***	CULICIDAE	*Polygonum chinensis*
12.	***Episyrphus balteatus*** (De Geer)	SYRPHIDAE	*Wedelia calendulaceae, Coriandrum sativum, Nicotiana plumbaginifolia, Cannabis* sp., *Foeniculum vulgare, Trifolium repens, Rubus elipticus, Solanum nigrum, Malus domesticus, Brassica campestris v. sarson, Solanum melongena, Capsicum frutescens*
13.	***Eristalinus (Eristalinus) arvorum*** (Fabricius)	SYRPHIDAE	*Tagetes patula, Santalum album, Mangifera indica, Zizyphus mauritiana, Polygonum chinensis, Brassica campestris v.sarson*
14.	***Eristalis (Eoseristalis) cerealis*** (Fabricius)	SYRPHIDAE	*Tagetes patula, Chrysanthemum* sp., *Helianthus* sp., *Xanthium strumarium, Ricinus communis, Melilotus alba*
15.	***Eristalis (Eoseristalis) arbustorum*** (Linnaeus)	SYRPHIDAE	*Sida rhombifolia, Tagetes patula, Chrysanthemum* sp., *Melilotus alba*
16.	***Eristalinus laetus*** (Wiedemann)	SYRPHIDAE	*Tagetes Patula*

Table 1. : *(Cont'd.).*

	NAME	FAMILY	PLANT SPECIES
17.	***Eristalinus (Eristalinus) obscuritarsis*** (de Meijere)	SYRPHIDAE	*Tagetes patula, Aegle marmelos*
18.	***Eristalinus quinquestriatus*** (Fabricius)	SYRPHIDAE	*Tagetes patula*
19.	***Eristalinus aenus v.taphicus*** (Wiedemann)	SYRPHIDAE	*Tagetes patula*
20.	***Eristalis (Eristalodes) paria*** (Bigot)	SYRPHIDAE	*Helianthus* sp.
21.	***Eristalis (Eristalis) tenax*** (Linnaeus)	SYRPHIDAE	*Tagetes patula, Chrysanthemum* sp., *Helianthus* sp., *Pyrus communis, Brassica campestris v. sarson*
22.	***Eristalis angustimarginalis*** Brunetti	SYRPHIDAE	*Brassica campestris v. sarson*
23.	***Exhyalanthrax absalon*** (Wiedemann)	BOMBYLIIDAE	*Solanum melongena, Cassia tora, Capsicum frutescens, Lycopersicon esculentum*
24.	***Graptomyza brevirostris*** (Wiedemann)	SYRPHIDAE	*Herpestis* sp.
25.	***Gasterophilus* sp.**	GASTEROPHILIDAE	*Allium cepa, Daucus carota, Brassica oleracea v.botrytis*
26.	***Heteralonia (Isotamia) insulata*** (Walker)	BOMBYLIIDAE	*Solanum melongena, Casstia tora, Capsicum frutescens, Lycopersicon esculentum, Ipomea* sp.
27.	***Hybomitra hirta*** Walker	TABANIDAE	*Anacardium occidentale, Sorghum vulgare, Coriandrum sativum*
28.	***Hemipyrellia liguirriens*** (Wiedemann)	CALLIPHORIDAE	*Polygonum chinensis*
29.	***Hemipyrellia pulchra*** (Wiedemann)	CALLIPHORIDAE	*Santalum album, Psidium guajava*
30.	***Ischyrosyrphus* sp.**	SYRPHIDAE	*Cannabis sativa*
31.	***Ischiodon scutellaris*** (Fabricius)	SYRPHIDAE	*Anogeissus pendula, Cassia tora, Panicum* sp., *Tagetes patula, Solanum melongena, Capsicum frutescens, Brassica campestris v. sarson*
32.	***Isomyia viridaurea*** (Wiedemann)	CALLIPHORIDAE	*Catharanthus roseus*
33.	***Litorhynchus lar*** (Fabricius)	BOMBYLIIDAE	*Solanum melongena, Capsicum frutescens*

Table 1. : *(Cont'd.).*

	NAME	FAMILY	PLANT SPECIES
34.	***Lucilia porphyrina*** (Walker)	CALLIPHORIDAE	*Scaevola sericea*
35.	***Melanostoma* sp.**	SYRPHIDAE	*Solanum nigrum, Eleusine indica, Cannabis sativa, Chrysanthemum sp.*
36.	***Melanostoma orientale*** (Wiedemann)	SYRPHIDAE	*Solanum nigrum, Canabis sativa, Sida* sp., *Rubus elipticus*
37.	***Melanostoma univittatum*** (Wiedemann)	SYRPHIDAE	*Brassica campestris v.sarson*
38.	***Mesembrius bengalensis*** (Wiedemann)	SYRPHIDAE	*Sida acuta, Wedelia calendulaceae, Tagetes patula, Polygonum chinensis, Spilanthes acmella*
39.	***Mesembrius quadrivittatus*** (Wiedemann)	SYRPHIDAE	*Wedelia calendulacea, Aegle marmelos, Rauvolfia serpentina, Polygonum chinensis, Spilanthes acmella*
40.	***Metasyrphus corollae*** (Fabricius)	SYRPHIDAE	*Brassica campestris v.sarson*
41.	***Metasyrphus (Metasyrphus) latifasciatus*** (Macquart)	SYRPHIDAE	*Cannabis sativa*
42.	***Microchrysa flaviventris*** (Wiedemann)	SYRPHIDAE	*Tagetes patula*
43.	***Musca (s.str.) domestica*** Linnaeus	MUSCIDAE	*Zizyphus mauritiana, Brassica oleracea v. botrytis, Daucus carota, Allium cepa, Wedelia calendulacea*
44.	***Musca (Philaematomyia) crassirostris*** Stein	MUSCIDAE	*Allium cepa*
45.	***Musca (Byomya) ventrosa*** (Wiedemann)	MUSCIDAE	*Polianthes tuberosa*
46.	***Musca* sp.**	MUSCIDAE	*Brassica campestris v. sarson*
47.	***Orthellia timorensis*** (Robineau-Desvoidy)	MUSCIDAE	*Scaevola sericea, Althaea rosea*
48.	***Orthellia viridis*** (Wiedemann)	MUSCIDAE	*Castanea sativa, Aesculus indica*
49.	***Orthellia* sp.**	MUSCIDAE	*Brassica campestris v. sarson*
50.	***Oplodontha rubrithorax*** (Macquart)	STRATIOMYIDAE	*Tagetes patula*
51.	***Paragus serratus*** (Fabricius)	SYRPHIDAE	*Solanum nigrum, Ageratum conyzoides, Wedelia calendulacea*
52.	***Paragus (Pandasyophthalmus) atratus*** de Meijere	SYRPHIDAE	*Solanum nigrum*

Table 1. : *(Cont'd.).*

	NAME	FAMILY	PLANT SPECIES
53.	***Paragus (Pandasyophthalmus) tibialis*** (Fallén)	SYRPHIDAE	*Solanum nigrum, Amaranthus spinosus*
54.	***Paragus (Pandasyophthalmus) rufiventris*** (Brunetti)	SYRPHIDAE	*Solanum nigrum*
55.	***Petrorossia albofulva*** (Walker)	BOMBYLIIDAE	*Solanum melongena, Capsicum frutescens, Lycopersicon esculentum*
56.	***Petrorossia nigrofemorata*** (Brunetti)	BOMBYLIIDAE	*Coriandrum sativum*
57.	***Phaenicia sericata*** (Meigen)	CALLIPHORIDAE	*Ficus carica*
58.	***Sphaerophoria* sp.**	SYRPHIDAE	*Eleusine indica*
59.	***Sphaerophoria indiana*** Bigot	SYRPHIDAE	*Brassica campestris v. sarson*
60.	***Sphaerophoria scripta*** (Linnaeus)	SYRPHIDAE	*Panicum* sp., *Eleusine indica, Eleusine* sp., *Sida* sp., *Solanum nigrum, Cannabis sativa, Cannabis* sp., *Chrysanthemum* sp., *Nicotiana plumbaginifolia, Foeniculum vulgare, Chenopodium ambrosoides*
61.	***Syrphus latifasciatus*** (Macquart)	SYRPHIDAE	*Cannabis sativa*
62.	***Syritta orientalis*** (Macquart)	SYRPHIDAE	*Ephedra gerardiana*
63.	***Syritta indica*** (Wiedemann)	SYRPHIDAE	*Polygonum chinensis*
64.	***Syritta pipiens*** (Linnaeus)	SYRPHIDAE	*Eleusine* sp., *Eleusine indica, Cannabis sativa, Nicotiana plumbaginifolia, Amaranthus spinosus, Panicum* sp., *Solanum nigrum, Anthemis cotula*
65.	***Scaeva latimaculata*** Brunetti	SYRPHIDAE	*Brassica campestris v.sarson, Melilotus officinalis*
66.	***Sargus metallinus*** (Fabricius)	STRATIOMYIDAE	*Bauhinia variegata v. candida*
67.	***Stomorhina discolor*** (Fabricius)	CALLIPHORIDAE	*Tagetes patula, Anogeissus pendula, Zizyphus* sp., *Syzygium jambos, Callistemon citrinus, Taraxacum officinalis, Zizyphus mauritiana, Polygonum chinensis*
68.	***Sarcophaga* sp.**	SARCOPHAGIDAE	*Brassica oleracea v. botrytis, Allium cepa, Daucus carota*
69.	***Villa aureohirta*** Brunetti	BOMBYLIIDAE	*Scaevola sericae*
70.	***Villa panisca*** (Rossi)	BOMBYLIIDAE	*Scaevola sericea, Tagetes patula*

Table 2. : List of Agricultural, Horticultural and Medicinal plants and their fly Pollinators in India

	NAME	FAMILY	POLLINATORS
1.	***Ageratum conyzoides*** Linnaeus	ASTERACEAE	*Paragus serratus*
2.	***Anogeissus pendula*** Wall	COMBRETACEAE	*Ischiodon scutellaris, Stomorhina discolor*
3.	***Allium cepa*** Linnaeus	LILIACEAE	*Chrysops dispar, Musca (M) domestica, Musca (Philaematomyia) crassirostris, Chrysomya bezziana, Gasterophilus* sp., *Sarcophaga* sp.
4.	***Aesculus indica*** Colebr. ex. Comb.	HIPPOCASTANACEAE	*Orthellia viridis*
5.	***Amaranthus spinosus*** Linnaeus	AMARANTHACEAE	*Asarkina (Asarkina) ericetorum, Paragus (Pandasyophthalmus) tibialis, Syritta pipiens*
6.	***Anthemis cotula*** Linnaeus	ASTERACEAE	*Syritta pipiens*
7.	***Althaea rosea*** Cav.,	MALVACEAE	*Chrysomya megacephala, Orthellia timorensis*
8.	***Anacardium occidentale*** Linnaeus	ANACARDIACEAE	*Hybomitra hirta*
9.	***Aegle marmelos*** Corr.	RUTACEAEA	*Mesembrius quadrivittatus, Eristalinus (Eristalinus) obscuritarsis*
10.	***Brassica oleracea*** Linn. ***v. botrytis*** Linn.	BRASSICACEAE	*Gasterophilus* sp., *Musca (M) domestica, Sarcophaga* sp.
11.	***Brassica campestris v. sarson*** Linn.	BRASSICACEAE	*Eristalinus (Eristalinus) arvorum, Episyrphus balteatus, Eristalis (Eristalis) tenax, Eristalis angustimarginalis, Eristalis polymacharus, Ischiodon scutellaris, Melanostoma univittatum, Spherophoria indica, Scaeva latimaculata, Metasyrphus corollae, Musca* sp., *Orthellia* sp.
12.	***Bauhuinia variegata v. candida*** Linnaeus	LEGUMINOSAE	*Sargus metallinus*
13.	***Castania sativa*** Mill	FAGACEAE	*Orthellia viridis*
14.	***Cassia tora*** Linnaeus	FABACEAE	*Asarkina (Asarkina) ericetorum, Ischiodon scutellaris, Exhyalanthrax absalon, Hetaralonia (Isotamia) insulata, Argyramoeba duvaucelli*

Table 2. : *(Cont'd.).*

	NAME	FAMILY	POLLINATORS
15.	***Chrysanthemum* sp.**	ASTERACEAE	*Sphaerophoria scripta, Melanostoma* sp., *Eristalis (E) tenax, Eristalis (E) arbustorum, Eristalis (E) cerealis*
16.	***Chenopodium ambrosoides*** Linnaeus	CHENOPODIACEAE	*Sphaerophoria scripta*
17.	***Coriandrum sativum*** Linnaeus	UMBELLIFERAE	*Hybomitra hirta, Petrorossia nigrofemorata*
18.	***Cannabis sativa*** Linnaeus	CANNABINACEAE	*Episyrphus balteatus, Spherophoria scripta, Metasyrphus latifasciatus, Melanostoma orientale, Melanostoma* sp., *Syritta pipiens, Ischyrosyrphus* sp.
19.	***Callistemon citrinus*** (Curtis)	MYRTACEAE	*Baccha (A) ampithoe, Stomorhina discolor*
20.	***Capsicum frutescens*** Linnaeus	SOLANACEAE	*Petrorossia albofulva, Exhylanthrax absalon, Hetaralonia (Isotamia) insulata, Litorhynchus lar, Ischiodon scutellaris, Episyrphus balteatus*
21.	***Cucurbita maxima*** Duchesne	CUCURBITACEAE	*Bactrocera (Zeugodacus) cucurbitae*
22.	***Catharanthus roseus*** Linnaeus	APOCYANACEAE	*Isomyia viridaurea*
23.	***Daucus carota*** Linnaeus	UMBELLIFERAE	*Gasterophilus* sp., *Sarcophaga* sp., *Chrysomya bezziana, Musca domestica, Chrysops dispar*
24.	***Digitalis purpurea*** Linnaeus	SCROPHULARIACEAE	*Melanostoma orientale*
25.	***Eleusine indica*** Gaertn.	GRAMINAE	*Syritta pipiens, Sphaerophoria scripta, Spahaerophoria* sp., *Melanostoma* sp.
26.	***Eleusine* sp.**	GRAMINAE	*Syritta pipiens, Sphaerophoria scripta*
27.	***Ephedra gerardiana*** Adans	EPHEDRACEAEA	*Syritta orientalis*
28.	***Foeniculum vulgare*** Gaertn.	UMBELLIFERAE	*Episyrphus balteatus, Sphaerophoria scripta*
29.	***Ficus carica*** Linnaeus	MORACEAE	*Phaenicia sericata*
30.	***Holarrhena antidysenterica*** Flem.	APOCYANACEAE	*Chrysomya megacephala*

Table 2. : *(Cont'd.).*

	NAME	FAMILY	POLLINATORS
31.	***Helianthus* sp.**	ASTERACEAE	*Eristalis tenax, Eristalis (Eristalodes) paria, Eristalis (Eoseristalis) cerealis*
32.	***Ipomea* sp.**	CONVOLVULACEAE	*Chrysotoxum baphyrus, Heterolonia (Isotamia) insulata*
33.	***Lycopersicon esculentum*** Mill	SOLANACEAE	*Exhyalanthrax absalon, Petrorossia albofulva, Heterolonia (Isotamia) insulata*
34.	***Mangifera indica*** Linnaeus	ANACARDIACEAE	*Eristalinus (Eristalinus) arvorum*
35.	***Malus domesticus*** Mill	ROSACEAE	*Episyrphus balteatus*
36.	***Melilotus officinalis*** Linnaeus	LEGUMINOSAE	*Scaeva latimaculata, Eristalis (Eoseristalis) cerealis*
37.	***Melilotus alba*** Lamk	LEGUMINOSAE	*Eristalis (Eoseristalis) cerealis, Eristalis (Eoseristalis) arbustorum*
38.	***Nerium indicum*** Linnaeus	APOCYANACEAE	*Adoxomyia heminopla*
39.	***Nicotiana plumbaginifolia*** Viv.	SOLANACEAE	*Episyrphus balteatus, Spherophoria scripta, Syritta pipiens*
40.	***Panicum* sp.**	GRAMINAE	*Syritta pipiens, Spherophoria scripta, Ischiodon scutellaris*
41.	***Pyrus communis*** Linnaeus	ROSACEAE	*Eristalis (s.str.) tenax*
42.	***Polygonum chinensis*** Linnaeus	POLYGONIACEAE	*Culex* sp., *Asarkina (Asarkina) ericetorum, Eristalinus (Eristalinus) arvorum, Mesembrius bengalensis, Mesembrius quadrivittatus, Syritta indica, Hemipyrellia liguirriens*
43.	***Psidium guajava*** Linnaeus	MYRTACEAE	*Hemipyrellia pulchra, Thelaira macropus*
44.	***Polyanthes tuberosa*** Linn.	AMARYLIDACEAE	*Musca (Byomya) ventrosa*
45.	***Ricinus communis*** Linnaeus	EUPHORBIACEAE	*Eristalis (Eoseristalis) cerealis*
46.	***Rubus ellipticus*** J.E. Smith	ROSACEAE	*Episyrphus balteatus, Melanostoma orientale*
47.	***Rubus* sp.**	ROSACEAE	*Melanostoma orientale*
48.	***Santalum album*** Linnaeus	SANTALACEAE	*Hemipyrellia pulchra, Eristalinus (Eristalinus) arvorum*
49.	***Scaevola sericea*** Vahl.	GOODENIACEAE	*Orthellia timorensis, Lucilia porphyrina, Villa aureohirta, Villa panisca*

Table 2. : *(Cont'd.).*

	NAME	FAMILY	POLLINATORS
50.	***Sida acuta*** Burm	MALVACEAE	*Mesembrius bengalensis, Asarkina (A) ericetorum*
51.	***Sida rhombifolia*** Linnaeus	MALVACEAE	*Eristalis (Eoseristalis) arbustorum*
52.	***Sida* sp.**	MALVACEAE	*Melanostoma orientale*
53.	***Solanum melongena*** Linnaeus	SOLANACEAE	*Petrorossia albofulva, Exhyalanthrax absalon, Exoprosopa insulata, Litorhynchus lar, Episyrphus balteatus, Ischiodon scutellaris*
54.	***Spilanthes acmella*** Linnaeus	ASTERACEAE	*Mesembrius bengalensis, Mesembrius quadrivittatus*
55.	***Syzygium jambos*** Alston.	MYRTACEAE	*Stomorhina discolor, Baccha (Allobaccha) amphithoe*
56.	***Sorghum vulgare*** Pears	GRAMINAE	*Bombylius maculatus, Hybomitra hirta*
57.	***Tagetes patula*** Linnaeus	ASTERACEAE	*Stomorhina discolor, Eristalinus aenus v. taphicus, Eristalinus (Eristalinus) arvorum, Eristalinus laetus, Eristalinus (Eristalinus) obscuritarsis, Eristalinus quinquestriatus, Eristalis (Eristalis) tenax, Eristalis (Eoseristalis) arbustorum, Eristalis (Eoseristalis) cerealis, Microchrysa flaviventris, Oplodontha rubrithorax, Mesembrius bengalensis, Ischiodon scutellaris*
58.	***Taraxacum officinale*** Wigg.	ASTERACEAE	*Stomorhina discolor*
59.	***Trifolium repens*** Linnaeus	UMBELLIFERAE	*Episyrphus balteatus*
60.	***Wedelia calendulacea*** Less	ASTERACEAEAE	*Mesembrius bengalensis, Mesembrius quadrivittatus, Paragus serratus, Musca (M) domestica*
61.	***Xanthium strumarium*** Linnaeus	ASTERACEAEAE	*Eristalis (Eoseristalis) cerealis*
62.	***Zizyphus mauritiana*** Lamk	RHAMNACEAE	*Stomorhina discolor, Chrysomya megacephala*
63.	***Zizyphus* sp.**	RHAMNACEAE	*Adoxomyia heminopla, Stomorhina discolor*