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POLLINATION BY INSECTS IN *TAGETES ERECTA* LINN

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Abstract

Flowers are the most beautiful among nature's creation. Flowering plants are with medicinal properties are threatened by global warming. Many of threats that endanger plants also place their pollinators at risk. The present study is carried out on pollination by insects in Tagetes erecta Linn. It is a perennial shrub which was objective for its insect visitors and pollination ecology for a period of 2 months from September to November in 2010. The study was carried out at Chinnamanur for 10 days. Six different types of insects were observed. Papilio glacus, Butterfly species, Anisoptera, Apis florea, Musca domestica and Vespa vulgaris. Papilio glacus was observed to be the significant pollinator and shows consistent foraging on Tagetes erecta Linn during September and November respectively. Honey bees response to color of wavelength between 500-650 nm, one of the four regions within color spectrum might be the reason for more floral visits to yellow flower of Tagetes erecta Linn. Hence, the diversity and abundance of pollinators must be conserved for their effective service.

Key Words: *Insects, Tagetes erecta Linn, Pollination, Diversity,*

1. Introduction

Flowers are the most beautiful among nature's creation. "Flower is the moment's representations of things that are in them eternal," says Sri. Aurobindo. In biological terms the flower is a condensed and modified shoot meant for sexual reproduction. The beauty of nature is exhibited by various structure, position, arrangement, size, colors, fragrance, nectars, functions and uses of flowers.

A flowering plant springs from a seed and grows, given flower emerges. Then pollination must occur. As the flower fades a fruit with seed is produced. To produce a seed or fruit, pollen must move from the anther to a respective stigma, this is pollination. When the proper compatible pollen adheres to the stigma, it germinates and a pollen tube grows the stigma and the style to the ovary. Fertilization takes place in the ovary when the nucleus of the ovule of female germ cell, now a seed is produced. This essential work of the flower is to secure the transformation of pollen grains from the anther to the stigma, this process known as pollination.

1. Types of Pollination

Two kinds of pollination occur in flowering plants.

Self pollination

Cross pollination

1.1.1. Self pollination

Pollen comes from same flower or same plant or from plants of identical genetic material. Flower must be self - fertile or self- compatible.

1.1.2. Cross Pollination

Pollen transfer from one flower to another flower must be cross compatible.

1.2. Fertilization

Union of male nucleus of pollen grains (passed through pollen tube) with female nucleus of ovule is fertilization. Mature fruits were produced from flowers that were open pollinated by means either cross pollination or self pollination.

The study of pollination brings together much discipline such as botany, horticulture, entomology and ecology. Pollination is important in horticulture because most plant fruits will not develop if the ovules are not fertilized.

1.3. Insect Pollination

Most flowers secrete nectar a sugary, scented liquid to help attract insects to the flower. This is usually offered deep within the flower near the base where petals originate from around the ovary. In seeking nectar or gathering pollen, the insect accidentally brushes against anthers so that the pollen grains are transferred to the stigma. Pollination is not a deliberate behavior but an accidental one performed by the insect as they collect food. The honey bee is well adapted for pollination which is available to forage for the food (pollen and nectar) that's required to rear their replacements. In a single day one bee makes 12 or more trips from the hive visiting several thousand flowers. On each trip it confines its visit to one plant species, collecting one kind of pollen. These characteristics make honey bees most valuable agent for cross- pollinating crops (Anonymous, 2000). The flower visitors foraged daily during day light hours from 0730 hours to 1800hrs (Christine Ndunage Muthoka, 2005). They foraged on male and female flowers indiscriminately and made relatively more visits on male flowers. Bees and thrips collect nectar and pollen from male flowers mostly in the same visit and nectar from female flowers. Ants and flies collect only nectar from both male and female flowers. The bees probed the flowers in an upright position by landing on the petals, styles and stigmas in female flowers. Insects are often very useful to flowers and in many cases seeds can only be developed when insects act as pollinators (Woodhead, 2003). Marigold is a common garden plant which is rather coarse, erect, branched and grows to about one meter high. However, there are short or dwarf varieties as well. The levels are very deeply incised and sharply toothed. Flower heads are solitary, long. Stalked and thickening upward. The flowers are bright yellow, brownish yellow or orange.

The present study looked at the number of pollinators visiting *Tagetes erecta* linn and their pattern of visit and fertilization efficiency.

2. Materials and Methods

2.1. The Systemic position of *Tagetes erecta* Linn

Kingdom	-	Plantae
Division	-	Magnoliophyta
Class	-	Mangnoliopsida
Order	-	Asterales
Family	-	Asteraceae
Sub Family	-	Asteroideae
Genus	-	Tagetes

2.2. Study plant

Marigold is a common garden plant which is rather coarse, erect, branched and grows to about one meter high. However, there are short or dwarf varieties as well. The leaves are very deeply incised and sharply toothed. Flower heads are solitary, long-stalked and thickening upward. The flowers are bright yellow, brownish yellow or orange.

2.3. Study area

The study was carried in Selayampatti at Chinnamanur .

2.4. Study Period

The study was carried out during September and November, 2010, ten days in each month.

2.5. Method

A plot of 1×1 m was chosen and the plants in the area was observed for insect visitors, plant characteristics such as flowers opening and closing time, flower color, number of petals, sepals, were recorded.

2.6. Data Analysis

The data collected in the present study was statistically analysed by following (Zar, 1996).

3. RESULTS

Foraging behavior of insect visitors and pollination ecology of *Tagetes erecta* Linn was studied for a period of two months of September and November 2010. The floral characteristics were observed. Numbers of visits are given in (Table 1). Figure 1a and 1b reveals the frequency of visits.

A group of plants occupying 1 m^2 area comprising of approximately 50 and 60 flowers during the month of November and December respectively were observed for the present study. The study was carried out for 10 days during September and November. Six different types of insects viz, *Papilio glacus*, Butterfly species, Anisoptera, *Apis florea*, *Musca Domestica* and *Vespa vulgaris* were found to visit the flowers during the study period of September and November of which five are pollinators. Frequency of visit of individual insect species was observed from morning time. Month wise maximum, minimum and average frequency of visits by individual insects was given in table 2. Figure 1a and 1ab reveals daily foraging activity of all the insects during the month of September and November respectively. The average foraging of insects during the study period is depicted in figures 2a and 2b.

Table 1.Number of visits and insects in Tagetes erecta Linn

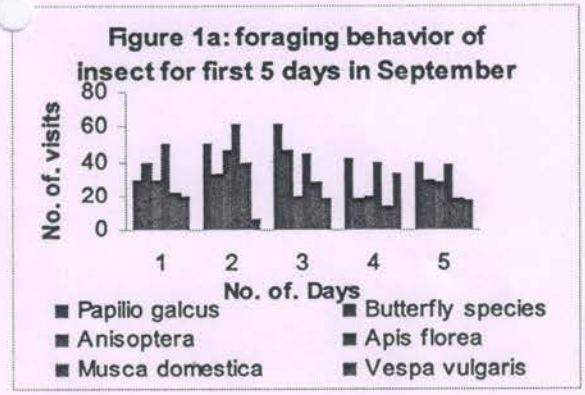
Names	September		November	
	Numbers	Visits	Numbers	Visits
Papilio glacus	371	474	222	268
Butterfly species	260	338	161	208
Anisoptera	61	110	53	109
Apis florea	361	439	203	395
Musca domestica	93	216	37	133
Vespa vulgaris	128	183	64	187

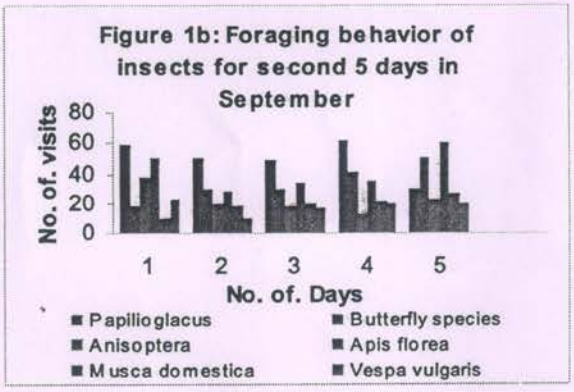
Table 2.Range and Average of visits by insect visitors of Tagetes erecta Linn:

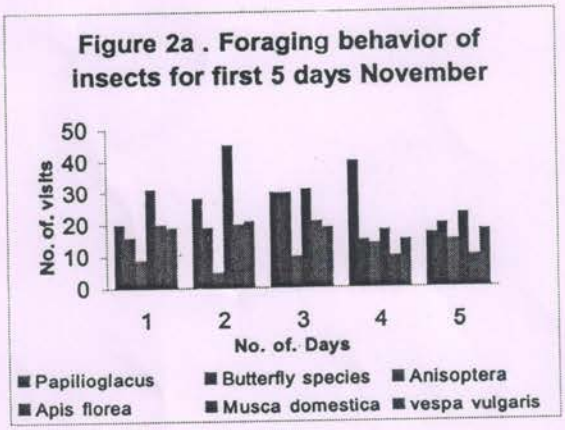
Insects	September		
	Maximum	Minimum	Average
Papilio glacus	22	61	43.9±11.18
Butterfly species	12	51	33.8±11.07
Anisoptera	2	47	25.6±10.33
Apis florea	20	62	47.3±11.96
Musca domestica	2	39	21.6±8.22
Vespa vulgaris	2	33	18.3±7.21

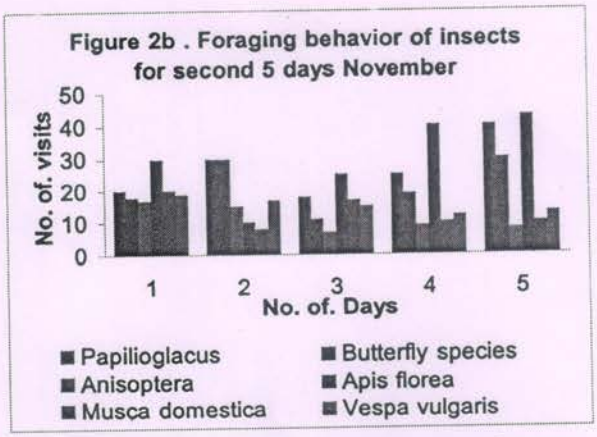
Table 3: Range and Average of visits by insect visitors of Tagetes erecta Linn

Insects	November		
	Maximum	Minimum	Average
Papilio glacus	15	40	26.8±8.429
Butterfly species	7	30	22.8±6.843
Anisoptera	2	15	10.9±4.039
Apis florea	10	45	29.5±11.117
Musca domestica	1	21	13.6±5.399
Vespa vulgaris	2	21	18.7±2.867









4. Discussion

In the present study the floral visitors of the plant *Tagetes erecta* Linn were continuously monitored from morning hours for days during September and November.

The florets of *Tagetes erecta* Linn are rich in the orange yellow caroteniod lutein and are used as a food colour (INS-number E1616) in the European union for foods such as pasta, vegetable oil, margarine, mayonnaise, salad dressing, backed goods, confectionary, dairy products, ice cream, yogurt, citrus juice and mustard. In the united states, however, the powders an extracts are only approved as colorants in poultry feed. Marigold is recorded as a food plant for some Lepidopteran caterpillars including the Dot Moth, and a nectar source for other Butterflies.

In this present study, the flowers are visited by *Papilio glacus, Thymelius flavus*, Anisoptera, *Apis folorea, Musca domestica and Vespulea vulgaris.* The frequency of honeybee's visits was more during the sunny time and gradually reduced Among these plants selfing can occur but cross pollination is needed for maximization of fruit and seed set, and these latter are their main reproductive mechanisms (Barrows, 1976, Goulson and Derwent, 2004). Among the visitors, Apis flora, *Papilio glacus* species were found to be a frequent visitor. The other insects, *Musca domestica*, Butterfly were not frequent and the visits of wasp and Dragonfly were highly occasional.

Though honey bees respond more to white and blue color, yellow flowers are also apparently conspicuous as of forms are of the primary colors of insect vision (Wigglesworth, 1984). It is also reported that bees that first visited a yellow flowers continued to highly favor yellow flowers (Cakmak and Wells, 1990). Another explanations that could be attributed to frequent visit by honeybee is flower constancy while foraging, insect pollinators often sequentially visit one type of flower even though equally or more often sequentially visit one type of flower even though equally or more rewarding flower types are available. This type of selective foraging behavior in pollination known as flower constancy, it was first documented in honey bee by Aristotle over 2000 years ago (Grant, 1950). Because of flower constancy an individual forager actually bypass rewarding flowers to restrict visits to a single plant species (Goulson, 2000, Goulson and Wright, 1998).

Apis mellilfera prefers flower constancy foraging strategy than others (Wells and Wells, 1986). A honey bee, on a single day makes 12 or more trips from the hive, visiting several thousand flowers, on each trip; it confines its visit to one plant species (Anonymus, 2000). Honey bee individuals show a high level of flower constancy sequentially visiting the flowers of one color while by passing flowers of equal rewarding alternate color. Under the same foraging conditions, bumble bees showed lack of constancy and more variations in their flower visit patterns than honey bees, ranging from random visitation of both colors to complete specialization on one color. Honey bees did not switch between two colors as readily as bumble bees (Gegear and Laverty, 2004). Flowers constancy provides reproductive benefit to our crossed flowering plants by both reducing the amount of pollen wastages and preventing stigma blockage by heterospecific pollen (Waser *et al.,* 1996). (Gegear and Laverty, 1995) observed strong individual constancy is honey bees.

The occasional visit of butterflies in the present study is supported by the observation of (Barrows, 1976). As well as present study seems the frequent visits of Papilo glacus. This is native to Australia, thorax and head of these bees are covered with golden hairs and abdomen is banded with pale blue bands on

blacks. This is a solitary bee but females built nest together in same location with other Blue-banded bees.

The plant-pollinator relationship is considered a mutualism because the plant benefits from the pollinator's transport of male gametes, where as the pollinators benefit from a reward (nectar, pollen, oil) by (Maloof *et al.*, 2000). These mutually beneficial relationships are sometimes so specialized that the loss of one species threatens the existence of the other, raising troubling questions about the likely consequences of declining diversity in pollinator networks.

Pollinator insects generally, do not often specialize on floral host species. Hence the degree of dependence of pollinators on particular plant species is usually less than that of plants dependence of pollinators (Inoue, 1993). Pollinators as organisms that provide an essential ecosystem service are important in agricultural lands, cultivated, pastoral and natural areas. Hence, the diversity and abundance of pollinators must be conserved for their effective service.

5. Summary

Tagetes erecta Linn is a perennial shrub which was observed for its insect visitors and pollination ecology for a period of two months September and November in 2010. The study was carried out at Selayampatti at Chinnamanur for ten days in September and November. Six different types of insects were observed. *Papilio glacus,* Butterfly species, Anisoptera, *Apis florea, Musca domestica and Vespa vulgaris* these are pollinators. *Papilio glacus* was observed to be the significant pollinator and shows consistent foraging on *Tagetes erecta* Linn during September and November respectively. Honey bees response to color of wavelength between 500-650 nm, one of the four regions within color spectrum might be the reason for more floral visits to yellow flower of *Tagetes erecta* Linn. However, the sequential visit of pollinators on one type flower termed as flower constancy, based on the dynamics of working memory could be the solid reason for the selective behaviour of honeybees.

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