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POLLINATORS VISITING SUMMER VEGETABLES RIDGE GOURD (*LUFFA ACUTANGULA*), BITTER GOURD (*MOMORDICA CHARANTIA* L.) AND BRINJAL (*SOLANUM MELONGENA*)

Imran Bodlah and Muhammad Waqar

Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Pakistan.

ABSTRACT

The forging activity of insect pollinators visiting the summer vegetables i.e. Ridge gourd (*Luffa acutangula*), Bitter Gourd (*Momordica charantia* L.) and Eggplant or Brinjal (*Solanum melongena*) observed. Two orders Hymenoptera and Diptera were identified as the major pollinators of these vegetables. The order Hymenoptera include six species (*Apis Sp., Bombus sp., Xylocopa sp., Halictus sp*. and two unidentified species 1 from Halictidae family and 1 from Megachilidae families) and order diptera include there 3 species of pollinators (*Eristalinus sp.* and 1 un-identified specie from family Syrphidae and Muscidae each). The foraging rate was much higher early in the morning i.e. 6-7 am. Ridge gourd (*Luffa acutangula*) have the more abundant number of insects pollinating it followed by Bitter gourd (*Momordica charantia* L.) and Brinjal (*Solanum melongena*). The total number if insect pollinators show that the order hymenoptera include the most abundant number of insect pollinators.

Keywords: Pollinators, *Luffa acutangula, Momordica charantia L, Solanum melongena*

INTRODUCTION

Pollination is most important activity in the ecosystem for the biodiversity of plants on earth. For the sustainability and continuity of the ecosystem insects play their vital role (Ali and Breeze , 2011) Pollination also increase the quality and efficiency of crop production. Incomplete pollination of crops may result in the less yield and inferior quality of fruit (McGregor, 1976).

Pollination by insects (Entomophily) increases the production of many crops. About 75% of the total crops depend on pollination through insects for their reproduction. 87 of the total food crops depend entirely on pollinators hence 35% of the global food production is from the crops which depend on pollinators (Klien , 2007).Through insect pollination and good management of pollinators the yield of the crops can be increased up to 50 to 60 percent, 45 to 50 percent and 100 to 150 percent in fruits, oil seed crops and cucurbitaceous crops respectively (Melnichenko and Khalifman, 1960)

The pollinators are used for the most economical and environmental friendly approach towards the increase in the yield of cross pollinated crops (Free, 1970).The value of insect pollinators in to the agricultural crop is about £400 million per year in UK and globally about £153 billion per year (Gallai, 2009).From which the honeybees and bumblebees contribute more than £173 million for the outdoor crops and £30 million for the greenhouse crops in UK. 80% of the plant species in UK, including majority crop plants need insects for their pollination (Carreck and Williams, 1998).

The major insect pollinators of plants are bees, hoverflies, butterflies and moths. Pollination by bees increase the production of many crops (Greenleaf and Kremen, 2006). *Apis millifera* is considered as the most contributing towards the crop pollination but the bumblebees are more effective pollinators because of their buzz pollination ability (Oronje , *2012)*. The production of the farm can be increased by the proper management of honey bees, solitary bees and other pollinators (Pattel, 2007).

A study shows that 34% of the pollination requirement of the crop plants are carried out by the total honeybee hives present in UK, which was 70% in 1984. In spite of the decrease in the pollination provided by the honeybee the production rises by 54% since 1984 which clears that the honeybees are not the only and major pollinators of crops.(Breeze , 2011)

Keeping in view the importance of Entomophily in the crop production the current study was conducted on three summer vegetables i.e. Ridge gourd (Luffa acutangula),

**Corresponding author:* e-mail: imranbodlah@gmail.com

Bitter Gourd (Momordica charantia L.) and Eggplant or Brinjal (Solanum melongena) with following objectives; identify the pollinators of these summer,observe the preference of insect pollinators among these summer vegetables and observe the peak forging time of insect pollinators.

MATERIALS AND METHODS

The study was carried out at the field area of PMAS-Arid Agriculture University, Rawalpindi from 15 May to 15 June, 2012. Three summer vegetables Ridge Gourd (*Luffa acutangula*), Bitter Gourd (*Momordica charantia* L.) and Eggplant or Brinjal (*Solanum melongena*) were selected for the study. The data was collected after two day interval.

The observations were recorded three times a day i.e. 6-7 am in the morning, 12-1 pm at noon and in the evening from 5-6 pm. Also the peak foraging activity of the pollinators was calculated by counting the total number of insects foraging during these time for whole month. The specimens were collected killed and taken to laboratory for their identification up to family level and where possible up to genus level.

The pollinator abundance through the whole study period was measured by the direct count of insects forging the crop. To study the preference and foraging behavior of pollinators among these vegetables, the stay time (seconds per flower) of each insect pollinator was also recorded.

RESULTS AND DISCUSSION

Two insect orders Hymenoptera and Diptera were identified as the pollinators of summer vegetables i.e. Ridge gourd (*Luffa acutangula*), Bitter Gourd (*Momordica charantia* L.) and Brinjal (*Solanum melongena*). Total nine species from five families were recorded as the pollinators of these crops among which 6 were from Hymenoptera and 3 were from Diptera (Table 1).

Among Hymenoptera the family Apidae include the most abundant and diverse combination of pollinators visiting all the three vegetables. *Bombus* sp. was the most abundant among pollinators foraging on Brinjal and ridge gourd with total of 203 and 106 individuals observed respectively on each vegetable followed by *Xylocopa* sp. with total 278 individuals forging only on ridge gourd. *Apis* sp. was observed foraging on bitter gourd and ridge gourd with 40 and 112 insects respectively. Halictidae family comprises of two pollinator genera *Halictus* sp. and an unidentified specie both feeding on Brinjal and bitter gourd. Megachilidae family with only one genera which forage on ridge gourd (Table 1).

Insects of hymenoptera, diptera, coleopteran and Lepidoptera orders were also observed as the pollinators of carrot by Ahmad and Aslam (2002) the also observed that the pollinators' activity was higher in the morning which is also effected by temperature and relative humidity.

Syrphidae and few individuals of Muscidae were recorded from order Diptera with two and one genera respectively. Syrphidae family was recorded forging only on ridge gourd and Muscidae on bitter gourd (Table 1). Among Syrphidae only *Eristanilus* sp. was identified with total abundance of 137 individuals lead by the unidentified genus of Syrphidae with 161 individuals. (Table 1)

Among vegetables ridge gourd (*Luffa acutangula*) have the more diverse and abundant number of insects pollinating it. The pollinator fauna of ridge gourd included six species among which Apis sp., *Bombus* sp., *Xylocopa* sp. and one unidentified specie of family Megachilidae from Hymenoptera and Syrphidae family from Diptera including *Eristanilus* sp. and an unidentified specie (Table 1).

Oronje , (2102) also reported honey bees (*Apis millifera*), *Lasioglossum* sp., *Xylocopa* sp. and *Plebiena hildebrandti* as the major insect pollinators of bitter gourd (*Momordica charanta*).Among them *P.Hildebrandti* (Apidae) and *Lasioglossum* sp. (Halictidae) are the most important floral visitors. The fruit set was very low without pollinators than the insect pollinated plants.

Bitter gourd (*Momordica charantia* L.) being the second in pollinator diversity with total four species pollinating it which include *Apis* sp. from Apidae, *Halictus* sp. and an unidentified species from Halictidae and one species of Muscidae.

Brinjal is a self-pollinating crop even then have three species of pollinators visiting it which include *Bombus* sp. from Apidae and *Halictus* sp. and an un-identified specie from Halictidae family.

Effect of pollination on self-pollinated crop was also studied by Greenleaf and Kremen in (2006) and found that the insect pollinators also increase the yield and production of tomato (a self-pollinated crop). They also found that the abundance of wild bees is more in organic fields where the environment is near to natural habitat. They suggest that the natural habitat should be preserved on the farm to increase number and diversity if insect pollinators on the farm.

Herren and Ochieng (2008) reported *Xylocopa sp.* and *macronomia sp.* as effective pollinators of eggplant (*Solonum melongena*) on the basis of floral visits and fruit set. He also suggest that the wild habitat near the cultivated land increase the pollination of crop by wild bees. Also five pollinators of *Solonum melongena* were recorded in 2006-2007 by Montemor and Souza (2009) from which *Exomalopsis sp.*, *Pseudaugochloropsis graminea* and *Bombus atratus* are considered as the important pollinators on the basis of their visitation frequency and increased fruit set.

On the basis of stay time per flower it was evident from the study that Brinjal is more preferred followed by ridge gourd and bitter gourd the least preferred by Apidae and Halictidae families (Figure 2). This is because the flowers of brinjal and bitter gourd offer more nectar and pollen than bitter gourd (Dobromilska, 1997).

For all the vegetable crops the peak foraging activity was observed early in the morning from 6-7 am which largely decrease at noon 12-1 pm and in afternoon 5-6 pm due to the hot weather in May-June (Figure 1). Other researchers also found that the peak foraging time of pollinators is in morning during hot weather (Ahmad and Aslam, 2002 and Dobromilska, 1997) .The pollinators activity is effected by temperature and humidity level(Ahmad and Aslam, 2002).

Pollinators from the order Hymenoptera are most abundant and diverse in foraging behavior. The most preferred time by the pollinators for foraging in summer is early in the morning from 6-7am. The pollinators which prefer a specific vegetable can be used commercially for the economical pollination and high production of cross-pollinated as well as for the self-pollinated crops.

Table 1. Pollinators of summer vegetables (Bitter Gourd, Ridge Gourd and Brinjal) their total abundance and stay time per flower.

Order	Family	Genus/ Species	Crop	Total Abundance				Stay Time
				6-7 am	12-1 pm	5-6 pm	Total	Sec/flower (± S.E)
Hymenoptera	Apidae	*Apis Sp.*	Bitter Gourd	31	6	3	40	2.46 ± 0.77
			Ridge Gourd	71	31	10	112	12.6 ± 6.48
		Bombus sp.	Brinjal	175	11	17	203	5.33 ± 2.044
			Ridge Gourd	95	9	2	106	4.57 ± 0.42
		Xylocopa sp.	Ridge Gourd	220	35	23	278	4.64 ± 1.27
	Halictidae	*Halictus sp.*	Brinjal	32	17	25	74	23.15 ± 6.45
			Bitter Gourd	67	13	17	97	11.35 ± 2.25
		sp. 2	Brinjal	41	9	15	65	17.95 ± 0.35
			Bitter Gourd	59	7	12	78	8.13 ± 0.41
	Megachilidae	*Sp. 1*	Ridge Gourd	21	2	5	28	5.73 ± 0.36
Diptera	Syrphidae	*Eristalinus sp.*	Ridge Gourd	82	21	34	137	7.23 ± 2.35
		Sp. 1	Ridge Gourd	107	25	29	161	5.62 ± 1.61
	Muscidae	*Sp. 1*	Bitter Gourd	13	1	5	19	3.21 ± 0.18

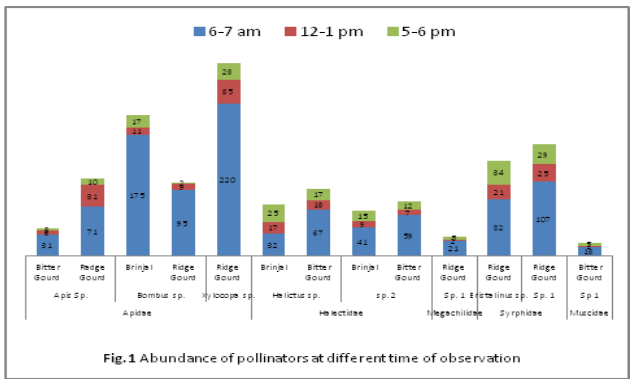

Fig. 1 Abundance of pollinators at different time of observation

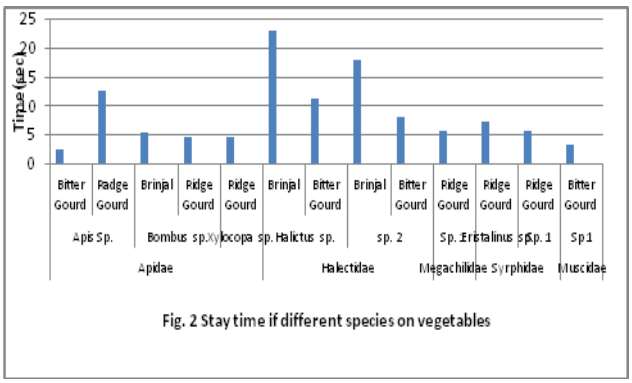

Fig. 2 Stay time if different species on vegetables

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