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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

FORAGING ACTIVITY and ROLE OF STINGLESS BEE *Tetragonula iridipennis* Smith (Hymenoptera: Apidae) in BITTER GOURD

İğnesiz Arı *Tetragonula Iridipennis*'in Smith (Hymenoptera: Apidae) Acı Kabakta Yayılma Faaliyeti ve Rolü

Kamatchi Murali NARMADHA[1*], Pernamallur Ayyaswami SARAVANAN[2], Govindasamy UMAPATHY[3], Muthusamy VELMURUGAN[4]

[1*]Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore 641-003, Tamil Nadu, INDIA, Corresponding author E-mail: narmadhakm@gmail.com, ORCID No: 0000-0002-2007-036X

[2]Tapioca and Castor Research Station, Yethapur, Salem 636-119, Tamil Nadu, INDIA, E-mail: entosaravanan@gmail.com, ORCID No: 0000-0001-8789-4497

[3]Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore 641-003, Tamil Nadu, INDIA, E-mail: umapathy@tnau.ac.in, ORCID No:0000-0002-5616-4544

[4]Department of Floriculture and Landscaping, Tamil Nadu Agricultural University, Coimbatore 641-003, INDIA, E-mail: hortmrvelu@gmail.com, ORCID No: 0000-0002-4196-2877

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ABSTRACT

In the bitter gourd cropping system, honey bees are the primary pollinators. In southern India, a field study was conducted at Coimbatore district at 10˚ 58' 46.164" N latitude and 76˚ 55' 53.562" E longitude, to record the foraging activity and pollination efficiency of the stingless bee *Tetragonula iridipennis* in bitter gourd. Bee foraging activity was recorded separately in male and female flowers, with the number of foragers/flower/min, and fruit set and yield were assessed under three different conditions: pollinator exclusion, bee pollination and open pollination. The abundance of pollinators and foraging rate of stingless bees observed on male flowers was 1.71 bees/ flower/ minute and flower handling time in seconds (37.86 sec) was higher than female flowers (1.22 bees / flower/ minute) and (25.73 sec), respectively. The peak foraging activity of stingless bees was observed between 08:00-10:00 hours with 3.30 bees/ 5 mins. The pollination efficiency index of stingless bees in bitter gourd flowers was 41600 pollen grains. The foraging activity of bees at the hive entrance was at its peak from 08:00 to 10:00 hours. *T. Iridipennis* colony growth parameters showed increased honey sealed area of 1464.5 g and brood development. The experiment results showed that yield was higher in the managed bee-pollinated condition in terms of the number of fruits/plant (18.2 fruits) and fruit yield per hectare (44.08 t/ha) than in the open-pollinated condition (16.5 fruits) and (38.30 t/ha), and with pollinators excluded, no fruit set was recorded.

Key words: Bitter gourd, *T. iridipennis,* Pollination efficacy, Foraging activity

ÖZ

Acı kabak yetiştirme sisteminde, bal arıları birincil tozlayıcılardır. Güney Hindistan'da, Coimbatore bölgesinde, 10˚ 58' 46.164" N enlem ve 76˚ 55' 53.562" E boylamında, acı kabakta arı *Tetragonula iridipennis*'in yiyecek arama aktivitesini ve tozlaşma verimliliğini kaydetmek için bir saha çalışması yapılmıştır. Arı tozlaşma aktivitesi erkek ve dişi çiçeklerde ayrı ayrı kaydedilmiş, tozlaşma sayısı/çiçek/dakika olarak belirlenmiş ve meyve tutumu ve verimi üç farklı koşul altında değerlendirilmiştir: tozlayıcıların dışlanması,

arı tozlaşması ve açık tozlaşma. Erkek çiçeklerde gözlenen tozlayıcı bolluğu ve iğnesiz arıların yiyecek arama oranı sırasıyla 1,71 arı/çiçek/dakika ve saniye cinsinden çiçek taşıma süresi (37,86 sn) dişi çiçeklerden (1,22 arı/çiçek/dakika) ve (25,73 sn) daha yüksek olarak belirlenmiştir. Erkek arıların en yoğun yiyecek arama faaliyeti 3,30 arı/ 5 dakika ile 08:00-10:00 saatleri arasında gözlenmiştir. Acı kabak çiçeklerinde iğnesiz arıların tozlaşma etkinliği indeksi 41600 polen tanesi, kovan girişindeki arıların yiyecek arama aktivitesi 08:00-10:00 saatleri arasında en yüksek seviyede kaydedilmiştir. *T. Iridipennis* koloni büyüme parametreleri 1464.5 g bal sızdırmaz alan ve kuluçka gelişiminde artış göstermiştir. Deney sonuçları meyve/bitki sayısı (18,2 meyve) ve hektar başına meyve verimi (44,08 t/ha) açısından yönetilen arı tozlaşması koşulunda verimin açık tozlaşma koşuluna (16,5 meyve) ve (38,30 t/ha) göre daha yüksek olduğunu, tozlaştırıcılar olmadan ise meyve oluşmadığını göstermiştir.

Anahtar kelimeler: Acı kabak, *T. iridipennis*, Tozlaşma etkinliği, Yayılma faaliyeti

GENİŞLETİLMİŞ ÖZET

Çalışmanın amacı: Çalışmanın amacı, bal arısı *Tetragonula iridipennis*'in Hindistan'daki acı kabak yetiştirme sisteminde yiyecek arama davranışını ve tozlaşma etkinliğini değerlendirmektir.

Gereç ve yöntem: Tozlayıcı yiyecek arama davranışını incelemek için, her bitkide haftalık aralıklarla üç çiçek gözlemlenirken, güney Hindistan'ın Coimbatore bölgesinde 10˚ 58' 46.164" N enleminde ve 76˚ 55' 53.562"de rastgele seçilen on bitki çalışma için etiketlenmiştir.

Beş dakikalık bir süre boyunca ziyaret edilen/çiçek toplayıcı sayısı, en yüksek tozlayıcı faaliyeti sırasında toplayıcının çiçek/dakika sayısı (tozlayıcıların bolluğu) ve her bir arı tozlayıcı/çiçek/dakika (toplama hızı) tarafından harcanan zaman olarak haftalık aralıklarla bir kronometre ile kaydedilmiştir. Tozlaşma etkinlik indeksi, vücuttaki gevşek polen tanelerinin sayısı ile acı kabak çiçeklerindeki tozlayıcıların yiyecek arama oranı ve bolluğu çarpılarak hesaplanmıştır. Arıların vücutlarındaki gevşek polen taneleri ölçülmüştür.

Muamele başına 350 dişi çiçek, verim değerlendirmesi yapmak için çiçeklenme başlangıcından sonra etiketlenmiştir. Tozlayıcı dışlama (T1), arı tozlaşması (T2) ve açık tozlaşma durumu (T3), her bir tozlaşma modunda yönetilen arıların tozlaşma etkinliğini değerlendirmek için kullanılmıştır. 08:00–10:00, 12:00–13:00 ve 16:00–18:00 saatlerinde kovan girişindeki yiyecek arama faaliyetleri, koloni büyüme parametreleri, koloninin başlangıç ağırlığı ve son ağırlığı alınarak sayılmıştır.

Bulgular: Acı kabak mahsulünün monoecious doğası, doğal tozlayıcıların daha az aktivitesi nedeniyle açık tozlaşma koşullarında zayıf meyve tutumu ile sonuçlanmıştır. Bu çalışmanın bulguları, çiçek üzerindeki *T. iridipennis* aktivitesinin 8:00 ile 10:00 saatleri arasında zirve yaptığını ve 16:00 ile 17:00 saatleri arasında herhangi bir aktivite olmadığını göstermiştir. Verimi ve meyve tutumunu arttırdığı için *T. iridipennis* acı kabak ekosisteminde etkili bir tozlayıcı olarak kabul edilir. Kovan girişindeki aktivite, toplayıcı aktivitenin 8:00 ile 10:00 arasında zirve yaptığını göstermiştir. Deney süresi boyunca, kapalı bal alanı için koloni büyümesi %4,8 olmuştur. Yönetilen arı tozlaşma alanı, açık tozlaşma ile karşılaştırıldığında en yüksek meyve tutumuna (bitki başına 18,2), meyve ağırlığına (261,6 g/meyve) ve verime (44,08 t/ha) sahip olduğu belirlenmiştir.

Sonuç: Açık tozlaşma koşulları ve tozlayıcı dışlama gibi diğer tozlaşma modlarıyla karşılaştırıldığında, mevcut çalışmamız, *T. iridipennis* ile yönetilen arı tozlaşma koşullarının daha yüksek meyve tutumu ve meyve ağırlığı ürettiğini ortay koymuştur. Buna karşılık, tozlayıcı dışlama kullanıldığında hiçbir meyve tutumu gözlenmemiştir.

INTRODUCTION

Bitter gourd has been mainly cultivated for its unique bitter taste and its high nutrient content, but nowadays it is gaining importance as a medicinal plant in India. Which is majorly cultivated in states like Maharashtra, Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, West Bengal, Uttar Pradesh and Gujarat. The cultivated area in India is 109 ha with a productivity is 1330 MT/ ha (Agricoop). Fruits and seeds have important pharmacological uses with antidiabetic anthelminthic, antimalarial, antiulcerogenic and immunomodulatory effects. It also contains vitamin A, vitamin C, vitamin B complex, minerals, iron, magnesium, potassium and flavonoids like β-carotene, α-carotene, zea-xanthin, and lutein (USDA). All these acts as protective

scavengers against oxygen-derived free radicals and reactive oxygen species (ROS) which act against cancer, aging and other diseases. It is effectively utilized in Ayurvedic medicines. It is a day-neutral plant, monoecious and herbaceous annual climber. It generally has male flowers more than the female flowers with a mean ratio of 19:1 or 25:1. Anthesis starts between 3.30 am to 7.30 am and receptivity of stigma lasts up to 24 h after anthesis (Deyto and Cervancia, 2019).

The Monoecious nature of bitter gourd crops requires pollinators for pollination and seed set. The presence of more staminate flowers favours efficient pollination. Pollinators are attracted by the bright yellow-colored flowers. Honey bees are the predominant pollinator in the bitter gourd cropping system. In successful pollinated condition, fruit development starts from second to fifth day and develops into an entire fruit. Insufficient pollination leads to flower drops or development of irregular shape fruits, which later turn yellow and fall off. Recent observations show that the fruit yield was 78% under open pollination and 80% in hand pollination conditions but higher fruit weight was reported in insect-pollinated condition (Deyto and Cervancia, 2009). Hence, the field study was conducted, to observe the foraging activity, pollination efficiency and colony growth parameters of the managed bee-pollinated condition of *T. iridipennis* in bitter gourd.

MATERIALS AND METHODS

Pollination potential of managed stingless bee, *T. iridipennis* in enhancing the yield of bitter gourd was conducted in farmer's field at Coimbatore district in Southern India, at an altitude of 430 m above the MSL, at 10˚ 58' 46.164" N latitude and 76˚ 55' 53.562" E longitude. Bitter gourd is a direct sown vegetable crop cultivated in pandal system. Surrounding crops in nearby fields were Coconut, Areca nut, Tomato. For this study, the observation of ten randomly tagged plants and three flowers per plant was monitored at weekly interval.

Foraging activity of *T. iridipennis* on bitter gourd

Pollinator abundance was recorded as number of foragers/ flower/ minute and foraging rate was recorded in both male and female flowers as average time spent by the individual bee pollinators/ flower/ minute (Fig. 1). Observations were taken at weekly intervals and the timings were recorded using stop watch during peak activity of pollinator. Peak foraging activity was recorded at an hourly interval from 06:00-18:00 h number of foragers visited/flower for a period of five minutes at fortnightly intervals (Yogapriya *et al.* 2019).

Pollination efficiency index

The foraging bees visiting the bitter gourd flowers during peak foraging time between 08:00 and 10:00 h were collected using a sweep net and were transferred to a glass vial containing 70% alcohol, shaken vigorously to unload the pollen grains from their body (Fig. 2a). The volume made up to 5 ml by adding distilled water and from this aliquot 0.01 ml was taken and placed over a hemocytometer and observed under a stereo zoom microscope (Fig. 2b). A total of five observations were made and the total number of pollen grains in 5 ml of solution was calculated (Balina *et al.* 2012).

Pollination efficiency index= No. of loose pollen grains on the body × foraging rate × abundance of the pollinators on flowers.

Evaluation of pollination potential of managed stingless bees

The pollination potential of managed stingless bees in enhancing the yield of bitter gourd was assessed for *T. iridipennis.* The experiment was conducted in a randomized block design with three treatments and seven replications. In each replication, ten flowers from five plants were selected and observations were recorded at periodical intervals. The treatments are T1 pollinator exclusion, female flower buds were covered with sleeve net cages (Fig. 3) before blooming to prevent the entry of pollinators accessing the flowers and one week after flowering the cages were removed, T2 bee pollination, two colonies of stingless bees were shifted and placed in bitter gourd field selected (Fig. 4), at 10% of the flowering stage of the crop and T3 open pollinated condition was controlled.

Yield parameters

Number of fruits per plant, fruit weight and yield

In tagged plants, the number of fruits was counted, and the mean fruit set was noted. Randomly picked fruits from tagged plants were weighed separately using a weighing scale, and the weight of the fruits was noted. Each tagged plant's fruits were harvested, weighed, and the yield per hectare was computed.

Colony growth parameter of *T. iridipennis* in bitter gourd field.

Colony growth of stingless bees was taken by calculating the initial and final weight of the shifted colony at 15 days intervals (Fig. 5a & 5b).

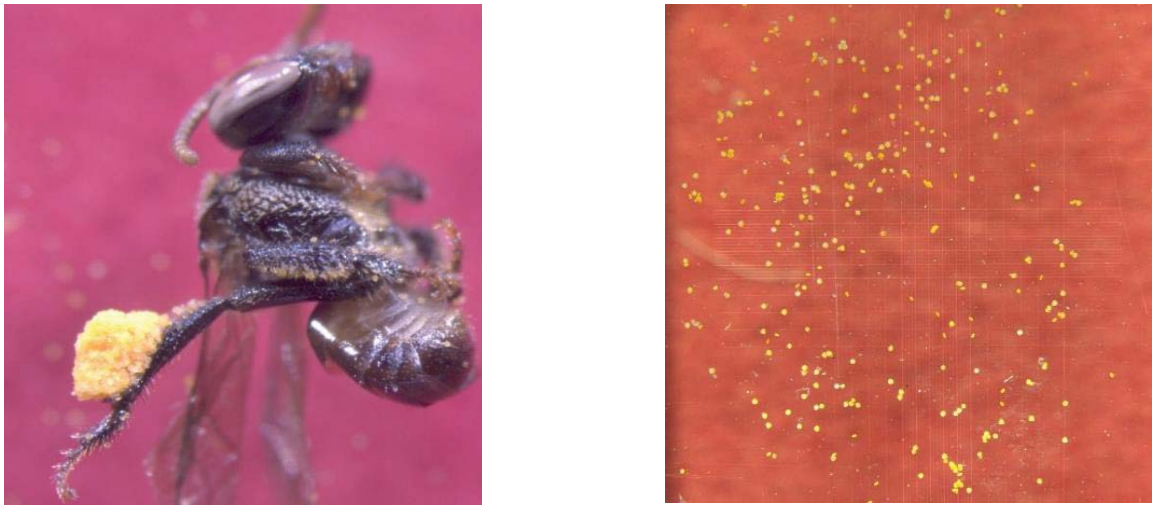
Foraging activity at the hive entrance

The foraging activity of *T. iridipennis* at the hive entrance was counted as the number of returning foragers with nectar, pollen and the number of outgoing bees for the day during 08:00-10:00, 12:00-13:00 and 16:00-18:00 for a period of five minutes was recorded (Fig. 6).

Statistical Analysis

The recorded data were analyzed using the ANOVA (Analysis of Variance) and least significant difference (LSD) performed at P=0.05 levels of significance. Other calculations are computed using MS Excel.

Figure 1. Foraging activity of Stingless bee on bitter gourd



(2a) Bitter gourd pollen collected in corbicula **(2b) Loose pollen grains counted using hemocytometer**

Figure 2. Pollination efficiency Index of stingless bee

Figure 3. Sleeve cage

Figure 4: Stingless bee colony placed in bitter gourd field

(5a) Colony growth after 15 days

(5b) Colony growth after 30 days

Figure 5. Colony growth of stingless bees in bitter gourd field

Figure 6. Foraging activity at the hive entrance

(7a) Pollinator exclusion (7b) Bee pollination (7c) Open pollination

Figure 7. Fruit set in different modes of pollination

RESULTS

The findings indicated that *T. iridipennis* activity was higher in bitter gourd male flowers (1.71 bees/ flower/ minute) than female flowers (1.22 bees/ flower/ minute). The stingless bee population was abundant on the 75th day in male flowers (2.53 bees/ flower/ minute) and female flowers (1.82 bees/ flower/ minute), and found minimum during the 15th day of the flowering period (1.05 bees/ male flower/ minute and 0.54 bees/ female flower/ minute) (Table 1).

The average time spent by a forager per male flower was 37.86 seconds and in female flowers was 25.73 seconds. The floral handling time for the collection of rewards by a forager per flower was maximum on the 75th day in male flowers (43.1 seconds) and female flowers (32.4 seconds) (Table 2).

The observations on the peak foraging activity of *T. iridipennis* revealed that the peak activity of stingless bees occurred from 06:00 to 12:00 h (number of foragers/flowers/5 minutes). Maximum activity was (3.30 bees) observed during 08:00–10:00 h followed by 06:00–08:00 h (3.04 bees) and at 10:00–12:00 h (2.77 bees) (Fig. 8). Overall activity of bees between 13.00-16.00 (0.55 bees). The number of foragers visiting per flower gradually declined during evening hours with a minimum activity at 16:00-17:00 h.

Pollination Efficiency Index (PEI)

The number of loose pollen grains adhering on a *T. iridipennis* collected while foraging on bitter gourd flowers was 41600 pollen grains. The pollination efficiency index of *T. iridipennis* was worked out by multiplying the number of loose pollen grains counted with the abundance of pollinator (1.71) and by foraging rate (37.86 seconds) (Table 3) Pollination Efficiency Index of *T. iridipennis* was 26,93,208.96 pollen grains.

Foraging activity of *T. iridipennis* at the hive entrance

The foraging activity of *T. iridipennis* was observed at the hive entrance in a day at different time intervals. The result showed that the mean number of outgoing bees was higher (38.76) and maximum during 08:00 – 10:00 h (Table 4). Among the incoming forgers, the nectar foragers were more (36.39), than pollen foragers (13.6). Forager movement was high at 08:00 to 10:00 h (41.16) followed by 12:00 to 13:00 h(25.4) and compared to evening hours 16:00 to 18:00 h(25.53).

Colony growth of *T. iridipennis*

The colony growth parameters of two *T. iridipennis* colonies placed in a bitter gourd field at Coimbatore district were periodically observed. The initial weight of the colonies before shifting to the bitter gourd field was 1397 g. After shifting the average weight of the colonies increased to 1464.5 g. The colonies gained 4.8% weight during the study period in bitter gourd (Table 5).

Effect of *T. iridipennis* on Pollination and Yield of bitter gourd

The observations on different treatments of pollination were given in Table 6. The bee pollination plot placed with two stingless bee colonies recorded significantly high fruit set of 18.2 fruits/plant while the open pollination plot recorded 16.5 fruits/plant (Fig. 7b &7c). The fruit weight was also higher (261.6 g/fruit) in the bee pollination plot compared to open pollination condition (250.7 g/fruit) and the fruits formed were 4.3 % heavier in weight under bee pollination than open pollination. The fruit yield recorded in the bee pollination plot was 44.08 t/ha compared to open pollination plot of 38.30 t/ha. The fruit yield obtained in the bee pollination plot was 15.09 % more than the open pollination plot. In pollinator exclusion treatment, no fruit set was observed under sleeve caged condition (Fig.7a).

Table 1. Abundance of *T. iridipennis* in bitter gourd flowers

	No. of foragers/flower/min								
	15th day	**30th day**	**45th day**	**60th day**	**75th day**	**90th day**	**105th day**	**120th day**	**Mean**
Male flower	1.05±0.02*	1.16±0.09	1.40±0.05	1.9±0.23	2.53±0.34	2.35±0.12	1.92±0.16	1.36±0.09	1.71
Female flower	0.54±0.01	0.72±0.14	1.19±0.17	1.16±0.02	1.82±0.23	1.70±0.23	1.32±0.4	1.28±0.19	1.22
Mean	0.80	0.94	1.30	1.53	2.18	2.03	1.62	1.32	1.46

Note: *Mean of 10 plant observations. Values followed by ± indicated standard deviation.

Table 2. Foraging activity of *T. iridipennis* in bitter gourd flowers

	Time spent by a forager/flower/min (seconds)								
	15th day	**30th day**	**45th day**	**60th day**	**75th day**	**90th day**	**105th day**	**120th day**	**Mean**
Male flower	33.2±1.6*	34.7±1.3	38.1±0.8	38.4±1.10	43.1±1.32	40.5±1.89	40.1±1.52	34.8±1.45	37.86
Female flower	19.3±1.5	22.6±2.5	25.2±2.6	31.31±1.1	32.4±1.98	29.4±2.3	25.3±0.52	20.39±0.6	25.73
Mean	26.23	28.64	31.65	34.86	37.75	34.95	32.72	27.6	31.80

Note: *Mean of 10 plant observations. Values followed by ± indicated standard deviation.

Table 3. Pollination efficiency index of *T. iridipennis* in bitter gourd

Bee species	Abundance (No. of foragers/ min)	Foraging rate (Foraging activity in flower /seconds)	Number of loose pollen grains on the body*	Pollination index (Abundance × Foraging rate × Loose pollen grains)
T.iridipennis	1.71	37.86	41600	26,93,208.96

Note: *Mean of five observations under stereo zoom microscope

Table 4. Foraging activity of *T. iridipennis* at hive entrance

Foraging Time	0800-1000h	1200-1300h	1600-1800h	Mean
Incoming nectar forager	49.78* (7.049)^{a}	23.7 (5.45)^{b}	45.7 (6.75)^{a}	36.39
Incoming Pollen forager	22 (4.68)^{a}	14 (3.74)^{b}	4.8 (2.17)^{c}	13.6
Outgoing bees	51.7 (7.181)^{a}	38.5 (6.203)^{b}	26.1 (5.098)^{c}	38.76
Mean	41.16	25.4	25.53	-

Note: *Mean of five observations; Figures in parentheses are $\sqrt{(x+0.5)}$ transformed values.

In rows means followed by different letters are significantly different at 5% level LSD

Table 5. Colony growth parameter of *T. iridipennis* colonies placed in bitter gourd field

Period of observations	Weight of the colony (g)*	Per cent increase in colony weight
Initial weight	1397.0	-
15th day	1421.5	1.75
30th day	1446.0	3.5
45th day	1464.5	4.8

Note: *Mean of two colony observations

Table 6. Effect of different mode of pollination on bitter gourd yield

Modes of pollination	No. of female flowers Observed	No. of picking /plant*	No. of fruits /plants*	Fruit weight (g)*	Per cent increase in fruit weight	Yield of 10 plants (kg)*	Yield (t/ha)	Per cent increase in yield (t/ha)
		0	0	0	-	0	0	-
Pollinator Exclusion	350	(0.71)^{c}	(0.71)^{c}	(0.71)^{c}		(0.71)^{c}		
Bee pollination		14.77	18.2	261.6	4.3	47.54	44.08	15.09
T. iridipennis	350	(3.9)^{a}	(4.34)^{a}	(16.2)^{a}		(68.96)^{a}		
Open pollinated condition		10.86	16.5	250.7	-	41.36	38.30	-
	350	(3.55)^{b}	(4.23)^{b}	(15.8)^{b}		(63.23)^{b}		
S.E (d)		0.013	0.026	0.055	-	0.69	-	-
C.D. (P=0.05)		0.03	0.060	0.13	-	0.314	-	-

Note: *Mean of five observations. Figures in parentheses are √(x+0.5) transformed values.

In column, means followed by letters are significantly different at 5% levels of LSD.

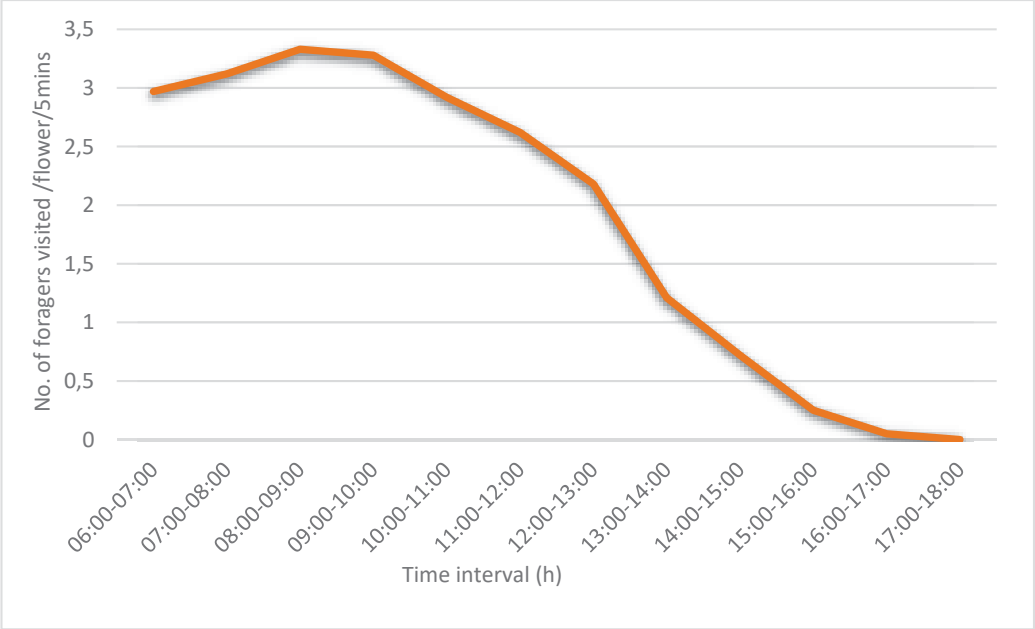


Figure 8. Peak foraging activity of *T. İridipennis*

DISCUSSION

The abundance and peak foraging activity of *T. iridipennis* on bitter gourd flowers was 2.18 bees/ flower/ minutes and 37.75 seconds respectively and it was recorded on the 75th day of the flowering period. *T. iridipennis* activity was higher in bitter gourd male flowers (1.71 bees/ flower/ minute) than female flowers (1.22 bees/ flower/ minute) are due to male flowers produce both pollen grains and nectar whereas female flowers produce only nectar. Pollinator spent more time for pollen collection than nectar was reported by Bomfim *et al.* (2015) The present study exhibits the maximum activity of bees during peak flowering time which is in agreement with the results of Yogapriya *et al.* (2019) who also reported that the abundance of *T. iridipennis* in bitter gourd flowers was 2.78 individual/ 5mins/ m^2. Subhakar and Sreedevi (2015) also stated that *T. iridipennis* was the most abundant flower visitor.

The foraging activity of *T. iridipennis* was at its peak during 08:00–10:00 h (3.33–3.28 seconds) in accordance with Subhakar (2011) who reported that peak foraging activity of *T. iridipennis* occurred during 09:00 h (24.41bees/m^2/5minutes) followed by 10:00 h with (21.40 bees/m^2/5minutes). Yogapriya *et al.* (2019) also recorded that maximum foraging activity was observed at 08:00 – 10:00 h (6.26/ m^2/ 5min). A similar observation was also reported by Deyto and Cervancia (2009) who recorded maximum foraging activity of *T. iridipennis* at 0630 h and the time spent per flower was 23.23 seconds. Similarly, Chauhan *et al.* (2021) also reported maximum activity at 08:00 h (31.66 bees) and minimum activity at 10:00 h (29.33 bees) in Nagaland.

The pollination efficiency index of *T. iridipennis* (26,93,208.96) was higher compared to *A. cerana indica*. Pangestika *et al.* (2017) also recorded similar observations that the pollination efficiency of three different species of stingless bees with a higher number of pollen grains in *Heterotrigona itama* (31392 pollen grains) followed by *Lepidotrigona terminate* (23017 pollen grains) and *T. laeviceps* (8015 pollen grains).

Stingless bee colonies placed in a bitter gourd field recorded a significant increase in the weight of the colonies from 1397 g to 1464.5 g. Previously Vasanthakumar *et al.* (2015) also reported that the colony growth of stingless bees placed in mango orchards has a substantial increase in colony weight from 1514.67 g to 1611.67 g in two months period of mango flowering.

Maximum activity of incoming nectar foragers, pollen foragers and outgoing bees was observed from 08:00 to 10:00 h (41.16) due to the synchronization of bees activity and flower opening time. Lintu *et al.* (2020) reported similar observations in cucumber where the incoming and outgoing foragers were maximum at 13:00 to 14:00 h (67.0 and 58.0 respectively).

Managed bee pollination with *T. iridipennis* resulted in an increased number of fruits per plant, fruit weight and yield in bitter gourd than in open pollination plots as Layek *et al.* (2021) also reported that managed bee pollination of *T. iridipennis* in water melon increased the fruit set by 14%. and fruit length 26.04 cm compared to open pollinated condition (24.48 cm), yield of watermelon also significantly increased (36.05%) after the introduction of stingless bee colonies for pollination. Bisui and Layek (2020) reported that the number of fruit sets and the yield was a maximum of 86±11.74 in managed bee pollination with *T. iridipennis* compared to open pollinated condition (75±12.69).

Conclusion

The lower yield of bitter gourd is caused by a pollination deficit under open pollination conditions. The cross-pollination activity of *T. iridipennis* in bitter gourd, significantly improved the yield. During the experimentation period, *T. iridipennis* colony growth also increased. Therefore, managed bee pollination of *T. iridipennis* is a successful approach for farmers and beekeepers to increase the yields of bitter gourd and honey, respectively.

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