Hardun, *Laudakia stellio,* A Serious Honey Bee Natural Enemy and Its Control in North Sinai

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Received: *5 /5 / 2008*

Abstract: Consumption of bees and other insects by adult males and females hardun, *Laudakia stellio*, caught during summer months in Rafah locality during two successive years (2005 and 2006), was studied using a total of 30 specimens for each sex. Classification of stomach contents of the dissected animals showed that out of 54.25 and 50.75 ingested insects by hardun males and females, 48.75 and 42.50 were honeybee individuals, representing 89.86 and 83.74%, respectively. This ensures the importance of this lizard as a serious honeybee predator in Rafah locality. The efficiency of traditional nets and traps for catching hardun, was also evaluated in Rafah locality during the same seasons. Obtained results revealed that, the highest efficiency of nets and traps 10.10 & 4.04% and 7.49% & 4.07% was recorded in June 2005 and June 2006, respectively, representing the total percentages of 14.14% and 11.56%, respectively. In spite of the efficiency of net as compared with traps, both tools were inefficient for catching hardun. So, it is advised to find out other methods to minimize the population of hardun around the apiary to protect bee colonies from its attack. On the other hand, the presence of nets around the experimental apiary for catching hardun caused an obvious increase in the mean amount of stored honey by 68.48%.

Keywords: Hardun, *Laudakia stellio,* Honeybee, Natural enemies, efficiency, nets, traps, Protection.

INTRODUCTION

Many amphibians and reptiles are primarily insect predators, but only a few species are known to eat bees in significant numbers. Apparently, bee stings deter virtually all of the smaller reptiles and amphibians, and most of the larger ones specialize in larger prey. Lizards are apparently the only reptiles recorded as bee predators and most accounts are anecdotal. In 1982, Seeley *et al.,* found agamid lizards preying on different honey bee species such as *Apis cerana*, *A. dorsata* and *A. flora* in Thailand. These reptiles are also found in India (Gandheker, 1959), in the southern coastal plain of North Colombia (USA) and in Khartuum, Sudan (Ambrose, 1975), in Zimbabwe (Papadopoulo, 1964). The agamid lizard, *Laudakia stellio* or (hardun), as it is locally known, is widely distributed in North Egypt (Ibrahim, 2002) and Sinai desert (Al-Johany, 1995). In North Sinai, it is represented by two subspecies *L. s. vulgaris* and *L. s. savigni* which inhabit the narrow Mediterranean costal area, where they are common on rocky grounds, buildings, ruins and olive plantations in El-Arish city, extending eastward to Rafah (Ibrahim, 1990).

Hardun, *Laudakia stellio* was referred to as a natural enemy of honeybees in North Sinai by El-Bassiony (2001). But no specialized studies have tackled hardun as a serious honeybee pest that causes damage to many apiaries. Continuous observations of the behaviour of this lizard showed that it didn't only feed on foraging worker bees but also entered inside the colony and swallowed great numbers of nurse bees in addition to the queen and hence destroyed the entire colony. The purpose of this study is to shed lights on hardun's preference for honeybee individuals for its feeding in Rafah locality through analysis of stomach contents, and to evaluate the efficacy of nets and traps in controlling this lizard and protecting honeybee colonies against it in North Sinai Governorate. In addition to calculating the rate of increment in the amounts of stored bee honey in colonies protected by nets.

MATERIALS AND METHODS

Field experiments were conducted in the apiary of Honey Bee Research center in Rafah locality during the seasons of 2005 and 2006. The apiary occupied a total area of 150 m² and was surrounded by fence to obtain a total area of 400 m². A number of pillars was situated around the apiary to fix the doubled net in order to capture hardun individuals. The following Two methods were evaluated to protect honeybee colonies against hardun:

The first method was conducted by using the thready nets. These nets were composed of two layers; the external layer had big holes (8×8 cm) and the internal one had small ones (2×2 cm). The nets height was 50 cm above the apiary ground. Harduns caught in between the two layers were collected by hands and their numbers were recorded during the experimental seasons.

Another method for controlling hardun was conducted by using stainless steel wire traps, each measured 40×15×10 for length, width and height, respectively, with a movable door. An attractive food, such as some live honeybee workers on a piece of wax, was put in the trap and the door was opened. When hardun entered the trap trying to eat the bees, the door was immediately shut and the reptile was caught.

Twenty traps were situated in the four directions around the experimental apiary at a distance of 2m between each other. Five traps were put in each direction. The number of reptiles caught in each trap was recorded during the whole period of the experiment.

A total of 60 adult male and female *Laudakia stellio* individuals captured either by nets or traps form the area surrounding the experimental apiary in Rafah locality during summer months of the experimental seasons, were transferred to the laboratory in El-Arish for dessection.

Samples were taken in the morning (from 8 a.m. to 11 a.m.) following the preliminary observation that *L. stellio* generally feeds during this period and the digestion is not yet advanced (Düşen and Öz, 2001)

Soon after capture, the lizards were directly anesthetized with ether in glass containers. The total body length, the head length and width, neck width, abdomen width, tail length and width, and lengths of fore and hind limbs for both male and female individuals were obtained during the experimental seasons

The lizards were then labeled, and kept, in deep freezer, at –20°C. Later, after thawing, animals' guts were dissected, according to the method adopted by Lamb (1984), using surgical scissors and forceps. The gut of each animal was picked up, weighed and its content was taken for investigation. The empty gut was reweighed. The indigested material of the gut was classified into remains of worker and drone honeybees, as well as other insect species according to their head capsules. The obtained data were recorded.

RESULTS AND DISCUSSION

Hardun feeding and its food preference:

After dissection, the stomach content of female was slightly heavier than that of the male. Means of 5.08 and 5.45 g were recorded for the stomach contents of male and female adult harduns, which were mainly indigestible parts of insects like head capsules, wings and cuticular segments, in addition to few amounts of herbs. In the present work, the stomach contents of the dissected animals were classified to bee remainders and other insect remainders. The classification in this study depends upon the numbers of head capsules in the stomach lumens.

The data given in Table (1) show that out of 54.25 ingested insects by male hardun, 48.75 were honey bee individuals, representing 89.86 %. In case of female, the total number of ingested insects was 50.75 of which 42.50 were honey bee individuals representing 83.74 %. This means that hardun prefers insects for its feeding especially honey bee individuals in Rafah locality. On the other hand, males consumed more insects than females. This may be due to the high activity of male as compared with female.

According to Atatür and Göçmen (2001), *L. stellio*, in Turkey, feeds mainly on insects, but can also ingest some plant material. Al- Johany (1995) in Saudi Arabia, recorded that lizards feed mainly on ants which are very abundant in their habitat and plant materials. Düsen and Öz (2001) in Turkey, identified a total of 1224 prey items in the guts of *L. stellio*. The majority of diet consisted of the class Insecta (99.18%) and within this class, hymenopterous insects (72.21%) were the major preys, primarily by the families Formicidae (49.83%) and Apidae (16.74%). The same authors added that in addition to insects, *L. stellio* feeds on plant materials, insect larvae and eggs, and even snails.

The present results indicate that hardun is considered one of the most serious natural enemies of honeybee colonies. This lizard not only feeds on foraging worker bees but also enters inside the colony and swallows great numbers of nurse bees in addition to the queen and hence destroys the whole colony. so, apiarists must give attention to its control in North Sinai Governorate.

Efficiency of nets and traps in capture of hardun

The efficiency of traditional nets and traps for catching hardun found around the experimental apiary in Rafah had been studied to evaluate such techniques for controlling this predator fed mainly on honeybee individuals. The obtained results are summarized in Tables (2-3).

During 2005 year

As shown in Table (2), 297 animals were observed in June (the peak number allover the year of 2005), where 30 individuals were caught by nets and 12 only were caught by traps, representing the total number 42 individuals caught by both nets and traps. Therefore, the efficiency of both techniques for catching hardun was found to be very low. The data clearly showed that the efficiency of nets and traps in June, 2005 was only 10.10 and 4.04%, respectively, representing the total percentage of 14.14%. This means that about 86% of the observed hardun were not caught either by nets or by traps, and hence escaped in the area of the apiary attacking honey bee workers.

The statistical analysis of the data showed highly significant difference between the inspection months (Table 2). Irrespective of the used techniques for controlling hardun, the number of lizards caught during 2005 could be arranged into the following seven descending categories as being affected by the inspection months:

First category: June (42 lizards), Second category: July (37 animals), Third category: May and August (24 and 26 animals, respectively), Fourth category: September and November (20 and 17 animals, respectively), Fifth category: October (12 lizard), Sixth category: April (9 lizards), Seventh category: March and December (2 and 2 animals, respectively).

The statistical analysis also showed that nets caught a highly significant number of lizards during this year as compared with the corresponding figures caught by traps.

It is important to notice that the total efficiency of nets and traps during December, 2005, which reached 50%, was false. This was due to the lowest number of observed animals (4 individuals only) during this month and the number of caught animals by nets and traps was 2 and 0, respectively.

During 2006 year

The data in table (3), clearly show that 467 animals were observed in June, 2006, where the peak monthly number of hardun was obtained as compared with those in other months during the year.

On the other hand, 35 individuals were caught by nets and only 19 individuals were caught by traps, representing the total number of 54 individuals caught by both nets and traps.

The efficiency of both techniques for catching hardun was found to be very low (lower than values obtained in 2005 year). The calculated monthly efficiency of nets and traps for catching hardun given in Table (3) emphasized this result. The efficiency of nets and tarps in June 2006, were only 7.49% and 4.07% respectively, representing the total percentage of 11.56%.

Table (1): Consumption of bees and other insects by male and female hardun, *L. stellio* adults caught during summer months in Rafah (Means of 10 individuals for each sex ± s.e..

Aspects		Sex			
		Male		Female	
		Mean ± s.e.	Range	Mean ± s.e.	Range
Total body weight (g)		86.30 ± 7.760	64 – 100	81.68 ± 2.205	75.5 – 85
Weight of stomach (g)	Filled	9.73 ± 0.716	8 – 11.5	9.28 ± 0.357	9 – 10.7
	Empty	4.65 ± 0.380	3.9 – 5.6	3.83 ± 0.278	3.2 – 4.5
Weight of stomach contents (g)		5.08 ± 0.477	3.8 – 5.9	5.45 ± 0.516	4.5 – 7.5
No. of remained bees in stomach / animal*		48.75 ± 3.146	40 – 55	42.50 ± 1.443	40 – 45
No. of remained other insects in stomach / animal*		5.50 ± 1.708	2 - 10	8.25 ± 1.109	5 – 10
Total No. of remained insects in stomach / animal*		54.25 ± 2.016	50 – 59	50.75 ± 1.109	49 – 54
Percentages of remained bees in stomach		89.86 %		83.74 %	

* No. of insects was calculated according to the number of remained head capsules found in hardun stomach

Table (2): Monthly Population of hardun, *L. stellio* caught by nets and traps as compared with that counted by daily observation in the experimental apiary in Rafah during 2005 year.

Inspection dates	Animal account by observation	Animal account		
		By nets	By traps	Total
Mar.	5	1	1	2
		(20.00)	(20.00)	(40.00)
Apr.	52	6	3	9
		(11.54)	(5.77)	(17.31)
May	217	19	10	29
		(8.76)	(4.61)	(13.36)
Jun.	297	30	12	42
		(10.10)	(4.04)	(14.14)
Jul.	223	25	12	37
		(11.21)	(5.38)	(16.59)
Aug.	168	18	8	26
		(10.71)	(4.76)	(15.48)
Sept.	120	15	5	20
		(12.50)	(4.17)	(16.67)
Oct.	100	9	3	12
		(9.00)	(3.00)	(12.00)
Nov.	115	13	4	17
		(11.30)	(3.48)	(14.78)
Dec.	4	2	0	2
		(50.00)	(00.00)	(50.00)
Total	1301	138	58	196
		(10.61)	(4.46)	(15.07)
F. value between months = 86.43**			, L. S. D. at 0.05 = 4.51	
F. value between nets and traps = 359.02**				
F. value between months for nets = 28.91**			, L. S. D. at 0.05 = 2.95	
F. value between months for traps = 55.76**			, L. S. D. at 0.05 = 3.01	

** Highly significant

* Values between brackets represent the percentages of nets and traps efficiency for catching hardun, *L. stellio* as compared with the observed number of animals.

This means that about 88.5% of the observed hardun were not caught either by nets or by traps and left free in the area of the apiary.

The statistical analysis of the data obtained during 2006 clearly showed highly significant difference between inspection months (Table 3). Irrespective of the technique used for controlling the experimental lizard, the number of this animal caught during 2006 could be arranged into the following seven descending groups as being affected by the inspection months:

First group: June (54 animals), Second group: July (40 animals), Third group: May and August (34 and 32 animals, respectively), Fourth group: October (26 animals), Fifth group: September (20 animals), Sixth group: April and November (8 and 12 animals, respectively), Seventh group: March and December (0 and 1 animal, respectively).

As in case of 2005 experiment, the statistical analysis showed that nets caught more number of lizards than that of traps, with highly significant difference between both.

From the fore-mentioned results it could be concluded that nets and traps situated around the experimental apiary were not highly efficient for catching hardun and it is advised to find out other methods or tools to minimize the number of this lizard to protect bee colonies from hardun attack.

Amounts of stored honey in normal colonies and those protected by nets against hardun, *L. stellio*

From the fore-mentioned results, it could be concluded that nets was more efficient than traps for catching hardun from the area surrounding the experimental apiary. Therefore, nets were used to evaluate their efficiency for storing honey in the honeybee colonies.

The data obtained in the present study was recorded during the autumn season of 2005, 2006 years and summarized in Table (4).

As shown in this table, in non-protected colonies the amount of stored honey during the summer season was 150 and 165 kg / 50 colonies during summer season of 2005 and 2006 respectively. After protecting the colonies with nets the amount of stored honey apparently increased to reach 260 and 270 kg / 50 colonies representing the increase rates of 73.33 and 63.63 %, during the preceding years, respectively.

From the fore-mentioned data, it could be concluded that the presence of nets around the experimental apiary for catching hardun caused an obvious increase in the mean amount of stored honey by 68.48% (Table 4).

Table (3): Monthly population of hardun, *L. stellio* caught by nets and traps as compared with that counted by daily observation in the experimental apiary in Rafah during 2006 year.

Inspection dates	Animal account by observation	Animal account		
		By nets	By traps	Total
Mar.	0	0 (00.00)	0 (00.00)	0 (00.00)
Apr.	153	6 (3.92)	2 (1.31)	8 (5.23)
May	325	23 (7.08)	11 (3.38)	34 (10.46)
Jun.	467	35 (7.49)	19 (4.07)	54 (11.56)
Jul.	411	27 (6.57)	13 (3.16)	40 (9.73)
Aug.	275	20 (7.27)	12 (4.36)	32 (11.64)
Sept.	243	15 (6.17)	5 (2.06)	20 (8.23)
Oct.	273	17 (6.23)	9 (3.30)	26 (9.52)
Nov.	43	9 (20.93)	3 (6.98)	12 (27.91)
Dec.	3	1 (33.33)	0 (00.00)	1 (33.33)
Total	2193	153 (6.98)	74 (3.37)	227 (10.44)
F. value between months = 76.59**			, L. S. D. at 0.05 = 4.36	
F. value between nets and traps = 358.23**				
F. value between months for nets = 26.54**			, L. S. D. at 0.05 = 3.98	
F. value between months for traps = 54.41**			, L. S. D. at 0.05 = 3.26	

** Highly significant

* Values between brackets represent the percentages of nets and traps efficiency for catching hardun, *L. stellio* as compared with the observed number of animals.

Table (4): Amounts of bee honey (Kg) produced from 50 honeybee colonies in an apiary protected with net against hardun, *L. stellio* as compared with the amounts produced from the same number of non-protected colonies in Rafah locality during the summer season.

Dates	Amounts of honey from 50 colonies (Kg)		Rate of increment due to net (%)
	non-protected	protected by net	
Sept. 2005	150	260	73.33
Sept. 2006	165	270	63.63
Mean	157.5	265	68.48

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