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INTEGRATED MANAGEMENT OF *VESPA ORIENTALIS* IN HONEYBEE COLONIES AT ELSHARKIA GOVERNORATE

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ABSTRACT: ***This study was carried out in the experimental apiary of the Plant Protection Research Institute of the Sharkia branch, which was carried out during the period of 2015-2018. In this study, the results obtained as when compared with food attract of workers (honey bee solution) record highest captured efficiency of 66.5 insect / trap / week, and the tuna recorded 36insect. Paste of Pollen substitutes the highest hunting efficiency of the queens was 80 insect / trap and tuna recorded 16.3.Application of three different methods of control (suspension of traps + regular feeding + narrowing the hive entrance)the hive entrance was narrow using gypsum, a total loss of the proportion of hives as a result of the attack Hornet was 66.7%.and hive the regular feeding of the cultivars was carried out every week during the Hornet activity to strengthen the hive. Percentage of loss in the hives was 46.7%.and control was the highest loss with 80% of the hive. The loss of hives in Use of trap to control Hornet attack was 60% and control was the highest loss with 80% of the hives at the same time. Were the results the percentage of losses in the hive due to the attack of the hornet was 6.7% in this treatment and the control record was the largest percentage of 80% of the hive.***

Key words: ***Vespa orientalis, traps, integrated management.***

INTRODUCTION

The Oriental hornet (*Vespa orientalis* L.) is a social insect belongs to Family: Vespidae, it is a member of genus *Vespa* which constitutes the true hornets, building their nests underground and consisting of caste system dominated by the queen. Nests contain multiple combs in which the colony lives. Among insects, the oriental hornet is the most important honeybee predator in the world and particularly known to induce serious damages in apiaries. The hornets attack honeybee hives and some species can easily destroy bee colony.

The oriental wasp, *V. orientalis* is considered one of the most important pests to honey bee industry, as well as it attacks many fruit trees in Egypt (Ibrahim and Mazeed, 1967). The wasp attacks bee colonies resulted in destroying the colonies and reducing their productivity (Matheson *et al*., 1989 and Sihag, 1992 a).

The population activity of the hornet varied greatly according to prevailing weather factors and the time of the day (Sihag, 1992b and Yousef Khalil *et al.,* 2000).

In Egypt many authors (Sharkawi, 1964, Ibrahim and Mazeed 1967, Yousif Khalil, *et al.,* 2000, and Khater, *et al.,* 2001) reported that the activity of oriental wasps is very low in winter, spring and early summer and gradually increased reaching the peak of abundance in the autumn particularly during October. The number of wasps starts to fall off gradually during the second half of November and disappeared in the middle of December.

Different types of traps either baited or not baited for capturing oriental wasps

were used by Ibrahim and Mazeed (1967) who evaluated seven types of traps that currently used in Egypt, and found that the wooden trap recommended by Ministry of Agriculture in Egypt with honey baits was the most efficient one, followed by the ordinary tin-can trap.

Ahmed (1999) found that the use of Ministry Agriculture traps exhibited a higher fitness for the high season of hornet population than the hanged trap (Abou- Elezz trap).

Matheson *et al*., 1989, Sihag, 1992, El-Sherif, 2003 and Bacandritsos *et al*., 2006 found that the wasps attack foraging workers and guard bees at hive entrances and result in weakening strong colonies, minimizing their productivity.

Several studies have demonstrate the potential of various materials as an attractive agents and baits to enhance integrated pest management control program for the oriental wasps (Gomaa and Abd El-Wahab, 2006). Recently, Abdelaal and El-defrawy, (2014) evaluated the efficacy of new designed traps in the control of oriental hornet *Vespa orientalis* in Egyptian apiaries.

This study is an attempt to protect and reduce hornet attacks as a serious problem to honeybee colonies, as well as to evaluate the efficiency of some control methods of wasps using some natural materials as attractants.

MATERIALS AND METHODS

The experiments were carried out in the research apiaries of the Plant Protection Research Institute at Elsharkia Governorate.

I. Evaluation of four traps in hunting queen wasps:

1- Ordinary (wood) wire trap.
2- Trap of the hive box.
3- Water trap (plastic bottle 2 L that opens from above and fills attractor with water) when the hornet feeds on the attractor, it slips in and dies in water.
4- Sticker trap (a glass plate placed on white paper and placed on the glass adhesive (ultra-rat used in the control of rat) .

The traps were placed from the beginning of May until the end of June 2015 (eight weeks) and bee honey solution was 33.3% (1 : 3 water) . The attractant was changed every two days. Monitored queens in the traps were counted every week.

II. Evaluation of four traps in hunting worker wasps:

1 - Wire trap.
2 – Hive box trap.
3 - Water trap.
4 - Sticker trap.

Traps were observed along September and October 2015.

III. Evaluation of five food wasp-queen attractants:

1- Honey solution.
2- Pollen substitutes beans (1kg powder beans + 500 g dry yeast +6 kg sugar powder + 2.5 kg honeybee + 10 g cinnamon) served as a paste.
3- Fermented syrup sugar cane.
4- Tuna fish cuts.
5- Syrup sugar cane and was used to trap the ordinary (wood) wire and the experiment was carried out in apiary Agricultural Research Center the Plant Protection Research Institute of Sharkia Branch the during the season of 2016 from May to the end of June 2016. The traps were read every week and the attractor was changed every two days.

IV. Evaluation of five food wasp-worker attractants:

This experiment was carried out along September and October of 2016 season

where there were high activities of hornet workers in the apiaries of Plant Protection Research Institute of Sharkia Branch. Five different types of food attractants used to attract the Oriental hornet:

1- Honey solution.

2- Pollen substitutes beans.

3-Fermented syrup sugar cane.

4 -Tuna fish cuts.

5- Syrup sugar cane.

The ordinary wood wire trap was used, where 50 ml of each attractor was added, and the attractant was changed every 48 hours. The trap was examined and trapped hornets were counted every week.

V. Evaluation of control methods of the Oriental wasp:

The experiments were conducted at a private apiary in Zagazig locality along 2017 season using four methods in wasp control:

1- Narrow the hive entrance using gypsum:

Narrow the hive entrance using gypsum (5-6 mm) to allow bees to pass and prevent hornet workers from passing. The apiary was divided into two groups:

- **Group 1 consists of fifteen hives, divided to three replicates each with five hives and narrow the hive entrance using gypsum (5-6 mm).**
- **Group 2 (control) where hives do not narrow (12-15 mm).**

2- Using feeding sugar syrup during activity season of hornet:

The experiments were conducted at a private apiary in Zagazig locality along 2017 season.

The experiment was divided into two groups;

- **Group 1 consists of fifteen hives. It was divided into three replicates each with five hives, feeding syrup sugar every week along experiment.**
- **Group 2 consists of fifteen hives (control) where no feeding process was done.**

3- Use traps as a means of control of the Hornet:

The hive box trap was used to attract pollen substitutes during the season of May and June 2017 (active season queens hornet). The modified wire trap was used with the diluted honey during the activity season of the workers (September, October and November 2017). The experiment was consists of fifteen hives and carried out in a private apiary at Zagazig locality along 2017 season.

4- Integrated control of the Oriental hornet:

The experiment was carried out in the apiaries of the Agricultural Research Center of the Plant Protection Research Institute of Sharkia Branch during 2017 season using the three different methods of control (traps, regular feeding and narrow the hive entrance).

RESULTS AND DISCUSSION

1. Comparison of four trap types in catching wasp queens along 2015 season:

Data presented in Table (1) cleared that the hive box trap recorded the highest trapped hornet queens, with total number of 79.9 followed by water trap 59.7 followed by the normal wire trap 39.7, while sticker trap recorder the least one (29.6) with mean number of trapped queens as (10 a, 7.46b, 4.96c,and 3.7d) for the hive box trap, the water trap, normal wire trap and sticker trap, respectively.

2. Comparison of four trap types in catching wasp workers along 2015 season:

Data presented in Table (2) revealed that the new wire trap recorded the highest trapped wasp workers with the mean number of workers 226a workers/week, followed by the hive box trap 157.7b, and the water trap 132.3 c, while sticker trap recorder the lest numbers 108 d.

3. Comparison of four trap types in catching wasp queens along 2016 season:

Data presented in Table (3) recorded that the pollen substitutes registered the highest numbers of trapped queens where the total number of queens was (80) queens, followed by honey bee solution (54.8) and the fermented sugar solution (40.9), while the sugar solution (25.9) and the tuna (16.3) recording the least numbers. The mean number of trapped queens by different traps were (10a, 6.85b, 5.1c, 3.24d and 2e) for the pollen substitutes, honey bee solution, the fermented sugar solution, the sugar solution and the tuna, respectively.

Table (1): Efficacy of trap type on the number of trapped hornet queens attacking honey bee colonies of Zagazig locality during May and June 2015.

Date of observation		Average No. of queens / trap			
		Wire trap	Box trap	Sticker trap	Water trap
May	7/5	15	31.3	11.3	21.7
	14/5	9	20.7	7.3	16
	21/5	5.7	11.3	11	8
	28/5	2	4.3	1.7	4
June	4/6	3	5.3	2	4.3
	11/6	1.3	2	1	2.7
	18/6	1.7	2.3	1.3	1.7
	25/6	2	2.7	1	1.3
Total		39.7	79.9	29.6	59.7
Mean		4.96c	10.00a	3.70 d	7.46 b

L.S.D.0.05 between the mean number of captured queens by traps = 0.77

Table (2): Comparative studied on the effect of trap type on the number of trapped workers hornet attacking honey bee colonies of Zagazig locality during September and October 2015

Observation dates		Average No. of workers / trap			
		New wire trap	Box trap	Sticker trap	Water trap
September	7/9	117.3	83.7	50.7	66
	14/9	132	99.3	67.7	79
	21/9	178	103.7	75.7	89.7
	28/9	198	139	92	119.3
October	5/10	202.3	142	98.7	130.3
	12/10	242	174.7	119.3	143.3
	19/10	327.7	237.7	158.3	189.3
	26/10	410.7	281.3	201.3	241.3
Total		1808	1261.8	864	1058.3
Mean		226 a	157.7 b	108 d	132.3 c

L.S.D.0.05 between mean numbers of captured workers by traps = 7.70

Table (3): Attractive effect of food types on number of trapped hornet queens attacking honey bee colonies at Zagazig locality during May and June 2016.

Date of observation		Average No. of queens / trap				
		Honeybee syrup	Pollen bean	Fermented sugar cane	Sugar cane syrup	Tuna fish
May	7/5	20.7	27.3	12.7	8	5
	14/5	10.7	13.7	7.3	4.3	2.3
	21/5	8.7	10	5.3	3.3	2
	28/5	3	6	3.3	2.3	1
June	4/6	3.7	7.7	4.3	3	1
	11/6	3.3	5.3	3	2	2
	18/6	3	5.7	3	2	2
	25/6	1.7	4.3	2	1	1
Total		54.8	80	40.9	25.9	16.3
Mean		6.85 b	10 a	5.1c	3.24 d	2 e

L.S.D.0.05 between the mean number of captured queens by attractants = 0.94

4. Comparison of four trap types in catching wasp workers along 2016 season:

Data presented in Table (4) recorded that bee honey solution, attracted the highest trapped workers of 66.5 insect / trap / week, followed by the paste of the pollen substitutes 56 and the fermented sugar solution 48, while the sugar solution recorded 40 and tuna 36 insect / trap / week.

In addition, data was confirmed with that of Bacandritsos *et al*. (2006) who found that the use of the wood-glue trap in combination with the fish as a bait was a reliable solution for controlling the wasps in apiaries. Special attention should be paid to the time the fresh bait is placed because the performance of the traps is the best early in the day. Also the baits should be changed regularly (every 1-2 days) because the decomposition reduces the total number of wasps captured.

Also, the obtained data were agree with Dawara and Hatoom (2013) who found that hive with honey chamber trap was the best, with mean catch of 1191.94 insects per two months, and the worst was the cylindrical trap, with mean catch of 925.17 insects per two months. Cow lungs were significantly the best attractive bait in these two years (2181.89 insects in 2004 and 1375 insects in 2005). The least attractive bait was poultry guts (749.44 insects in 2004 and 446.33 insects in 2005). Mean catch in 2004 (1259.37 insects) was higher than that of 2005 (816.67 insects), and the number of collected wasps in the traps decreased by 35.15%, mainly due to the use of traditional control measures around the experiment site such as toxic baits and mechanical control.

5. Comparison of new wire and wire trap:

Data presented in Table (5) clear that mean number of workers / trap recorded (186.75a and 50b) wire wide trap and wire trap normal Res.

Table (4): Effect of food attracts on number of trapped workers hornet attacking honey bee colonies at Zagazig locality during September and October 2016.

Observation dates		Average No. of workers / trap				
		Honey syrup	Pollen bean	Fermented sugar cane	Sugar cane syrup	Tuna fish
September	7/9	47.3	42.3	39	34.3	33.3
	14/9	54.3	48	42	37.3	32
	21/9	61	51	45.3	39	34.3
	28/9	57.7	49.7	44	38.7	35.3
October	5/10	60	53	46	39.3	35
	12/10	71.3	59.7	50.3	40.3	37.3
	19/10	80	64.7	55.7	43.3	39.3
	26/10	100.7	79.3	62	48	42
Total		532	448	384.3	320.2	288.5
Mean		66.5a	56b	48c	40d	36 e

L.S.D.0.05 between the mean number of captured workers by attractants = 1.1

Table (5): Comparative studied on the effect of trap type on the number of trapped workers hornet attacking honey bee colonies of Zagazig locality during October and November (2018).

Date of observation		weekly average No. of workers / trap	
		wide wire trap	normal wire trap
October	7/10/2018	170.7	45.3
	14/10/2018	226.7	68.3
	21/10/2018	281.3	71.7
	28/10/2018	323	84.7
November	4/11/2018	298.3	73
	11/11/2018	113.7	34.3
	18/11/2018	53.7	16.3
	25/11/2018	25.7	5.7
Total		1492.4	398.9
Mean		186.75a	50b

L.S.D.0.05 between mean number of workers captured by wide wire and normal wire trap =14.35

The obtained results are in agreement with that of Ahmed (1999) who found that The mean number of hornet visiting baits were attracted mostly to fresh fish (88.3±3.03/h), followed by animal lung (77.00± 0.11/h). fresh honey (52.33± 1.45/h), fermented honey (43.67± 1.86/h) fermented sugar (43.00 ±1.15/h), dead bees (26.33 ± 3.76/h) baits.

6. Integrated control of *Vespa orientalis:*

6.1. Narrow the hive entrance using gypsum:

Data presented in Table (6) show that the hive entrance which was narrow using gypsum, gave a total loss of the proportion of hives as a result of the attack hornet as 66.7%, compared to the control which gave losses as 80% of the hives.

6. 2. Use of feeding as a means of control of the Hornet:

Data presented in Table (6) reported that the regular feeding of the cultivars was carried out every week during the hornet activity to strengthen the hive gave 46.7% loss in the hives, compared to control as with 80% loss of the hives.

6.3. Use of trap to control the hornet:

Data presented in Table (6) clear that the loss of hives in the treatment of using traps to control hornet attack was 60%, compared to 80% of the hives in control.

6.4. The use of three control methods:

Data presented in Table (6) clear that using of three methods of control (suspension of traps + regular feeding + narrow of the entrance hive), resulted only 6.7 % loss of hives, compared to control as 80% of the hives.

The obtained data agree with Wafa, *et al*. (1969) who found that control of the hornet *Vespa orientalis* Fab., was high when poisoned honey baits for application to hornets nests were applied, one containing 4.75% malathion gave the best control.

Data disagree with Bacandritsos, *et al*. (2006) who found that the use of the wood-glue trap in combination with the fish as a bait was a reliable solution for controlling the wasps in apiaries. Special attention should be paid to the time the fresh bait is placed because the performance of the traps is the best early in the day. Also the baits should be changed regularly (every 1-2 days) because the decomposition reduces the total number of wasps captured.

Table (6): Integrated control of *Vespa orientalis* hornet different methods of the period April, May, June, August, September, October and November 2017.

Control methods	No, of hive before treatment	No, of hive before treatment	No, of hive loses	Losses %
Narrow hive door	15	5	10	66.7%
Feeding	15	8	7	46.7%
Captured by trap	15	6	9	60%
Narrow, Feeding, Trapped	15	14	1	6.7%
Control	15	3	12	80%

The obtained data were in agreement with that conducted by Glaiim, *et al.* (2008) who covered the hive entrance with a piece of queen excluder to prevent the hornet from entering the hive. Also, the position of hive stand was reversed to deprive the hornet from using the flight board as a stage for waiting and creeping toward the defending bees. The second method was carried out by fixing a cardboard cone as a bee passage at the hive entrance to hinder the entry of the hornet into the hive. Both of these methods were found to be unsuccessful to control the hornet.

The data agree with Dawara and Hatoom (2013) who showed that, hive with honey chamber trap was the best, with mean catch of 1191.94 insects per two months, and the worst was the cylindrical trap, with mean catch of 925.17 insects per two months. Cow lungs were significantly the best attractive bait in these two years (2181.89 insects in 2004 and 1375 insects in 2005). The least attractive bait was poultry guts (749.44 insects in 2004 and 446.33 insects in 2005). Mean catch in 2004(1259.37 insects) was higher than that of 2005 (816.67 insects), and the number of collected wasps in the traps decreased by 35.15%, mainly due to the use of traditional control measures around the experiment site such as toxic baits and mechanical control.

The obtained data confirmed by Abd Al-Fattah *et al.* (2014) who used three modifications on hive entrance to protect honeybee colonies from the serious damage occurred by the predatory hornet, *Vespa orientalis* Fab. These modifications were large or small cuboid queen excluder (LCQE & SCQE, respectively) and a piece of queen excluder (QE) covered wintering entrance of the hive door, in comparison with unprotected colonies, (control). The numbers of predatory hornets attack SCQE and control colonies was significantly higher (6.8 & 6.7 hornets/col./3 min., respectively) than those attacking colonies supplied with LCQE and winter hole with QE, (6.0 & 6.3 hornets/col./3 min., respectively). The peak of hornet onslaught recorded during October and September (9.6 & 8.8 hornets/col./3 min., respectively). Unprotected colonies were significantly lost the highest number of bees by predation, (2.39 es /col./3 min.) in contrast with LCQE and SCQE (0.27 & 0.29 bees/col./3 min.) treatments. Sever attack resulted in extermination of control colonies within three weeks of September and colonies of QE through October. Good success was attained using LCQE and SCQE stabled over hive entrance which resulted in 100 % survival.

While, data disagree with Bassam, *et al.* (2016) who shows that the bottle trap was the most efficient in controlling the oriental wasp. This type of trap was able to catch high numbers of the oriental wasp the highest mean number of the oriental wasps collected by the bait using the bottle traps in the four locations was in sardine bait. The lowest mean numbers was in the chicken bait from the four locations with significant differences between the baits. The most attractive bait was in sardine. It gave large numbers in the traps in the four locations. This resulted in attraction of large numbers of the oriental wasps to the bottle trap during the 24 hours period. Sardine bait could be considered the most attractant for the oriental wasp in the four studied locations during the carrying out of the experiments of attractiveness, but only in the first 24 hours.

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المكافحة المتكاملة لدبور البلح الأحمر فى طوائف نحل العسل بمحافظة الشرقية

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الملخص العربي

تمت هذه الدراسة في المنحل البحثى ومنحل خاص بمعامل معهد بحوث وقاية النباتات فرع الشرقية خلال الفترة من ٢٠١٥-٢٠١٨ لدراسة المكافحة المتكاملة لدبور البلح الأحمر فى طوائف نحل العسل بمحافظة الشرقية.

حيث تم تقييم اربع أنواع مختلفة من المصائد لصيدالملكات وهى : ١- المصيدة السلكية العادية ٢- مصيدة صندوق الخلية ٣- المصيدة المائية ٤- المصيدة اللاصقة وتم وضع المصائد من بداية شهرمايو حتي نهاية شهر يونيو ٢٠١٥ (ثماني أسابيع) سجلت مصيدة صندوق الخلية اعلي كفاءة صيد حيث بلغ عدد الملكات المصادة ٧٩,٩ حشرة والمصيدة المائية ٥٩,٧ ثم المصيدة السلكية العادية ٣٩,٧ وأخيرا المصيدة اللاصقة والتى سجلت ٢٩,٦ .

كما تم تقييم استخدام اربع أنواع من المصائد لصيد الشغالات ١- المصيدة السلكية المعدلة ٢- المصيدة صندوق الخلية ٣- المصيدة المائية ٤- المصيدة اللاصقة وذلك من بداية شهر سبتمبر إلي نهاية شهر أكتوبر موسم ٢٠١٥ وكانت النتائج المتحصل عليها كتالي سجلت المصيدة السلكية المعدلة اعلي كفاءة صيد حيث بلغ عدد الشغالات المصطادة متوسط أسبوعي ٢٢٦ حشرة / الأسبوع والمصيدة صندوق الخلية ١٥٧,٧ ثم المصيدة المائية سجلت ١٣٢,٣ وأخيرا سجلت المصيدة اللاصقة ١٠٨ حيث كانت اقل كفاءة.

كما تم استخدام اربع أنواع مختلفة من الطعوم الجاذبة الغذائية المستخدمة في جذب ملكات الدبورمنها ١- محلول عسل نحل مخفف ٢- عجينة بدائل حبوب اللقاح ٣- محلول سكر متخمر ٤- قطع سمك تونة ٥- محلول سكري وتم استخدام المصيدة السلكية العادية خلال موسم ٢٠١٦ من بداية شهر مايو إلي نهاية شهر يونيو ٢٠١٦ وتم قراءة المصايد كل أسبوع وكانت النتائج المتحصل عليها كتالي سجلت عجينة بدائل حبوب اللقاح اعلي كفاءة صيد للملكات بلغ ٨٠ حشرة ومحلول عسل النحل ٥٤,٨ ثم المحلول السكري المتخمر سجل ٤٠,٩ وسجل المحلول السكري ٢٥,٩ وأخيرا سجل التونة ١٦,٣ حشرة وتم استخدام اربع أنواع مختلفة من الجاذبات الغذائية المستخدمة في جذب شغالات الدبور منها ١- محلول عسل نحل ٢- عجينة بدائل حبوب اللقاح ٣- محلول سكر متخمر ٤- محلول سكر عادي تم قراءة المصيدة كل أسبوع.

وأظهرت النتائج المتحصل عليها ان محلول عسل النحل سجل اعلي كفاءة صيد للشغالات بلغ ٦٦,٥ حشرة / المصيدة / الأسبوع وعجينة بدائل حبوب اللقاح ٥٦ ثم المحلول السكري المتخمر سجل ٤٨ وسجل المحلول السكري ٤٠ وأخيرا سجل التونة ٣٦ حشرة وتم تطبيق ثلاث طرق مختلفة من المكافحة (تعليق المصائد + التغذية المنتظمة + تضييق باب الخلية مع ترك فتحات صغيرة تسمح بدخول النحل دون الدبور) في نفس الوقت.

وكانت النتائج المتحصل عليها كتالي نسبة الفقد في الخلايا نتيجة لهجوم الدبور كانت ٦,٧٪ في هذه المعاملة (الثلاث طرق مكافحة مجتمعة في نفس الوقت) وكانت نسبة الفقد في الخلايا نتيجة لهجوم الدبور ٤٦,٧٪ في حالة التغذية المنتظمة فقط وكانت نسبة الفقد في الخلايا نتيجة لهجوم الدبور ٦٠٪ في حالة تعليق المصيدة فقط وكذلك نسبة الفقد في الخلايا نتيجة لهجوم الدبور كانت ٦٦,٧٪ في حالة تضييق مدخل الخلية باستخدام الجبس فقط وسجل الكنترول اكبر نسبة فقد بلغت٨٠٪ من الخلايا.

أسماء السادة المحكمين

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