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TIME APPEARANCE OF NON - INFECTIOUS CHILLED BROOD DISEASE AND ITS EFFECT ON HONEYBEE BROOD AND BEE FORAGING ACTIVITY

Hosafy, M. Eshbah - Yasmin, G. Mostafa - Darwish, M.
Plant Protection Dept., Faculty of Agriculture, Minia University, Egypt

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ABSTRACT

Climate changes especially temperature played a big role in the survival of honeybee. The present study evaluated the effect of chilled brood disease from three axes: relationship with temperature, brood area and foraging activity during the two successive winter seasons of 2019/2020 and 2020/2021. Results recorded negative relation between chilled larvae and inter/outer temperature: -0.8707 and -3.6313 for inter temperature, -0.3462 and 0.6065 for outer temperature in 2019/2020 and 2020/2021, respectively. On the other hand data showed significant decrease in mean area of larvae reared chilled brood diseases in bad wintering which showed 26.50 inch^2 comparing with 36.46 inch^2 in reared in perfect wintering (control) and brood area which reduced from 36.46 to 26.50 inch sq. and from 40.59 to 28.88 inch sq. in winter 2019/2020 and 2020/2021, respectively. Finally, foraging bee activity of bees in the obtained results showed high effect between chilled brood symptoms and foraging rate, which decrease the number of returned workers from10.71 to 6.88 bee/min. and from 13.00 to 8.21 bee/min. in seasons 2019/2020 and 2020/2021, respectively.

INTRODUCTION

Honey bee brood and adult stages of workers and drones exposed to non-infectious diseases such as chilled brood, neglected brood, starved brood, overheating, pesticide poisoning, plant poisoning and queen bee problems like caused by disease pathogens but its happens by other causes **(Sarwar, 2016)**. However, honey bee colonies contained individual bees, ranging from 15,000 to 60,000 **(Southwick and Heldmaier 1987)** but the brood may die from hypothermia **(Bonning and Miller 2010)**. Non-infectious diseases were included as genetic diseases such as dietary deficiencies that can caused by neglect, chilling, overheating, poisoning from plants or pesticides **(Calderone and Tucker 1997)**. Chilled brood was found at

the edges combs or cluster, where chilled larvae and pupae turned from white to yellow and finally became brown or black **(Jacobsen, 2008)** Bees controlled inside temperature to be ranged between 32 and 36 °C, where brood was located (**Stabentheiner, et al. 2010**). Also, **Tautz, et al. 2003** revealed that honey bee stages, larvae and pupae need temperature 35 °C to complete their development. When temperature raised at 32 °C showed different dances performance with only 20% of the dance circuits and a larger different in the duration of the waggle phase compared to normal workers. Honey bees kept their brood in order to protect them from changes of temperatures in the hive (**Stabentheiner et al. 2010**). **Petz et al. (2004)** found that in winter season bees displays advanced regulation of the nest climate. In addition, brood nest temperature of 32-36 constant development speed.

MATERIALS AND METHODS

Six Carnioilan honeybee colonies (*Apis mellifera carnica*) having equal strength (bees covered 6 wax combs), equal stored honey and pollen and located in Minia region, Egypt. Trails of the study were conducted through two successive winter seasons (2019/2020 and2020/2021).

Bad wintering: Three bee colonies in the same conditions were received bad wintering. Three hives were prepared to the trail by removing inter cover, division board and made small holes in its bodies and placed in shadow place containing bee colonies. The other three hives have received good wintering process reverse the process mentioned above were acted as control set **(Douglas, 1993)**.

Brood area: Colonies inspected at 12 day intervals over the season. The brood area was measured by using wired grad frame divided to 1.0 inch^2 **(De Jong, 1976)**.

Temperature measure: Two temperature places, inter brood nest and outer the hives were used to point their effect on child brood disease of the honeybee. Data of the average inter temperature over the season was obtained by glass thermometer (average two records for day 7 am and 3 pm). While the outer temperature was recorded from the meteorological station and the mean temperature was calculate by the average of minimum and maximum temperature **(Bonmatin et al., 2005).**

Monitoring foraging activity: Foraging activity was measured by the number of bees returning to the hive in a min. **(Pernal and Currie, 2010; Ali, 2011; Joshi and Joshi, 2010).**

Statistical analysis: Comparison between chilled brood percentage and each of brood area and foraging activity were evaluated based on unpaired T test at 5% level. Also, regression coefficient was accorded by method of **Mead et al. (1993)**.

REULTS AND DISCUSSION

Data in Table (1) and Fig. (1) showed that the highest mean % of dead larvae were 7.27 and 5.46% recorded at 14 January of the two studied seasons, respectively. In addition along with inter temperatures of 28 and 26ºC and out temperatures of 14.5 and 14 ºC in winter of 2019/2020 and 2020/2021, respectively. On the other hand, the lowest mean % of dead larvae were 0.02 and 0.06% which

recorded at March 15th along with by average inter temperatures of 34, 35ºC and out temperature 18, 20 ºC in 2019/2020 and 2020/2021, respectively. Regression coefficient between mean percentages and inter temperature were - 0.8707 and – 3.6313, which means that decreasing of inter temperature by one degree, due to increasing dead larvae percentage by 0.8707 and 3.6313% in winter 2019/2020 and 2020/2021, respectively. The same effected in out temperatures, decreasing of out temperature by one degree, due to increasing percentages by 0.3462 and 0.6065%, respectively. These results are in agreement with **Wang, et al. (2016**) and **Heinrich, (1993)**.

Results in Table (2) and Fig. (2) showed that colonies left in bad wintering caused decreasing brood area compared with perfect wintering from 36.46 to 26.50 inch sq. and from 40.59 to 28.88 inch sq. in winter 2019/2020 and 2020/2021, respectively supported with **Southwick, E. (1988)** and **Omran, (2011)**. The obtained results revealed high effect of perfect wintering process on brood area. Statistical analysis showed significant between bad wintering and perfect wintering in seasons 2019/2020 and 2020/2021 (P= 0.00035 and P= 0.00027, respectively).

The corresponding data in Table (3) and Fig. (3) showed that the beekeeper introduce heating for its apiary improve bee forging. The mean bee forgers with those colonies supplied with perfect wintering was 10.71 and 13.00 bee/min. compared with colonies subjected to low temperature for seasons 2019/2020 and 2020/2021, respectively. These data going agreed with that of **Joshi and Joshi (2010).** Statistical analysis showed high significant effect between bad and perfect wintering for the two seasons (P= 0.0091 and P= 0.0285, respectively).

Table (1): Mean dead percentage of dead larvae and inter/outer temperature during winter seasons of 2019/2020 and 2020/2021.

Date	2019/2020			2020/2021		
	% Mean dead larvae	Mean daily temperature ºC inside hive	Mean daily temperature ºC outside hive	% Mean dead larvae	Mean daily Temperature ºC inside hive	Mean daily temperature ºC outside hive
21-Dec	3.94	29	14.0	2.39	28	15.5
02-Jan	3.92	28	14.5	4.25	28	16.5
14-Jan	7.27	28	14.5	5.46	26	14.0
26-Jan	5.45	26	12.5	4.50	24	12.5
07-Feb	2.77	27	14.5	2.37	29	16.0
19-Feb	1.72	29	12.0	1.50	30	13.0
03-Mar	0.17	33	15.5	0.24	32	14.0
15-Mar	0.02	34	18.0	0.06	35	20.0
Reg. Dead L./ inside Temp.	-0.8707			-3.6313		
Reg. Dead L./ outside Temp.	-0.3462			-0.6065		

*Reg. = Regression coefficient L. = Larvae Temp.= Temperature

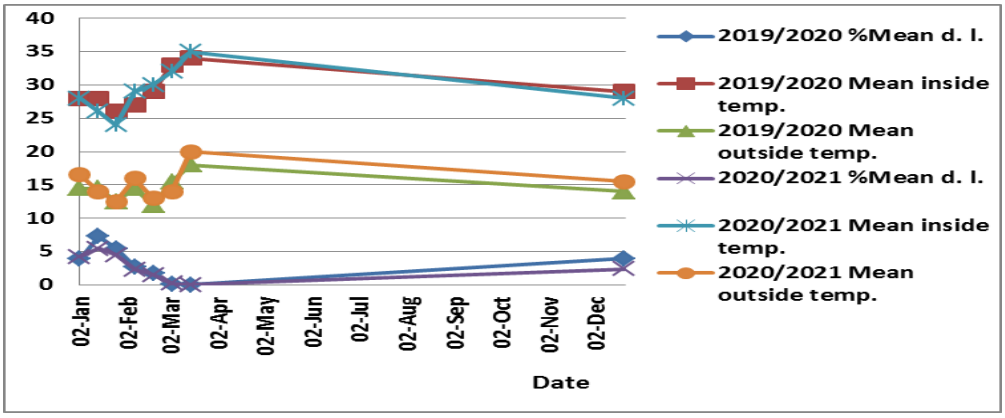

Figure (1): Mean dead percentage of dead larvae and inter/outer temperature during winter seasons of 2019/2020 and 2020/2021.

Table (2): Mean of brood area (inch^2) under bad and perfect temperature during seasons of 2019/2020 and 2020/2021 at Minia region.

Date	2019/2020		2020/2021	
	Brood area (bad wintering)	**Control (perfect wintering)**	**Brood area (bad wintering)**	**Control (perfect wintering)**
21-Dec	9.67	23.00	23.00	35.67
02-Jan	24.00	33.33	10.33	21.33
14-Jan	12.00	27.33	28.00	34.33
26-Jan	20.00	25.67	12.00	27.33
07-Feb	29.67	39.00	33.67	47.33
19-Feb	30.00	36.33	42.00	49.00
03-Mar	31.67	39.33	22.00	39.00
15-Mar	55.00	67.67	60.00	70.67
Mean	**26.50**	**36.46**	**28.88**	**40.59**
T test Calculated	7.226		7.594	
Probability (P)	0.00035		0.00027	

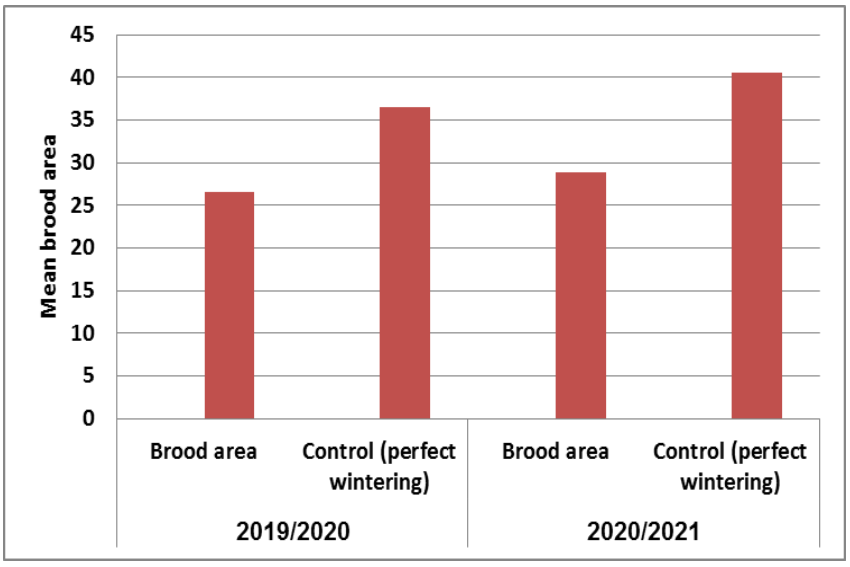

Figure (2): Mean of brood area (inch^2) under bad and perfect temperature during seasons of 2019/2020 and 2020/2021 at Minia region.

Table (3): Effect of bad wintering on foraging activity (n. bees returning to the beehive/min) during winter seasons 2019/2020 and 2020/2021 at Minia region.

Date	2019/2020		2020/2021	
	Bad wintering (Mean bees/min.)	**Control (Mean bees/min.)**	**Bad wintering (Mean bees/min.)**	**Control (Mean bees/min.)**
21-Dec	5.67	7.33	7.00	8.33
02-Jan	1.33	2.67	2.33	4.00
14-Jan	0.00	2.00	1.67	2.67
26-Jan	0.33	1.33	0.00	1.67
07-Feb	4.67	8.67	6.00	9.67
19-Feb	11.67	16.67	13.67	18.33
03-Mar	15.33	23.33	16.67	28.33
15-Mar	16.00	23.67	18.33	31.00
Mean	**6.88**	**10.71**	**8.21**	**13.00**
T test Calculated	3.781		2.866	
Probability (P)	0.0091		0.0285	

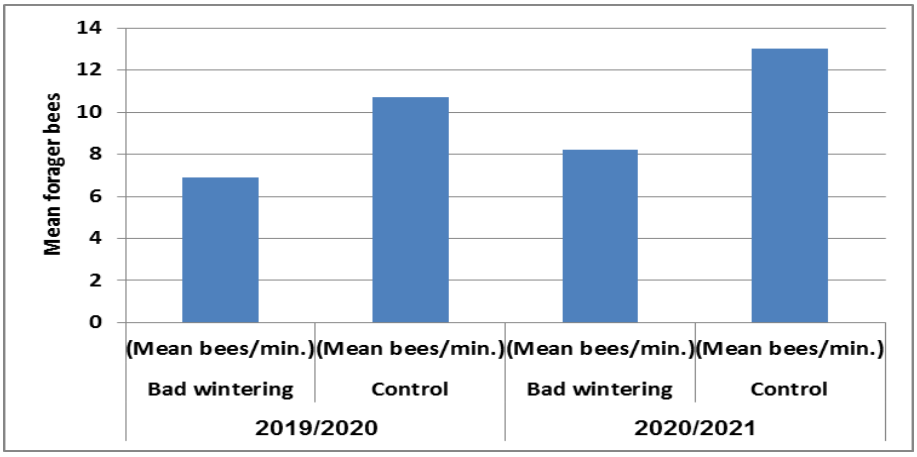

Figure (3): Effect of bad wintering on foraging activity (n. bees returning to the beehive/min) during winter seasons 2019/2020 and 2020/2021 at Minia region.

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الملخص العربي

توقيت ظهور مرض برودة الحضنة الغير معدي وتأثيره على حضنة نحل العسل ونشاط سروح النحل

حصافي محمد كمال الدين - ياسمين جمال مصطفى - محمود جمعة درويش

.قسم وقاية النبات – كلية الزراعة – جامعة المنيا – مصر

الملخص:

لعبت التغيرات المناخية وخاصة درجة الحرارة دورًا كبيرًا في بقاء نحل العسل. قيمت هذه الدراسة تأثير مرض برودة الحضنة من ثلاثة محاور: علاقة المرض بدرجة الحرارة، مساحة الحضنة ونشاط السروح خلال موسمي الشتاء المتتاليين 2020/2019 و 2021/2020. سجلت النتائج علاقة سلبية بين اليرقات الميتة بالبرد ودرجة الحرارة الداخلية / الخارجية: −0.8707 و −3.6313 للحرارة الداخلية، −0.3462 و 0.6065 لدرجة الحرارة الخارجية في 2020/2019 و 2021/2020 على التوالي. من ناحية أخرى، أظهرت البيانات انخفاضًا معنويًا في متوسط مساحة اليرقات المرباة بواسطة مرض برودة الحضنة في التشتية السيئة حيث أظهرت 26.50 بوصة 2 مقارنة بـ 36.46 بوصة 2 في فصل التشتية المثالية ومساحة الحضنة انخفضت من 36.46 إلى 26.50 بوصة مربعة ومن 36.46 إلى 26.50 بوصة مربعة. 40.59 إلى 28.88 بوصة مربعة في شتاء 2020/2019 و 2021/2020 على التوالي. أخيرًا، أظهر نشاط سروح النحل في النتائج التي تم الحصول عليها تأثيرًا عاليًا بين أعراض برودة الحضنة ومعدل السروح، مما قلل من عدد الشغالات العائدة من 10.71 إلى 6.88 نحلة/ دقيقة. ومن 13.00 إلى 8.21 نحلة/ دقيقة. في مواسم 2020/2019 و 2021/2020 على التوالي.