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Biology, seasonal incidence and the effect of the sowing dates on population density of the leafhopper, *Empoasca decedens* (Paoli) (Cicadellidae: Hemiptera) on cowpea in Iraq

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Key words: Cowpea leafhopper, *Empoasca decedens*, Seasonal incidence, sowing dates, Cowpea.

Abstract

The present experiments were conducted at laboratory and field of college of Agriculture, Baghdad University todiagnose the species (s) that attack cowpea fields and the nature of damage they cause and to study some aspect of biology and to assess, seasonal incidence and the effect of sowing date on leafhopper population density. Identification of the species were made by dissecting leafhopper male genitalia .While seasonal incidence and other experiment were done by estimation of randomly samples leafhopper numbers on cowpea plant leaves . Cowpea leafhopper was identified as *Empoasca decedens* which considered to be a new record on cowpea in Iraq. Laboratory studies showed that the incubation period of *E. decedens* was ranged between (6-7) days, the leafhopper had a 5 nymphal instars and the total nymphal period between (9-10) days, sex ratio were (2.0 F : 1.0 M) and adult longevity ranged between (17-20) days at 25°-30°C and 60-70 % RH . Results indicated that *E. decedens* had one peak of 8 nymph / leave on cowpea plants in November and another peak of 24 .8 nymph / leave occurred during mid of May. *E. decedens* population density were higher and caused significant damage and loss to the cowpea plants on spring season compared with autumn season. The fluctuation of the leafhopper population of each season depending mainly on daily temperatures. There were no significant differences in the population density of the 2 sowing dates, but a significant differences were recorded between a spring sowing dates, so it recommended to sow cowpea on the end of March.

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Introduction

Cowpeas *Vigna unguilata* L. is one of the most important legume crop grain are used mainly as food for humans, it is considered one of the main crops in the agricultural cycle and its increases fertility of the soil (Timkoand singh, 2008). The leafhopper *Empoasca decedens* has a small slender body and yellowish green coloration (Al-Asady,2002).It has considered generally as middle eastern countries species ,It has been recorded in Iraq , Iran ,Egypt , Jordan, Libya, Pakistan, Turkey (Ataken,2009) ,and in various western Asiatic countries such as India , China , North Korea and Slovakia (Haghighian and sadighia, 2001; Al-Asady, 2002; Kaya *et al* 2018). *E. decedens* have been recorded from more than 60 plant species belonging to 29 different families (Freitas and Aguin – Pombo, 2004). These host plants including herbaceous, ornamental and field crops and fruit trees.

The leafhopper *E. decedens* is a polyphagous species and consider as an important pest on several cultivated plants and fruit trees including field crop such as cotton, potato, raspberries and fruit trees such as almond, citrus and peach. *E. decedens* feeding on leaves cause discoloration , deformation of leaves leaf curling and necrosis of leaves form it apex to the base , this symptom usually known as " hopper burn " (Atakan, 2009).In Egypt, Hashem *et al.* (2009) studied the leafhopper species and their associated predators on some leguminous crop. Leafhoppers, *E. decedens*, *E. decipiens* and *cicadulina chinia* (Ghaui).

In Iraq , Al-azawii*et al*. (1990) listed the leafhopper, *Empoasca* sp is one of 4 insect species that attack cowpea in Iraq .Al- Asady (2002) studied external morphology of the leafhopper *E. decedens* paoil, particularly male genitalia which was dissected and illustrated . Al-Obaidi and Al-Gorani (2016) studied the resistance of some cotton cultivars to the leafhopper *Empoasca* sp. Al-Hasnawi (2017) estimated the population density, seasonal abundance and damage of the leafhopper *E. decedens* paoil on 4 corn cultivars.

Recently leafhopper caused a heavy infestation to cowpea fields in the middle of Iraq which we think it may be caused by *Empoasca* sp. This study has been conducted to identify, study some aspect of biology, population incidence and the nature of damage caused by leafhopper that attack cowpea cropped in Iraq.

Material and methods

Identification of cowpea leafhopper

Leafhopper adults was collected from cowpea infested plant by using sweeping net. Emptied into a polyethylene bags and placed in the freezer for about 30 minutes until they were killed. Males were separated from the Females by distinguishing them by their male genitalia on the end of the abdomen. Leafhopper specimens were labeled and sent to Dr. Hassan S. Al-Asady, Dept. of Biology, college of Ibn Al-Hay them for identification.

Biology, Nymphal period and adult longevity

Cowpea seeds (Ramshorn variety) were sown in small pots containing 1 kg of sterilized sandy loam soil and placed inside awooden cages (1.0 m height x 2.0m long) covered with muslin to prevent any pest infestation. After four weeks from cowpea seedling emergence about 100 of adult leafhopper were collected from infested cowpea plants and released into these cages and left for about 24 hours for egg laying on cowpea plants inside the cages. Cages covered were removed to let the leafhopper adults leave the cages .After that plants were monitored and examined daily until the appearance of about 50% of the first instar nymphs and used as a colony source of the leafhopper for biological studies. A glass petridishes (15cm x 3cm) with filter paper on it base were used to determine the nymphal period and adult longevity under laboratory conditions of (25-30°)C and(60-70) % Relative humidity (RH) (Jayaro *et al.*,2015, Al-Hamadany and Al-Karboli, 2017) .10 newly hatched first instar nymphs was carefully transferred by using fine camel brush to each 9 petri dishes with fresh cowpea leaves on it base for nymphs

feeding. Then petri dishes of this experiment were observed daily and new cowpea leaves were supplied every 48 hours. The experimental design was CRD with three replicating (three petri dishes / replicate). Nymphal period from the first instar to the fully development of the fifth nymphal instar was recorded for each replicate and the mean was used as nymphal period .Duration of the adult leafhopper from fifth instar to their death and sex ratio was recorded. This experiment was repeated twice and their means were used (Al-Hamadany and Al-Karboli, 2017).

Field experiments

This study was conducted during the cowpea growing seasonal 2017/ 2018 at the field of the college of Agriculture university of Baghdad / Al-Jadriya in Baghdad. All agricultural practices such as field preparation, irrigation, tillage, fertilization and crop service carried out according to cowpea crop cultivation (Matlub, 1997). Cowpea seeds (Rasmshonvariety) was sown in rows measuring 3 meter long with spacing of 75 and 40 cm between rows and plants respectively. Cowpea seeds was sown on 01 and 15 of August for the autumn season / 2017 and on 15 and 30 of March / 2018 for the spring season. Field experiments were laid out in a randomized complete Block Design (RCBD) with three replication and one row for each treatment.

Estimation of leafhopper population density

After cowpea seedling emergence, three cowpea plants was randomly selected from each replicating and three leaves (top, middle and lower) were selected from each cowpea plants and numbers of nymphs / leaf were counted (Mahmoud *et al* 2002 ; Latif *et al* , 2015) . Cowpea leafhopper sampling was carried out at 7 days intervals between germination to the end of the each season. Cowpea leaves with leafhopper nymphs were placed in a labeled polyethylene bags. Samples were put in the freezer for about 10 minutes to immobilize its movement before counting numbers by using a 4x magnifying lens (Al-Karboli and Al-Aanbaki, 2014).

Statistical analysis

Statistical analysis was done using the program Gen Stat Discovery Edition 12 and the differences between treatments means were compared using L.S.D. (P=0.05).

Result and discussion

Adult specimens of the cowpea leafhopper were identified by a specialist Dr. H. S. Al- Asady as *Empoasca decedens* paoil. Which considered to be new record on cowpea in Iraq. Result from Table 1 indicated that the period required for the development and hatching (incubation period) of the cowpea leafhopper *E. decedens* ranged from (6-7) days at a mean 7 day. Eggs are cylindrical and yellowish to yellowish green color. Mohammed and Yehia (2008) reportedan egg developmental time for *E. decedens* on potatoes leaves were ranged between (8-9) days which are slightly higher from our result.

Table 1. Some biological aspects of the cowpea leafhopper *E. decedens* paoil On cowpea.

Development stage	Development period	
	Range (days)	Mean (days)
Egg	6-7	7
1 st nymphal	1-2	2
2 nd	2	2
3 rd	2	2
4 th	2	2
5^{th}	2	2
Total nymphal duration	9-10	10
Adult longevity	17-20	19
Sex ratio	1 Male : 2 Famale	

Result indicated that *E. decedens* have a 5 nymphal instars and total period for nymphal development from 1st to5th instar were ranged from (9-10) days at a mean of 10 day, (Table 1) The first nymphal instar was yellowish – white color and compound eye was reddish-brown, the second nymphal instar was yellowish -green with reddish brown compound eyes and beginning of the a appearance of wing pad. Nymphs of the third instar was yellow with a small wing pads.

Table 2. Effects of sowing dates on population density of cowpea leafhopper, *E. decedens*.

Sampling Dates	No. of *E. decedens* during Autumn season 2017		Sampling Dates	No. of *E. decedens* during Spring season 2018	
	01/ August	15/ August		15/March	30/March
11/10/2017	1.5	3.73	16/4/2018	0	0
18/10/2017	3.86	4.13	23/4/2018	3.96	0
25/10/2017	5.56	6.2	30/4/2018	11.23	0.53
31/10/2017	6.73	7.13	07/5/2018	10.23	5.03
7/11/2017	6.96	7.43	14/5/2018	23.63	13.16
14/11/2017	8.6	6.93	21/5/2018	24.86	12.2
21/11/2017	8.53	8.36	28/5/2018	15.7	16.3
29/11/2017	8.33	7.76	04/6/2018	13.63	21.43
6/12/2017	7.7	7.1	11/16/2018	6	5.33
13/12/2017	4.13	6.5	18/6/2018	3.66	0
20/12/2017	2.1	3.96	25/6/2018	3	0
27/12/2017	0	0	28/6/2018	2.33	0
Mean	5.8	6.3		9.86	6.17
LSD	1.77 *				

The thorax area of the 4th nymphal instar were greenin color with yellowish – green abdomen with increase size of wing. Nymphalof the 5th instar was green in color and the expanding of a full wing to covered the abdomen. Mean development time for the 1st , 2nd ,3rd ,4thand 5th nymphal instars were 1 , 2 , 2 , 2 , 2 days and total nymphal period were range from (9-10) days (Table 1). Habib *et al.* (1972) reported that *Asymmetrasca decedens* paoil passed through five nymphal instars and host plants proved to a profound effect on duration of the nymphal instars. In Mousil (Iraq) Mohammed and Yehia (2008) studied biology and control potatoes leafhopper *E. decedens* and observed that egg incubation period was 9.8 days with 5 nymphal stages which is coinciding with our results of a different nymphal duration of 15.7 days which may be to the different in the rearing temperature and the host plant.

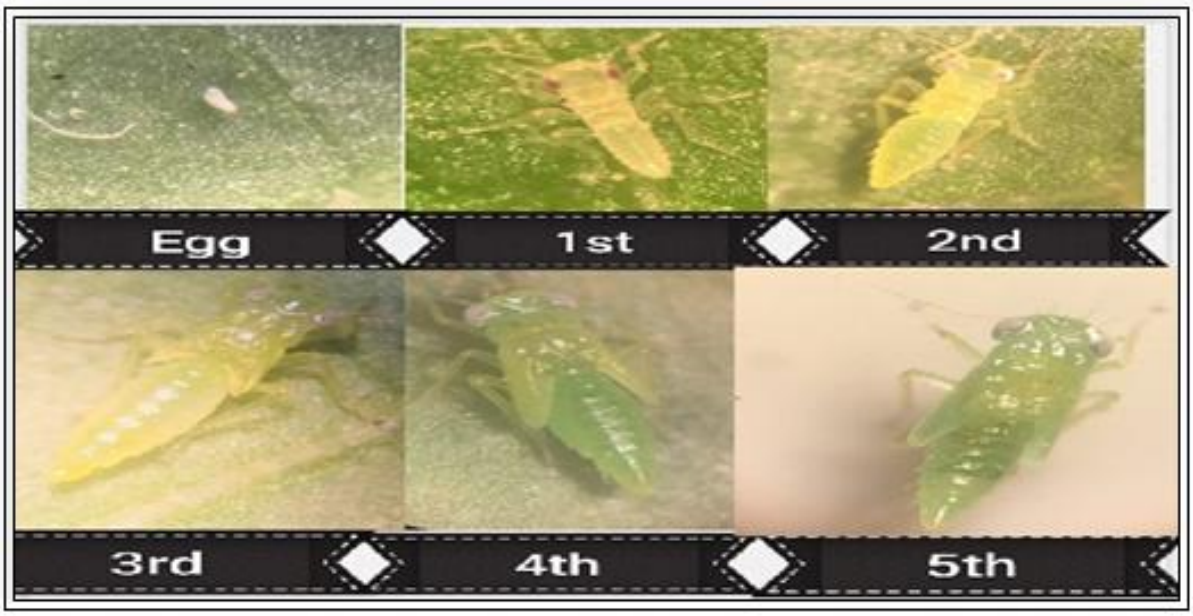

Fig. 1. Life cycle of the cowpea leaf hopper *E. decadence* egg , 1st , 2nd , 3rd ,4th , 5th instar nymph(40X).

The sex ratio obtained was (1 male : 2 female) in favor for female while Habib *et al.* (1972) Mohammed and Yehia 2008 reported result a different sex ratio of (2:3) & (1.0:1.0) respectively. Results in` Table 1 indicated that adult leafhopper longevity fed on cowpea leaves ranged from (17-20) days which correspond to what referred by Mohammed and Yehia (2008).

Fig. 2. Female and male of cowpea leafhopper, *E. decedens* ventral view (left) and dorsal view (right)(40X).

Seasonal incidence and population density of the cowpea leafhopper E.decedens during autumn season / 2017

The first appearance of the leafhopper adult during the autumn season / 2017 were observed at the end of September after 54 days of sowing. Results from Fig.3 revealed that numbers low less than 1nymph/ leave where a save rage minimum and maximum temperature were between (16-32°) Cduring October as shown in Fig.4, Then daily minimum and maximum temperature began to decreased gradually to (11-20°) Cduring in mid-November and leafhopper number increased to a first peak of 8 nymph / leaf.

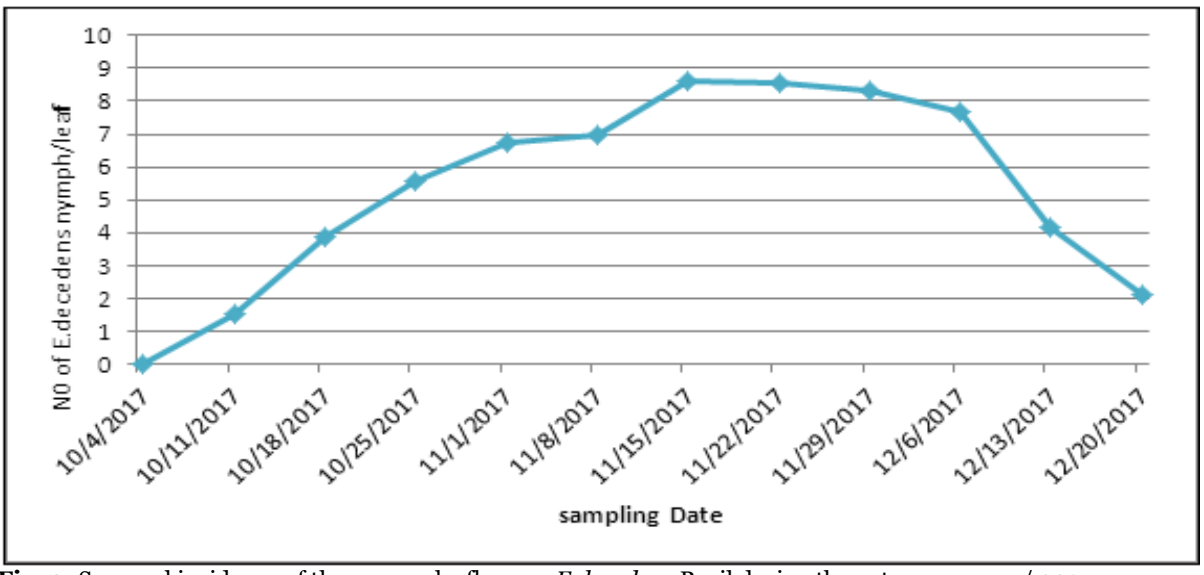

Fig. 3. Seasonal incidence of the cowpea leafhopper *E decedens* Paoil during the autumn season / 2017.

The jassed population decreased to 4 nymph / leave when the daily temperature decreased to (4-22°) Cduring December and the end of the cowpea growing season until its disappeared from the field at the end of December when the cowpea plant died and the leafhopper adults moved to feed on other crops around the cowpea field such as potatoes, weed and egg-plant inside the green house. These results are in agreement with that of Mohammed and Yehia (2008) were the first appearance of the leafhopper *E. decedens in* potatoes field during the third week of September. Hashem *et al* (2009)reported that there are two peaks of *E. decedens* on cowpea field in Egypt during July and August.

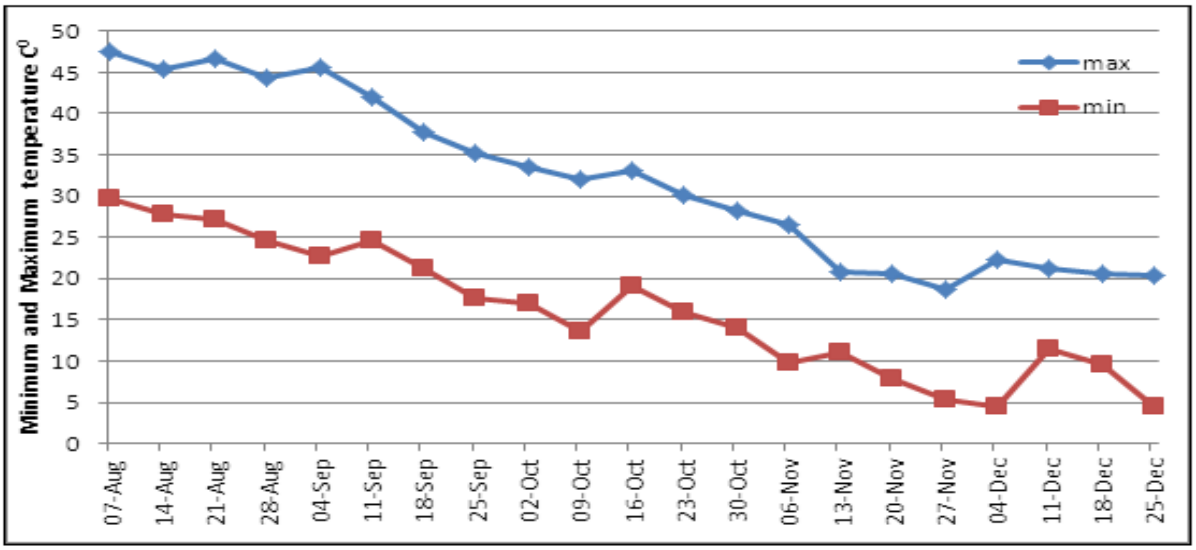

Fig. 4. Minimum and maximum temperature (C°) recorded during August- December / 2017.

Seasonal incidence of the cowpea leafhopper E. decedens for the spring season / 2018

As for the seasonal incidence of the spring season /2018 .Result in Fig.5indicated that population of *E. decedens* was started from the first week of April after 25 days from sowing, then Numbers increased gradually and reached a number of 3 nymph/ leave during mid of April where minimum and maximum temperatures were (17-20°) Cand then number began to increase gradually to reach it peaks of 24.8 nymph / leave in mid-May at the beginning of pod formation. Minimum and maximum temperatures were (26-41°) CT hereafter, leafhopper population declined to 2 nymph/ leave with the increase in temperatures (29-45°)C at the end of June and the end of the season .This observation is in agreement Al-Hasnawi (2017) reported that the corn leafhopper. *decedens* began to appear after the emergence of corn seedling and there were two peaks at the last week of April and the second peak at the third week of May. Raupach *et al.* 2002) found that temperatures and host plant had a significant effect on the development of the leaf hopper *E. decipiens* a 3- folds longer development time of 15 C° compared to temperature ≥ 28°C. The result of this study revealed that number of the cowpea leafhopper *E. decedens* were higher during the spring season more than autumn season and the leafhopper infestation to the cowpea plants occurred early after emergence, so it caused a severe damage to plants and reduced the crop yield. Numbers of the *E. decedens* during the autumn season were lower and the infestation started later during the growing season so it's caused less crop yield. We think this due mainly to daily temperatures during each growing season as shown in Fig 4and Fig6. It is clear that maximum temperature during March , April to mid of the May ranged between (30-40°) C which is suitable for the development of the leaf hopper as stated above by Raupach *et al* (2002) . Daily temperatures at beginning of the autumn season were too high ranged between (30-40°) C tills November and dropped to below 30 c° till the end of the season.

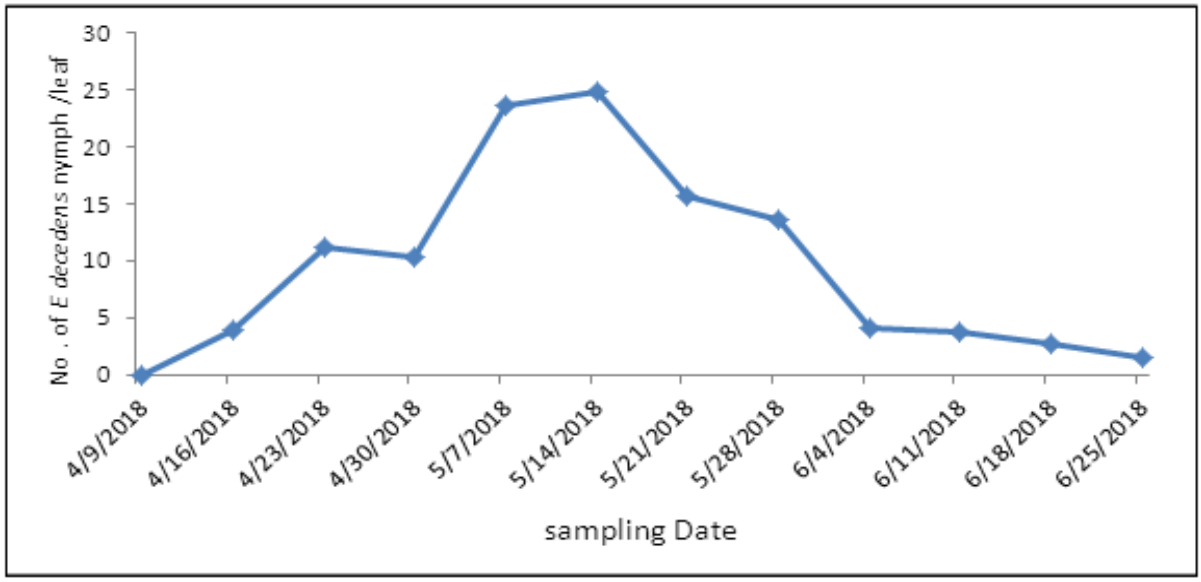

Fig. 5. Seasonal incidence of the cowpea leafhopper *E. decedens* Paoil during the spring season / 2018.

Effects of sowing dates on population density of E. decedens

Result of Table (2) indicated that there was a significant difference between the 4 sowing dates, the highest number of the leafhopper nymphs was recorded on sowing dates of 15 March of the spring season, while the lowest was on sowing dates of 1/ August, where the mean nymph number of all season were 9.86 and 5.8 nymph / leave respectively.

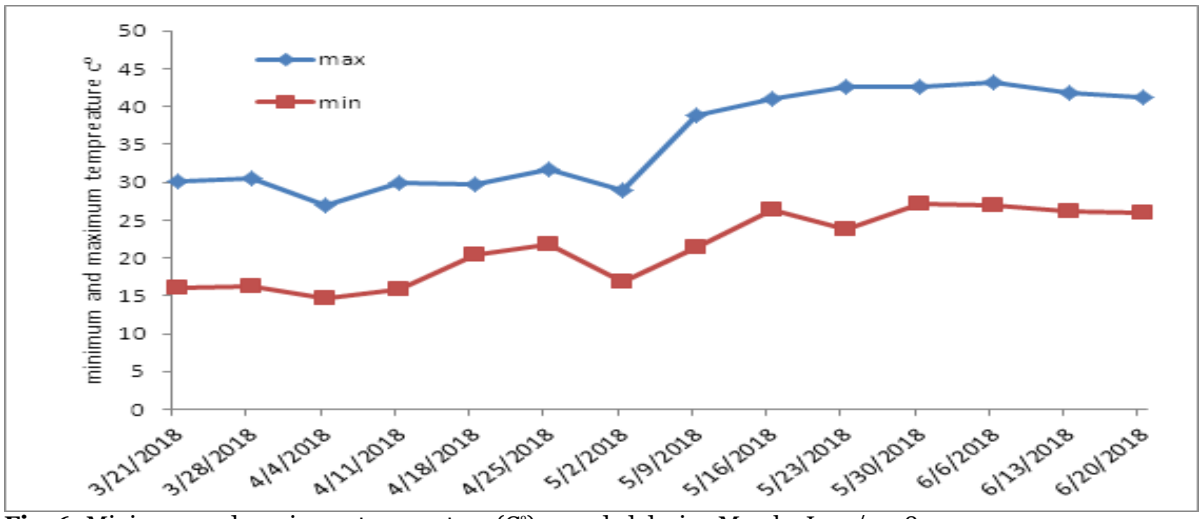

Fig. 6. Minimum and maximum temperature (C°) recorded during March- June/2018.

Results obtained in Table (2) indicated that there were no significant differences between the two sowing dates of 1and 15 August in the number of the *E. decedens* nymph but there was a significant differences between the 2 sowing dates during the spring season were the mean numbers of leafhopper nymphs was 9.86 and 6.17 nymph / leave for swing dates 15 and 30 / March respectively.

So and according to these results it better to sow cowpea on the end March.

Again as we mentioned in the previous experiments above, Daily temperatures were lower and more convenient during the spring for the development and a high population of the cowpea leafhopper.

Conclusion and recommendation

The study were identified that *E decedens* Paoli was responsible for the heavy attacks on cowpea Fields in the middle of Iraq . Daily temperatures during the cowpea spring and Ataman season were suitable for the rapid growth development and the spread of the leafhopper infestation which make it difficult to control. We think that *E. decedens* is the key pest and limiting factor for the cowpea cultivation at the present time which required more detailed studies in the future.

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