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Seasonal Fluctuations of the Cabbage White Butterfly, *Pieris rapae* (L.) and its Natural Enemies on Cabbage in Middle Egypt

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ABSTRACT

Field experiments were conducted at Naser fields in Beni-Suef Governorate, Egypt in the growing seasons 2018/2019 and 2019/2020 to study the population fluctuations of the cabbage white butterfly, *Pieris rapae* (L.) and its associated parasitoid and predatory species in cabbage plantations. *P. rapae* has from three to four generations per season on cabbage. Five primary parasitoid species; *Trichogramma buesi* V., *Cotesia glomerata* (L.), *Hyposoter ebeninus* Grav., *Brachymeria femorata* Panz and *Pteromalus puparum* L. were found parasitizing on the developmental stages of this pest. The predator *Chrysoperla carnea* Stephens, was recorded. Combined effect of three weather factors on the population density of *P. rapae* was studied.

***Keywords*:** *Pieris rapae*, Cabbage, Natural enemies, Egypt.

Introduction

Cabbage, *Brassica oleracea* var. *capitata* L., is an economic vegetable crop in Egypt as well in many other countries. Cabbage is attacked by many insect pest species which cause considerable losses in the yield. *Pieris rapae* (L.) (Lepidoptera: Pieridae) is the most destructive one causes serious economic damage and reduces commercial value of the crop (Ikeura *et al*., 2010).

P. rapae was found attacking other cruciferous crops such as mustard, cabbage, cauliflower, knoll-khol, kale and turnip (Deen Mohd and Bhagat, 2009).

The parasitoids associate with *P. rapae* when attacking cruciferous crops. Rearing of larvae and pupae of *P. rapae* yielded these parasitoids, *T.* buesi, *C*. glomerata, Hyposoter sp., *P. puparum* and *B. femorata* in cabbage field. The two predatory insects; *Paederus alfierii* Koch, *C. carnea* and spiders were also found (El-Fakharany, and Hendawy, 2014).

The combined effect of climatic factors (daily mean temperatures, relative humidity and wind velocity) was remarkably moderate on the population density of *P. rapae* (El-Fakharany, and Hendawy, 2014).

The present study aimed to monitor the population fluctuations of *P. rapae* and some of its associated parasitoid and predatory species on cabbage as affected by weather factors.

Materials and Methods

1. Field studies

Field experiments were conducted at Naser fields in Beni-Suef Governorate, Egypt in the growing seasons 2018/2019 and 2019/2020 from 25th Sep. to 19th March.

Population fluctuations of the cabbage white butterfly, *P. rapae* and its associated parasitoid and predatory species were studied on cabbage plantations in three plantations dates; 25th August, 20th November and 15th January. Inspection started 30 days after transplanting and continued weekly till the end of the crop season. At each inspection date, 40 cabbage plants were inspected and number of *P. rapae*' immature stages (larvae, pupae) were collected and counted (fig.2).

2. Survey of Natural enemies:

Eggs, larvae and pupae of *P. rapae* were collected from the cabbage field and kept individually into Petri-dishes in the laboratory up to emergence of parasitoids or complete of the following stage. The kept larvae were provided with fresh cabbage leaves for feeding. The emerged parasitoid species

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from eggs, larvae and pupae were preserved every one alone in vials containing 70% ethanol and glycerin.

The predacious insects were separated from the plants during the initial examinations. Feeding tests were run to them to ensure that predators were natural enemies of this pest.

These predators and parasitoids were identified in different departments of Plant Prot. Res. Ins., Ministry of Agric.

Weekly means of relative humidity, min. and max. temperatures of Beni-Suef Governorate were obtained from the Central Laboratory for Agricultural Climate at Dokki, Giza (fig.1).

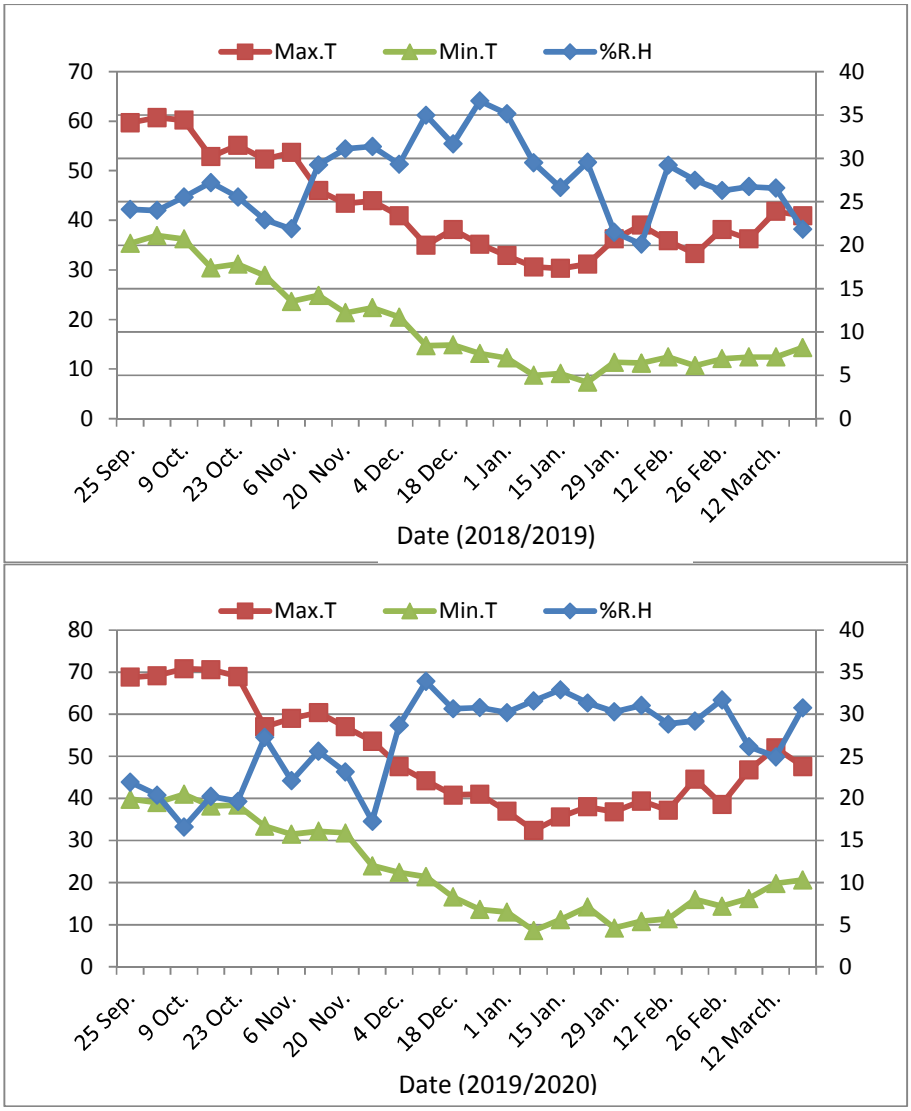

Fig. 1: Weakly means of maximum (Max. T.) & minimum (Min. T.) temperatures (°C) and percentage of relative humidity (R.H.%) throughout two successive seasons of study 2018/ 2019 and 2019/2020 from 25th Sep. to 19th March in Beni-Suef Governorate, Egypt.

3. Statistical analysis

The weekly counts of *P. rapae*' immature stages (larvae, pupae) were considered as the dependent variable (y), while the corresponding means tested climatic factors represented the independent variable (x).Partial correlation (r) and regression coefficient (B), t-values (t) and analysis of variance (F- test and explained variance E.V.%) were calculated. The relationship between these climatic factors and *P. rapae* population was estimated according to Fisher (1950).

The explained variance E.V.% = $r^2 \times 100$ (r = correlation value)

The calculations and statistical analysis of the whole data were carried out by using (MSTAT-C & SPSS Computer Programs).

Results and Discussions

1. Population fluctuation of *Pieris rapae* :

Population densities of *P. rapae* on cabbage plants 2018/19 and 2019/20 seasons are shown in (fig.2). This pest started to appear in the 3rd week of September. In the first season 2018/19 *P. rapae* has four generations. The highest population densities of immature stages (larvae and pupae) were recorded in October 30, November 27, January 22 and February 12, with 22, 29, 18 and 11 population densities, respectively. While *P. rapae* has three generations in second season 2019/20 that recorded in October 30, December 4, and January 22 with 16, 31 and 12 population densities, respectively. These results agreed with El-Fakharany, and Hendawy, 2014 who recorded from two to four generations for this pest per season. Maxwell and Fadamiro (2006) found that infestation levels of the cabbage white butterfly varied with the growing season, and population densities were higher in spring than in fall.

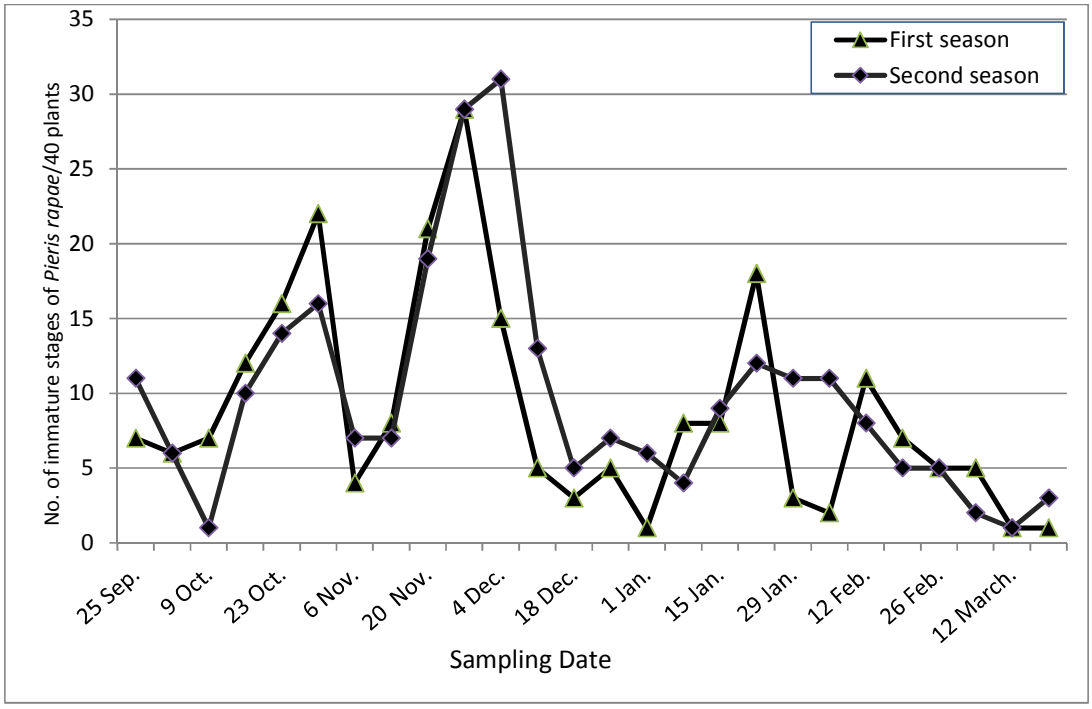

Fig. 2: Population fluctuations of *Pieris rapae* (larvae and pupae) on cabbage plants during the growing seasons 2018/2019 and 2019/2020 from 25th Sep. to 19th March in Beni-Suef Governorate, Egypt.

2. Survey of natural enemies of *Pieris rapae:*

Five primary parasitoid species; the egg-parasitoid; *Trichogramma buesi* Voegele (Hym.: Trichogrammatidae), two larval parasitoids, *Cotesia glomerata* L. (Hym.: Braconidae), *Hyposoter ebeninus* Grav. (Hym.: Ichenuomonidae) and tow pupal parasitoids, *Brachymeria femorata* Panz (Hym.: Chalcididae), *Pteromalus puparum* L.(Hymenoptera: Pteromalidae) were found parasitizing on the different developmental stages of *P. rapae*. The predator *Chrysoperla carnea* (Stephens) (Neur.: Chrysopidae) was recorded. These results agreed with El-Fakharany, and Hendawy, 2014 surveyed *T. buesi*, *C. glomerata*, *Hyposoter* sp., *P. puparum* and *B. femorata*. The authors found also two predatory insects; *P. alfierii* and *C. carnea* and spiders on cabbage field. But Deen Mohd and Bhagat, 2009 surveyed three parasitoids, *C. glomerata*, *H. ebeninus* and *B. femorata* from larvae and pupae of *P. rapae*. As well, Kolaib *et al*. (2009) recorded *C. glomerata* in Egypt attacking *P. rapae* at El-Menoufia Governorate, Egypt and also surveyed it from alfalfa fields of some Western Desert Oases, Egypt (Abu El-Ghiet *et al*., 2014).

The parasitoid species; *P. puparum*, *Cotesia rubecula* and *C. glomerata* were reported as efficient agents for controlling *P. rapae* (Madanagopal and Kim 2006; Dong *et al*., 2007 and VanDriesche, 2008). Deen Mohd and Bhagat, 2009 reported that the parasitoids associated with insect pests of cruciferous crops. Rearing of larvae and pupae of *P. rapae* yielded three parasitoids, viz. *C. glomerata*, *H. ebeninus* and *B. femorata*.

3. Relationship between some climatic factors and population density of *P. rapae* :

As shown in table (1), Partial correlation (r) and regression coefficient (B), t-values (t) and analysis of variance (F- test and percentage of explained variance E.V. %) of the total count of immature stages *P. rapae* (larvae and pupae) as affected by weekly means of percentage of relative humidity (%R.H.), Max. and Min. temperatures throughout the two successive seasons. Throughout the two successive seasons, percentage of relative humidity had insignificant negative effect on population density of *P. rapae* but min. temperature had significant positive effect at probability level 0.05. Max. temperature had insignificant negative effect in the first season but significant negative effect in the second season at probability level 0.05. The combination effect of these three climatic factors together was insignificant with 2.17 and 1.79 F-tests during the two seasons respectively.

On the other hand, the influence of these factors together on the population density of this pest was moderate. It was expressed in table (1) as percentage of explained variance (E.V.%); it was 22.8% and 19.6% for the two seasons, respectively.

Table 1: Partial correlation (r) and regression coefficient (B), t-values (t) and analysis of variance (F-test and percentage of explained variance E.V. %) of the total count of immature stages of *Pieris rapae* (larvae and pupae) on cabbage plants as affected by weekly means of percentage of relative humidity (%R.H.), Max. and Min. temperatures throughout two successive seasons 2018/2019 and 2019/2020 from 25th Sep. to 19th March at Beni-Suef Governorate, Egypt.

Season	Factor	Analysis of Partial regression			Analysis of variance	
		r	B	t	F	E.V. %
2018/19	%R.H	0.48	-0.07	-0.25	2.17	22.8%
	Max.T		-2.1	-1.6		
	Min.T		2.46	1.9*		
2019/20	%R.H	0.44	-0.53	-1.69	1.79	19.6%
	Max.T		-3.13	-2.16*		
	Min.T		2.89	2.08*		

Significant at probability level 0.05

El-Fakharany, and Hendawy ,2014 studied the daily mean temperatures, relative humidity and wind velocity on *P. rapae* at Kafr El-Sheikh and Al-Gharbiya Governorates, and found that the combined effect of these climatic factors was remarkably moderate on the population density of *P. rapae*. The temperature had insignificant negative effect and wind velocity was significant negative effect in both regions. Relative humidity had insignificant positive and insignificant negative effects at Kafr El-Sheikh and Al-Gharbiya Governorates, respectively.

In conclusion, *P. rapae* has from three to four generations per season. Maximum abundance of this pest was recorded in October, November and January on cabbage plants in Beni- Suef. The predator *C. carnea*, was recorded. Five primary parasitoid species were found parasitizing on different developmental stages of the pest. They were *T. buesi* , *C. glomerata*, *H. ebeninus* and *B. femorata P. puparum*. The combined effect of relative humidity and daily temperatures was insignificant. The influence of these factors together was remarkably moderate on the population density of *P. rapae*. It was 22.8% and 19.6% for the two seasons, respectively.

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