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Role of the Parasitic Mite, *Pyemotes Tritici* (La Greze-Fossat and Montane) (Acari: Pyemotidae), and Certain Weather Factors in the Natural Mortality Percentage of Diapause Larvae of Pink Boll Worm, *Pectinophoragossypiella* (Saunders) In Cotton Bolls and Infestation Rate by Pbw in the Next Year

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Abstract

The experiments were carried out during the cotton seasons of 2017 and 2018 inSakha Agricultural Research Station, Kafr El-Sheikh Governorate to evaluate the parasitic mite, *Pyemotes tritici* ***(La Greze – Fossat and Montane)***(Acari: Pyemotidae) role and certain weather factors on the natural mortality percentage of diapause larvae of pink bollworm, *Pectinophoragossypiella* (Saund.) in cotton bolls and infestation ratein the next year. The parasitic mites began in little numbers, after the numbers of parasitic mites to increased through the two seasons. In the first season the lowest mortality % (29.61%) was recorded on The 21Th of January at mean number of (19.75parasitic mites /50 cotton bolls), but the highest mortality%(45.28%) was recorded on the 5 Th of February atmean number of (183.00 parasitic mites/ 50 cottonbolls) .In the second season ,the lowest and highest mortality% (31.97,80.36%)were recorded on the 7Th of January and 19Th of March at mean numbers of (48.75,204 parasitic mites/ 50 cotton bolls) ,respectively. The role of the parasitic mite, *P. tritici* on the natural mortality % of larvae diapause of PBW was recorded significant positive correlation (0.455* and 0.511*) in the two seasons 2017 and 2018, respectively. The effect of temperatures was recorded significant negative correlation (-0.526* and -0.477*) on the natural mortality percentage of diapause larvae of pink bollworm in the two seasons, respectively. On the other hand the effect of relative humidity recorded positive and insignificant correlation (-0.367 and -0.178) in the two seasons, respectively. Therefore the rainfall was recorded significant positively correlation (0.592* and 0.484*) during the two seasons, respectively. In the 2017 season, the lowest mortality%(29.61%) at means of (12.26^{0}C,72.99%R.H. and 1.2mm/day f rainfall).while the highest mortality% (45.28%) at means of (11.29^{O}C,70.87%R.H. and 13.50mm/day of rainfall).and the 2018 season, the lowest and highest mortality% (31.97,80.36%)at means of (17.18,16.28^{o}C;77.63,74.00%R.H. and 1.46,2.97mm/day of rainfall),respectively.

Introduction

Pink bollworm is one of the most important pests of cotton and other crops in Egypt. This pest attacks the fruit bodies of cotton and cause heavy loss in the yield. PBW causes losses of cotton of about 10% in Yangtse River valley, China (**Cai*et al.*, 1985).** The diapaused pink bollworm larvae in the cotton bolls at the end of cotton season are considered the main source of infestation of the cotton plants during next seasons. **Hussain and Kostandy (2002)** found a positive correlation between the average numbers of pink bollworm larvae in green bolls at the end of the cotton season and the average numbers of moths emerged from diapaused larvae in the following spring. Many factors affected on the natural mortality percentage of diapause larvae of pink bollworm in bolls, one of this factors, the parasitic mite *Pyemotes tritici (La Greze – Fossat and Montane)* which normally parasitizeslepidopterous larvae, where it could reduce the pest population density below economic and reduce plant damage below economic injury levels, and used as a biological control agent for a number of this pest (**Bruce and Le Cato 1979, 1980 and Gahukat, 2006),**and its effectiveness as parasitoid results from several characteristics: (1) high reproductive potential; (2) short life-cycle; (3) no intermediate hosts of food sources required – all development occurs within the opisthosomal sac of the adult female and all offspring are born live as sexually mature adults; (4) only females are parasitic and represent about 90-95% of the population, (5) female mate immediately at birth and begin host-seeking activity, (6) populations are easily reared and synchronized in the laboratory; and (7) they are cosmopolitan in distribution (**Bruce and LeCate, 1979, 1980 and Bruce, 1989). Tawfik *et al.* (1984)** found *P. tritici* in stored cotton seeds and is highly toxic to man and reared in the laboratory in Egypt at 27.5^{o}C and 56% R.H on the larvae of PBW, the parturition period of the viviparous mite lasted 7.6 days, resulting in 540 progeny/25 females, on *P. gossypiella*, and the changes caused by parasitism in the colour and shape of the host larvae are described. **Hoschele and Tanigoshi, 1993).** They found the impact of various densities of *P. tritici* on flour moths indicated that complete destruction of cohorts of 400 *Anagastakuehniella* (Lepidoptera: Pyralidae) larvae was achieved by adding about 80 female *P. tritici* 10 days after the eggs were laid or 6 days after the larvae hatched in the laboratory.

And factors of weather (temperature, relative humidity and rainfall), also affected on the natural mortality percentage of diapause larvae of PBW in bolls. Survival of diapause larvae during winter as

affected by low temperature, rainfall, relative humidity, are a key factors determining the range of PBW in the next season **(Bariola, 1984, Gutierrez *et al.*, 2006 and Mohapotra, 2007)**

The present study was designed to add to the knowledge on the effect of parasitic mite, *P. tritici* and certain weather factors (temperature, R.H. and rainfall) on the natural mortality percentage of diapause larvae of PBW in bolls cotton and infestation by PBW in the next year, during two successive cotton growing seasons 2017 and 2018.

Materials and Methods

The cotton bolls were collected at the end of the two tested experimental seasons, 2017 and 2018. The infested cotton bolls were taken from variety Giza 88, planted at Sakha Agric. Research Station, Kafr El-Sheikh, Egypt. The plants were received normal agricultural practices and recommended pesticides. Infested cotton bolls by pink bollworm (diapaused larvae) were left in open place in the field for six months from October to last March.

1. Sampling technique :

Samples of dried infested bolls by PBW (diapaused larvae) were prepared (50 bolls/replicate), four replicates for week of the January, February and March and kept in tightly closed polyethylene bags, then dissected and examined in the laboratory of Plant Protection Research Institute at Sakha, Kafr El-Sheikh.

2. Extraction method :

The samples were put in piece of cheese cloth of 15 x 20 cm closed from its upper edge by thread and transferred directly to Batteries of Modified Tullegran-Funnels. Electric bulbs of 40 watt were used on top of each funnel served as the heat light source to drive the parasitic mite downward into Petri-dishes of 10 cm diameter containing water. Formaldehyde 1% was used when there were a lot of organisms to prevent animal escape. The process of extraction took place for 48 hours (**Tadros, 1984).** Before and after mounting samples, funnels and sieves had to be cleaned up using a suitable brush and cloth cleaning.

3. Clearing and mounting :

The mites were selected and counted according to mode of nourishment. Mites were then transferred in other small pots, by using a very fine camel hair brush under a binocular microscopy. After the transferring of all mites, they were covered with 10% potassium hydroxide for few minutes to be cleared up, after that were washed in distilled water and posited in the center of cleaned glass. Slides containing Hoyer's media and covered with glass cover of 18 x 18 mm. This process was carried out under binocular microscope. The covers must be ranged by asphaltum to prevent the media from spreading out and avoid the absorption of moisture. The slides were labeled with needed and placed hot-plate at 45ºC for two days to get dry.

4. Identification:

Identification of mite species was carried out by using the permanent preparation and the research microscope under the maximum magnification force. The parasitic mite was identified using the keys of **Hughes (1976), Krantz (1978) and Zaher (1986).**

5. Survey survival and dead larvae :

The samples of bolls taken for determining the number of survival and dead larvae of PBW. Also, the developed pupae were counted in each replicate with the survival larvae. Effect of the parasitic mite and weather factors were evaluated according to the effectiveness in reducing the number of survival pink bollworm larvae.

$$Reducing\ \% = \frac{No.of\ dead\ larvae}{Total\ No.of\ larvae\ (survival\ and\ dead)} x100$$

6. Weather factors

For studying the effect of certain ecological weather factors such as temperature, atmospheric relative humidity and rainfall, the daily means of the three factors were provided by the Ministry of Agric., Agric. Res. Center Training Center, during the whole period of the two tested seasons of 2017 and 2018.

7. Statistical analysis:

The statistical analysis was conducted using the software-programme MSTATC to show the effect of each factor as well as the interactions on the natural mortality percentage of diapause larvae of pink bollworm in bolls.

Results and Discussion

The parasitic mite, *Pyemotes tritici* (La Greze – Fossat and Montane):

As clearly shown in Figs. (1 and 2), the mean number of parasitic mite, *P. tritici* during period of the first of January to the end of March of the two seasons (2017 and 2018), and the natural mortality % of larvae diapause of pink bollworm during the same period of the two seasons The parasitic mites began in little numbers, after the numbers of parasitic mites to increased through the two seasons. In the first season the lowest mortality % (29.61%) was recorded on The 21Th of January at mean number of (19.75 parasitic mites /50 cotton bolls), but the highest mortality % (45.28%) was recorded on the 5 Th of February at mean number of (183.00 parasitic mites/ 50 cottonbolls) .In the second season ,the lowest and highest mortality% (31.97,80.36%)were recorded on the 7Th of January and 19Th of March at mean numbers of (48.75,204 parasitic mites/ 50 cotton bolls) ,respectiveiy.

The data presented in Tables (1 and 2) show that the effect of parasitic mite, *P. tritici* on the natural mortality% of larvae diapause of PBW was recorded significant positive correlation (0.455* and 0.511*) in the two seasons 2017 and 2018, respectively. *P. tritici* was parasitizes a wide range of larvae of Lepidoptera,

and has shown potential as a biological control agent for a number of different insects,

The weather factors (temperature, relative humidity and rainfall):

The results in Figs. (1 and 2) clearly show the means of certain weather factors (temperature, relative humidity and rainfall) during period of the first of January to the end of March of the two seasons (2017 and 2018), and the natural mortality % of larvae diapause of pink bollworm during the same period of two seasons.

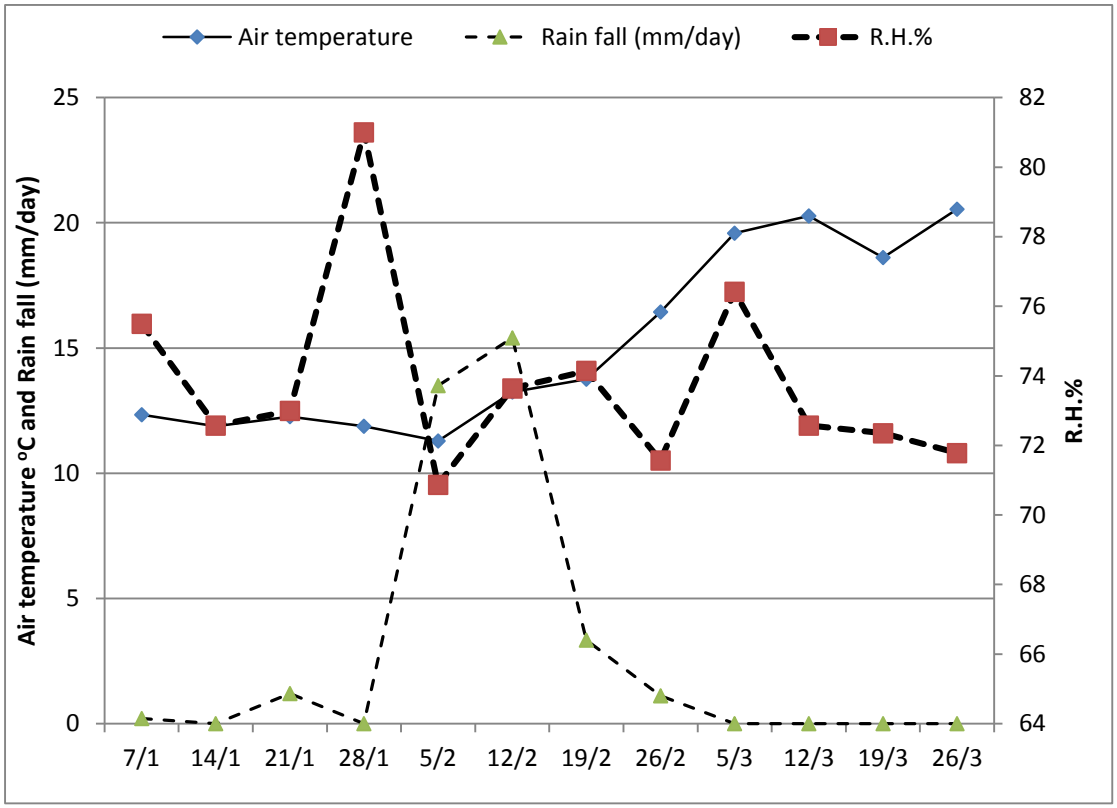
In the 2017 season, the lowest mortality%(29.61%) at means of (12.26^{0}C,72.99%R.H. and 1.2mm/day of rainfall).while the highest mortality% (45.28%) at means of (11.29^{O}C,70.87%R.H. and 13.50mm/day of rainfall).and the 2018 season, the lowest and highest mortality % (31.97,80.36%)at means of (17.18,16.28 ^{o}C;77.63,74.00%R.H. and 1.46,2.97mm/day of rainfall),respectively.

The data presented in Table 1 and 2 show that the effect of certain weather factors (temperature, relative humidity and rainfall) on the natural mortality % of diapause larvae of PBW in bolls of cotton.

The effect of temperatures was recorded significant negative correlation (-0.526* and -0.477*) on the natural mortality % of diapause larvae of PBW in the two seasons (2017 and 2018), respectively. This results agreed with **Tawfik and El-Sherif (1974)** they found, temperatures below 15^{o}C in winter and early spring accounted for a large part of the mortality in December-March. So, **Bariola (1984)**, he found the higher temperature to faster the emergence of the overwintered moths of diapause larvae in the spring in central Arizona. **El-Lakwah *et al.* (1999)** they found accumulation of low heat unit rate affected larval mortality and was significantly associated with the timing and size of the spring emergence of the pest. **Gutierrez *et al.* (2006)**, they found the survival of diapause larvae during winter as affected by low temperatures, a key factor determining the range of PBW in Arizona and California.

The effect of relative humidity on the natural mortality% of diapause larvae of PBW in bolls of cotton was recorded negative and insignificant correlation (-0.367 and -0.178) in the two seasons, respectively.

The effect of rainfall on the natural mortality % of diapause larvae of PBW in bolls of cotton was recorded positive and significant correlation (0.592* and 0.484*) in the two seasons (2017 and 2018), respectively.



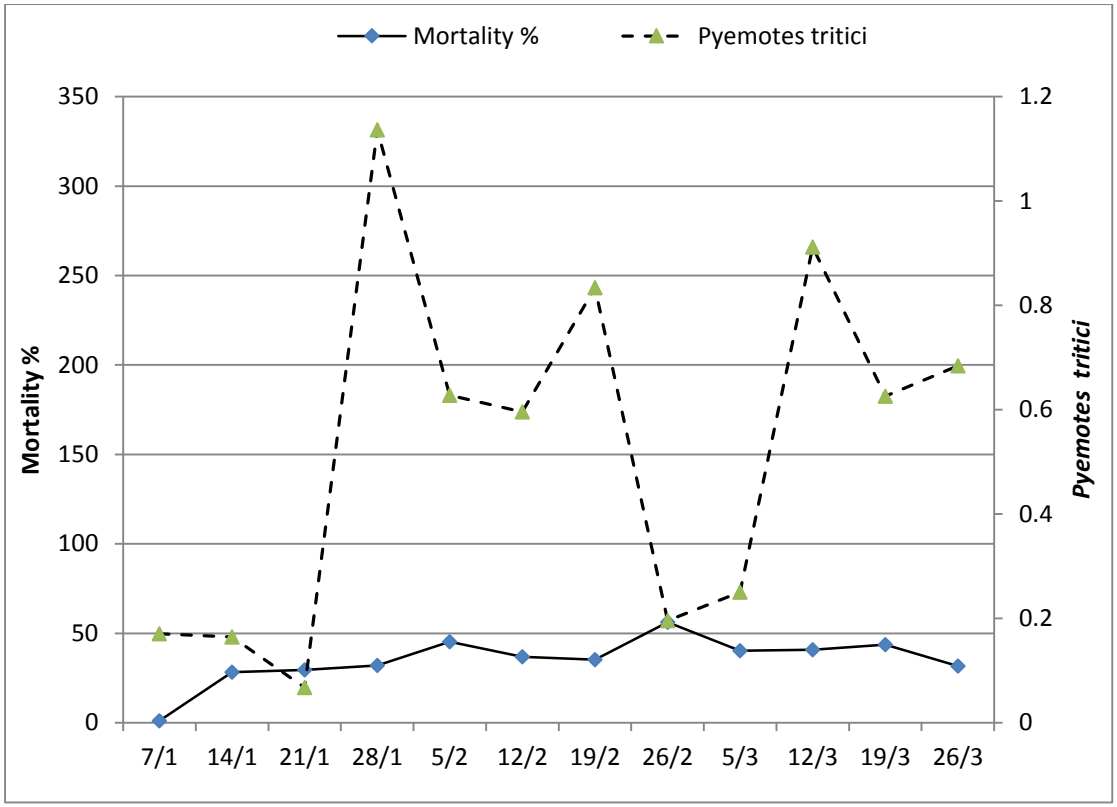


Fig. (1): Mortality% of larvae diapaused of pink bollworm, mean numbers of *Pyemotes tritici* and means of three weather factors during 2017 season.

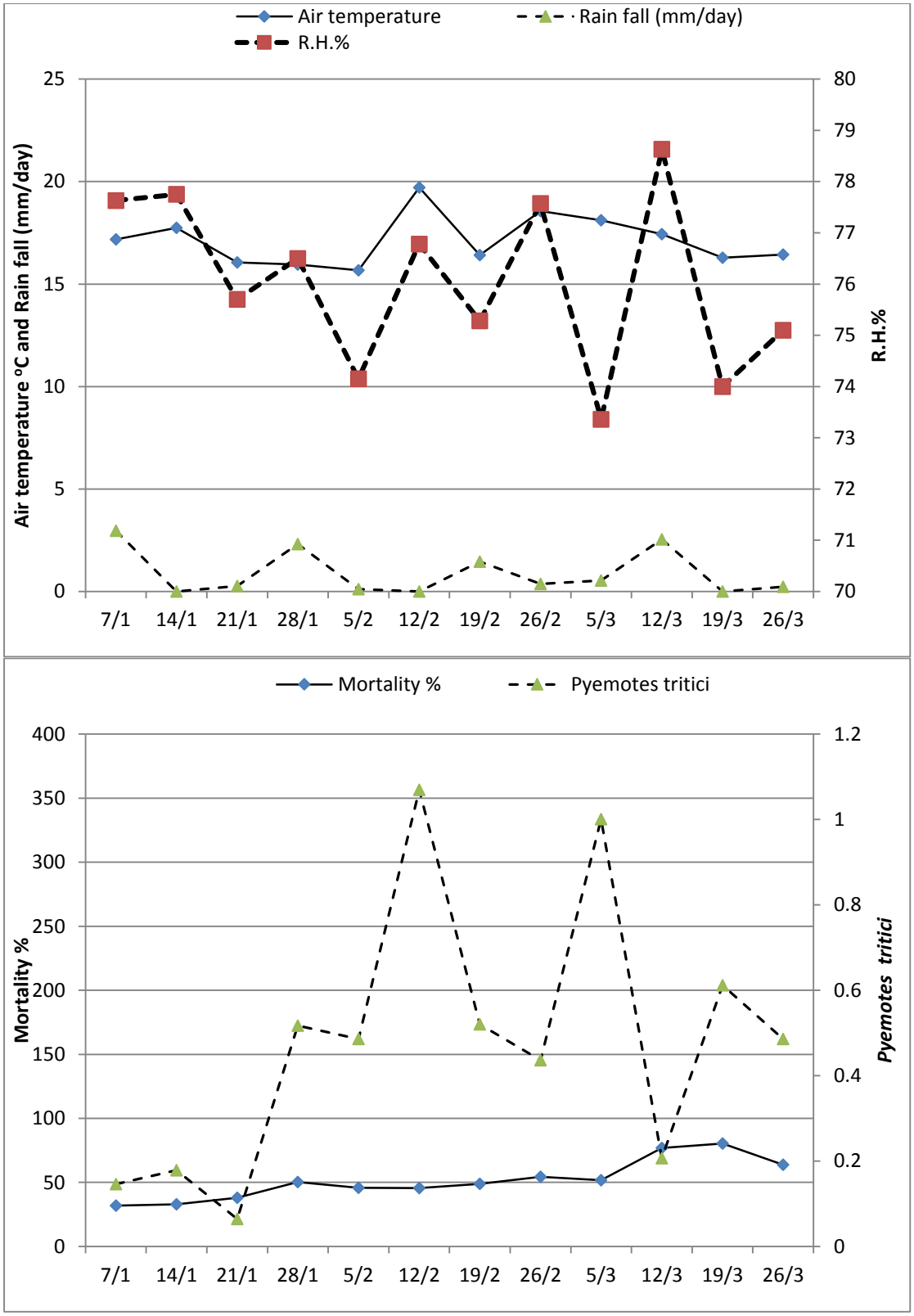


Fig. (2): Mortality% of larvae diapaused of pink bollworm, mean numbers of *Pyemotes tritici* and means of three weather factors during 2018 season.

Table 1. Combined analysis for five traits over two years

S.O.V.	d.f	Mortality %	Pyemotes tritici	Temp. ºC	R.H.%	Rain fall mm/day
Years (y)	1	4798.26**	1100.26^{NS}	74.35*	414.03**	14.65*
Rep/Y	6	222.29	2560.81	5.01	6.00	1.61
Reading date (D)	11	832.13**	52129.14**	24.79**	204.70**	2.14**
D x Y	11	382.18^{NS}	32716.51**	0.36**	374.00**	0.363*
Error	66	225.38	3300.07	0.002	0.002	0.099

*, ** significant and highly significant at 0.05 and 0.01 level of probability, respectively.
NS: Not significant

Table 2. Sample correlation coefficient between mortality % of larvae diapaused of pink bollworm, *Pyemotes tritici*, temperature, relative humidity and rainfall for two years (2017 and 2018).

Correlation coefficient ®		*Pyemotes tritici*	Temp. ºC	R.H.%	Rain fall mm/day
Mortality%	2017	0.455*	-0.526*	-0.367	0.592*
	2018	0.511*	-0.477*	-0.178	00.484*

*, ** significant and highly significant at 0.05 and 0.01 level of probability, respectively.

These results agreed with **Bariola (1984),** he found the rainfall significant reduced survival and emergence of overwintered moths of diapause larvae in the spring in central Arizona. Reduce survival and emergence of overwintered moths of diapause larvae in the spring, could reduce the pest population density below economic thresholds and reduce plant damage below economic injury levels in the next year.

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دور الطفيل الأكاروس (Pyemotidae: Acari)*Pyemotes tritici* وبعض العوامل الجوية على نسبة الموت الطبيعية ليرقات دودة اللوز القرنفلية الساكنة فى لوز القطن والإصابة فى العام التالى

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معهد بحوث وقاية النباتات . مركز البحوث الزراعية . الجيزة . مصر

تمت هذه الدراسة خلال موسمى 2017 ، 2018 فى مزرعة محطة البحوث الزراعية بسخا . محافظة كفرالشيخ لتقييم دور الطفيل الأكاروس) ***Pyemotes tritici***وبعض العوامل الجوية على نسبة الموت الطبيعية ليرقات دودة اللوز القرنفلية الساكنة فى لوز القطن والإصابة فى العام التالى وكانت النتائج كما يلى:

- بدات اعداد الطفيل الاكاروسى باعداد قليلة ثم ازدادت خلال الموسمين
- في الموسم الأول كانت اقل نسبة موت (29.61%) قد سجلت في يناير بمتوسط(19,75طفيل اكاروسى /50 لوزة قطن) لكن اعلى نسبة موت كانت (45,28%) قد سجلت في 5 فبراير بمتوسط (183,000طفيل اكاروسى / 50لوزة قطن)
- في الموسم الثانى كانت اقل واعلى نسبة موت (31,97%.80,36%) قد سجلت في 7 يناير و19 مارس بمتوسطات (48.75،204طفيل اكاروسى /50 لوزة قطن) على التوالي
- كان تأثير الطفيل الأكاروسى على نسبة الموت الطبيعية ليرقات دودة اللوز القرنفلية الساكنة فى اللوز موجبا ومعنوى (−0.455* ، 0.511*) فى موسمى الدراسة 2017 ، 2018 بالترتيب.
- كان تأثير درجات الحرارة على نسبة الموت الطبيعية ليرقات دودة اللوز القرنفلية الساكنة فى لوز القطن سالبا ومعنوى (−0.526* ، −0.477*) فى موسمى الدراسة بالترتيب.
- كان تأثير نسبة الرطوبة النسبية على نسبة الموت الطبيعية ليرقات دودة اللوز القرنفلية الساكنة فى لوز القطن سالبا وغير معنوى (−0.367 ، −0.178) فى موسمى الدراسة بالترتيب.
- كان تأثير سقوط المطر على نسبة الموت الطبيعية ليرقات دودة اللوز القرنفلية فى لوز القطن موجبا ومعنوى (0.484* ، 0.592*) فى موسمى الدراسة بالترتيب.
- في الموسم الأول ،اقل نسبة موت كانت (29.61%) عند متوسطات (12,26م°، 72,99% رطوبة نسبية و1,2مم/ يوم من المطر) بينما كانت اعلى نسبة موت (45,28%) عند متوسطات (11,29م°،70,87%رطوبة نسبية و13,50مم/ يوم من المطر)
- في الموسم الثانى ، اقل واعلى نسبة موت كانت (31,97% ، 80,36%) عند متوسطات(16,28،17,18م^0؛74,00،77,63%رطوبة نسبية و1,46، 2,97مم/يوم من المطر) على التوالى .