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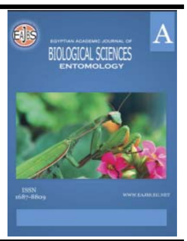

Annual Generations and Population Fluctuation of Tomato Leaf Miner Moth *Tuta absoluta* (Meyrick) (Lepidoptera :Gelechiidae) in El-Behera Governorate, Egypt.

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ABSTRACT
Egypt is considered one of the important tomato producers in the world that has appropriate climate for tomato along year in three different plantation seasons *viz*., winter, autumn and summer. Tomato infestation with tomato leaf miners (TLM) reached 70% in El-Behera governorate in 2011. So current study aimed throw some lights on population fluctuation of TLM males along two year (2013-2014) and different seasons by using pheromone traps, in addition studying the effect of climatic factors (Maximum, minimum, mean temperature and relative humidity)on males activity. Moreover and basically estimation numbers, duration of annual generations and population density in all observed generation by applying two different mains[First main depend on Daily Degree Units and second main suggested by Audemard and Millaire (1975) and emended by Iacob (1977)] in generation estimations were also concerned. Results reflected that TL Mmale population density of LTM varied from season to another. Spring season was the highest followed by summer, but each of winter and autumn were the lowest, that there were no significant differences between the last two seasons. Effect of tested climatic factors is obvious along a year, not can be observed in specific seasons, that their combined effects responsible as a group for 34.09% and 35.76 % on population density in the both years of study, respectively. Eleven annual generations were observed along a year in both years of study, moreover times and duration of all estimated generations were paralleled in the both used mains of generation estimations. The first and eleventh generations were nearly longest but with lowest in TLM male population numbers. The Ninth generation, considered as overlapped generation between summer and autumn season. Each of spring, summer and autumn season have three generations.

INTRODUCTION
Tomato, (*Solanum lycopersicum* L.) is considered as the most economically important feeding crop allover world. Tomato leafminer, *Tutaabsoluta* (Meyrick), first described in Peru in 1917s,is a serious and a devastating pest of tomato cultivations (EPPO, 2005). Although tomato is the preferred host plant of *T. absoluta*, its larvae can also develop on other cultivated plants such as *Solanum tuberosum* L. (potato), *Solanum melongena* L. (eggplant), *Solanum muricatum* Aiton (sweet pepper), *Nicotiana tabacum* L. (tobacco), *Phaseolus vulgaris* L. (bean) and *Physalisperuviana* L. (cape gooseberry) (Desneux *et al*., 2010).

It is originated from South America that introduced from Chile in 1964 (García & Espul, 1982) and finding the shores of the Mediterranean (Urbaneja *et al*., 2007) a perfect new home.

Recently, it become major insect pest infesting tomato crops in countries of the

Mediterranean basin (Germain *et al.*, 2009; Desneux *et al.*, 2010; Desneux *et al.*, 2011; Balzan and Moonen 2012 and Tropea Garzia *et al.*, 2012), then spread quickly in central and northern European countries (Potting, 2009; Desneux *et al.,* 2010) and threat European and North African tomato production. Without adequate controls, infestations can result in 90 to 100% loss of field-produced tomatoes (Vargas, 1970 and Estay, 2000).

Egypt, lies in the subtropical region, is considered one of the important tomato producers in the world [according to Bulletin of World Processing Tomato Council (WPTC) in 2011] that has an appropriate climate for tomato throughout the year in three different plantation seasons *viz*., winter, autumn and summer. Annually, it produces about 9,204,097 tons of tomato fruits from about 9,000 ha of cultivated area. Tomato crop is one of the most important vegetable crops in Egypt and is considered as the fifth largest tomato producer in the world but one of the world's countries that suffer from TLM population increase.

TLM invaded Egypt in the nearest governorate to Libya (Marsa Mtrooh) in 2009. By 2010 it had reached Giza, becoming well established in all Governorates of Egypt that reported its presence in other parts of the Delta valley. Later, the pest was discovered to have rapidly spread in the upper and lower regions of Egypt and reaching the border and north part of Sudan on June 2011 (Tamerk, 2011;Gaffar, 2012 and Mohamed *et al.*, 2012). El-Behaira governorate represented the lowest infestation amounting to 21% and 70% in seasons 2010 and 2011, respectively (Moussa *et al.,* 2013).

T. absoluta is a multivoltine species, which rapidly develops in favourable environmental conditions, with overlapping life cycles (Guenaoui *et al*., 2010) with a high reproductive potential. Larvae do not enter diapause when food is available and depending on the environmental conditions, so up to 12 generations per year may be able to develop (EPPO, 2005). Sex pheromone trap is using as an early detection tool and to be effective to control *Tuta absoluta*.

Since the introduction of *T. absoluta* in the Mediterranean region, several studies have been conducted on the ecology of this pest as well as on its control, and several native natural enemies have been identified as potential biological control agents (Arno´ *et al*., 2009; Cabello *et al*., 2009 a,b; Nannini, 2009; Arno´ and Gabarra, 2010 and Desneux, 2010). So current study aimed to throw some lights on population fluctuation of TLM males along year and different seasons in addition studying the effect of climatic factors on its activity. Moreover, estimation numbers, duration of annual generations and population density in all observed generation by applying two different techniques in generation estimations were also concerned.

MATERIALS AND METHODS

To estimate Annual generations of *Tuta absoluta* at solanaceae plants fields in El-Behera Governorate, Current field study conducted for two consecutive and successful years (2013 and 2014) in two districts of El-Behera Governorates. In addition, three feddan were cultivated with tomato or potato depending on time of year, and supplemented with three pheromone traps (Trap per feddan). Numbers of captures for each trap were recorded weekly for each trap.

Synonyms of *Tutaabsoluta* Meyrick, 1917

Scrobipalpuloides absoluta (Povolny, 1987)

Scrobipalpula absoluta (Povolny, 1964; Becker, 1984)

Gnorimoschema absoluta (Clarke, 1962)

Phthorimaea absoluta (Meyrick, 1917)
The correct name of the species is now *Tuta absoluta* (Povolny, 1994)

Locality:

Two farmlands cultivated with tomato or potato (Depending on time of year) In El-Behera Governorate. The first year of investigation (2013) was conducted in farm land in Abo-homos district (E30° 16' 30") (N31° 06' 53") that cultivated with tomato plants from April to September, 2013, while in the rest months of year, the farm was cultivated with potato plants. During the second year of investigation (2014), this field study conducted in another district of El-Behera Governorate to confirm obtained data of first year. So Farmland in Ety-Elbaroud District (E30° 36' 54") (N30° 52' 37") was chosen for this purpose and cultivated with the same tested crop and in the same schedule.

Traps:

Sticky pheromone traps and water pan pheromone traps were chosen to estimate population fluctuation and annual generations of tomato leaf miner moth males. During the first year of the study, water pan pheromone traps (made of yellow plastic material in oblong shape 30 x 20 x 10 cm, placed in field at 50 cm height from ground level) were used, while it was replaced with sticky pheromone traps (Red delta traps with white rectangular sticky board 9.5 x 20 Cm hanged at 100 cm height from ground level)during the second year. The pheromone traps were loaded with sex pheromone capsules, Synthetic sex pheromones of the tomato leaf miner 3E, 8E, 11Z-14 AC (C16 H26 O2), (E, Z, Z)- 3, 8, 11- Tetradecatrienyl acetate, w obtained from Pheromone Production Unit, Plant Protection Research Institute, Dokki, Giza. Pheromone capsule, saturated with 0.5 mg of sex synthetic pheromone Chermiti and Abbes (2012), was kept frozen to preserve their effectiveness until using. Pheromone capsule of each trap was exchanged every 7-8 weeks. Weekly numbers of capture males' form each trap were counted and recorded, in addition water or sticky board were replaced with fresh one, weekly.

Data Recording:

Obtained weekly mean numbers of TLM males were recorded from the three monitored pheromone traps. On the other hand records of daily means of maximum and minimum temperature as well as relative humidity of the years of study (2013 and 2014) were obtained from El- Delengate Metrological Station.

Data analysis:

Estimation of annual generation, population fluctuation of TLM males and effect of climatic factors on TLM males population dynamics are the main objectives of this current study. The previous objectives were achieved as follow:-

Annual Population Fluctuation of TLM Males:-

To investigate annual fluctuation of TLM males, weekly mean numbers of TLM male, captured by pheromones traps, graphically illustrated to detect periods of abundance and rearing of males along year. Moreover those mean numbers of TLM male were compared in the four seasons of year (Winter-Spring-Summer Autumn), so obtained data subjected to ANOVA test analysis to detect abundance and rearing seasons.

Effect of Physical Ecological Factors on TLM Males Activity at Solanaceae Plants Fields:-

Means of main climatic factors i.e. daily maximum, minimum and mean temperature as well as mean relative humidity were calculated 7 days earlier from corresponding sampling dates. To clarify the simultaneous effects of those physical ecological factors on TLM males' activity, all obtained physical and biotic data subjected to statistical analysis by applying simple correlation analysis as correlation coefficient value (**r**) and applying partial regression formula (C-multiplier, Fisher, 1950) to clarify the combined effect of the four factors as a group on the population dynamic of TLM males.

Estimation Number and Duration of Annual Generations of TLM:-

Two different mains of TLM annual generation calculation were concerned during current study as follow:-

Estimation annual generation depending on thermal constant and day degree:-

The first main depend on determination of *Tuta absoluta* accumulated daily thermal units by transforming recorded daily maximum, minimum temperature and threshold of development (zero of development) of TLM to Daily Degree units (DDU) by applying following formula.

$$DDU = (Max.\ Temp. + Min.\ Temp.)/2 - Threshold\ of\ Development\ Temp\ (t_0).$$

Then estimation number and duration of *T. absoluta* annual generations could be possible in the field by using calculated value of Thermal constant of *T. absoluta* developments (C) and applying following formula according to Jasic, 1975.

$$Number\ of\ Generations = \Sigma\ (D.D.U)\ /\ C$$

Estimated Values of threshold of development (zero of development) (t_0) and Thermal constant (C) of *T. absoluta* to develop from egg to adult were 8°C and 460 thermal units, respectively according to Barrientos *et al.*, (1998).

Estimation annual generations according to Audemard and Milaire (1975) and Iacob (1977):-

The second main suggested by Audemard and Millaire (1975) and emended by Iacob (1977), which depended on weekly mean captured numbers of TLM males by pheromone traps. Those mean numbers of TLM males were accumulated along the tested year and arranged, and then illustrated graphically on semigaussian paper (scale gausses). Whether, the number and duration of annual field generations could be detected.

All statistical analysis of obtained data were conducted by using COSTAT statistical computer program.

RESULTS AND DISCUSSIONS

Annual Population Fluctuation of TLM Males:-

Weekly mean numbers of TLM males, captured by pheromones traps, were recorded along two successive years (2013-2014) at Abo-homos and Ety-Elbaroud districts in El-Behera Governorate and graphically illustrated in Figure (1 a and b).

Mean numbers of captured TLM moths during the first year of the study (2013), graphically illustrated in Figure (1a), showed that pheromone traps captured limited mean numbers (190.67 male) of TLM in beginning of the year then decreased along winter season till near the end of February, so winter season was lowest season of TLM moths activity with mean population fluctuation range 68: 407.66 male. Near the end of winter season especially in beginning of March male population increased gradually again to achieve highest levels of TLM mean number in next spring that highest mean numbers occurred during this season that ranged from 302.33 to 917male. So highest two increasing peaks noticed in spring 2013 the first one (535.33 male) was in 16 April and the other (917 male) was the more than pervious one that observed in 28 May, then population decreased sharply again toward the end of spring season. As result of decreasing population density of male moths near end of spring, mean numbers of TLM males in summer season was moderated that mean numbers of the population fluctuated between 132 and 464 male, comparing with spring season, so two moderated increasing period were observed during it, the first one was in July and the other in September (near end of summer), while the population size was relatively low in August. Finally, TLM male population decreased in autumn so mean population size was low along this season and not increase than 222.33 male in mid-October.

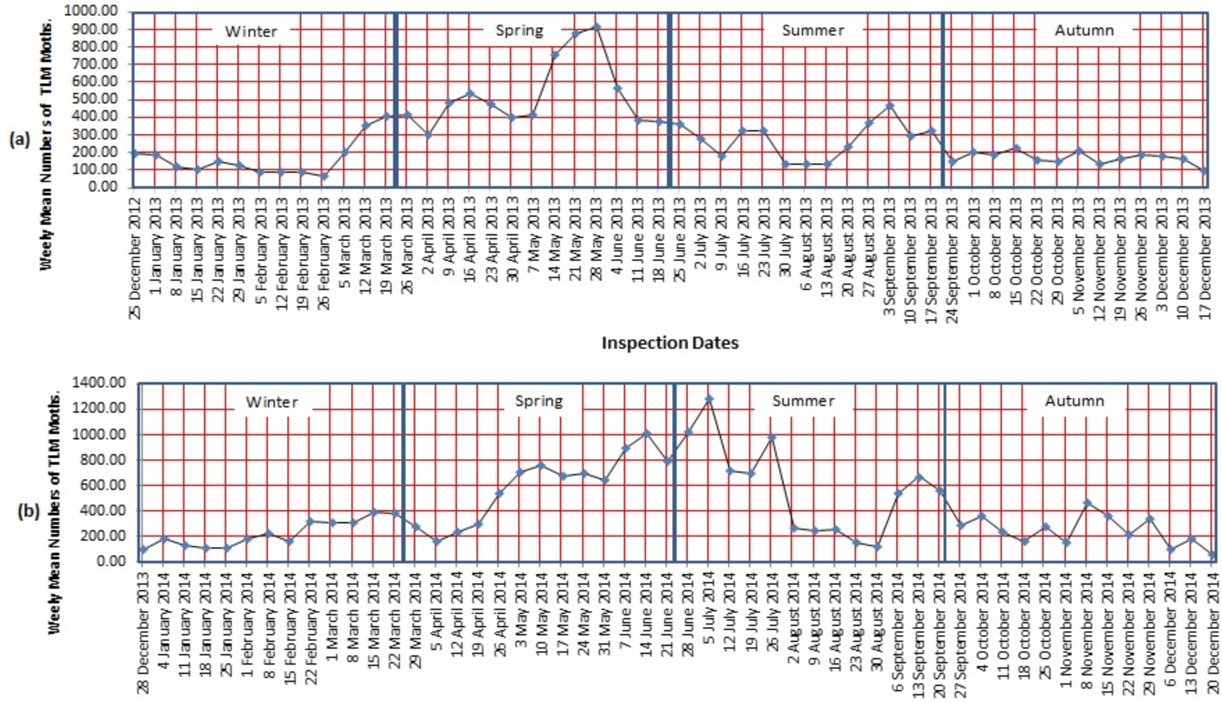

Fig. 1: Population dynamic of *T. absoluta* male moths along two consecutive years (2013-2014) at (a) Abo-homos and (b) Ety-Elbaroud districts, respectively in El-Behera Governorate.

Results of statistical analysis reflected that male population density of LTM varied from season to another that ANOVA test declared high significant difference among seasons (F value = 81.986*** and L.S.D. = 54.116). Spring season was the highest followed by summer, but each of winter and autumn were the lowest that there was no significant difference between them.

Mean numbers of captured TLM moths during the second year of the study (2014), graphically illustrated in Figure (1b), that showed pheromone traps captured gave limited mean numbers (102.33 male) of TLM in beginning of the year. This limited numbers continued near the mid of February then increased from last third of winter season to achieve highest increasing peak in mid-March (390.33 male), so winter season was also lowest season of TLM moths activity (223.64 male). Abundant levels of male population was observed in both of spring (591.36 male) and summer (577.21 male) seasons, respectively that male population increased gradually from beginning of April to achieve two highest levels in mid-May (757.67 male) and mid-June (1015 male) of spring seasons. While the two increasing peak were delayed nearly 14-24 days than those of last year. Abundant mean numbers of TLM males continued along summer season especially in July and September, while it was relatively low in August as occurred at previous year. Highest male population was 1280.33 male which observed at beginning of July. Finally, it decreased in autumn (247.08 male) so mean population size was low along this season as winter season of the same year and not increase than 462.67 male in 8th November.

Finally, Obtained data and results of statistical analysis confirmed the obtained results of previous year that male population density of LTM varied also from season to another. ANOVA test declared high significant difference among seasons (F value = 26.470*** and L.S.D. = 109.57). Summer and spring season had highest levels of TLM males compared with winter and autumn, which were the lowest, moreover no significant difference was observed between them.

Tomato of Autumn plantation, harvested during end of August to early September demonstrating, were harbor the highest levels of infestation expressed as number of larvae/plant foliage in two separate trials in Grosseto (Tuscany). Weekly data for adult *T. absoluta* captured through the use of pheromone lures shows an exponential increase in population size, starting off from a count of fewer than 10 adults per trap per week from the beginning of June to mid-July, and increasing throughout the remaining weeks up to the first week of September, when counts reached an average of 105 adults per trap per week, just before crop harvest Balzan and Moonen (2012). The highest level of TLM infestation were observed in springs of 2009, 2010 and 2011 in Sardinia (Italy) and decreased in following summers then decreased moderately during autumn and was maintained in winter Nannini *et al.* (2012). In Tunisia, pheromone water traps during the period January-May, three flight peaks of *T. absoluta*males were recorded in Takelsa greenhouses, with the highest trap counts recorded in spring Cherif *et al.* (2013). The pest cannot survive under winter temperatures and establish permanent populations outdoors. *T. absoluta*has most likely been introduced in Bulgaria on tomato fruits and packing material in the spring of 2009 from Turkey and Greece. Karadjova *et al.* (2013). In Baltiem district, Kafrel-Sheikh Governorate, Egypt, total numbers of captured male moths were higher in spring plantation than of those during summer plantation season khider *et al.,* (2013).

Effect of Physical Ecological Factors on TLM Males Activity at Solanaceae Plants Fields:-

Means of main climatic factors i.e. daily maximum, minimum and mean temperature as well as mean relative humidity were calculated 7 days earlier from corresponding sampling dates. Simultaneous effects of those factors on TLM males' population density were differed from season to another. Each of maximum, minimum and mean temperature had positive significant effects on TLM males' population during winter season of 2013, that correlation coefficient values for them were 0.693** (P= 0.0086), 0.756** (P=0.0028) and 0.749** (P=0.0032), respectively. On contrary, the same results weren't observed during winter 2014, that those factors had positive insignificant effects on it. While mean relative humidity had negative significant effect on it in both the two years, that correlation coefficient values were -0.791** (P= 0.0013) and-0.855*** (P= 0.0002), respectively. The previously mentioned climatic factors hadn't any significant effects on population density of TLM males during spring and summer seasons of 2013 and the same results were confirmed during summer season of 2014 but temperature factors had highly positive significant effects on population density during spring of 2014 that correlation coefficient values were 0.902*** (P = 0.0000), 0.864*** (P=0.0001) and 0.917*** (P=0.0000), respectively and mean relative humidity had highly negative significant effect on it (r value = -0.855***) (P=0.0002). Effect of the climatic factors on population density of TLM male during autumn differ also from year to another that their effects ranged from insignificant to low significant effect on the population. Wherever, each of minimum and mean temperature had low positive significant effect on it, with "r" values 0.596* (P=0.0694) and 0.555* (P=0.0491), respectively, in addition relative humidity had negative low significant effect on it, with "r" values -0.665* (P=0.0132) only during autumn of 2013. So we can concluded from previous results changes in population density of TLM male, during summer seasons may be refer to other factors. Effects of tested climatic factors during rest seasons differ from year to another.

Those selected climatic factors had obviously effect on population density of TLM males along a year whether results of statistical analysis declared that each of maximum, minimum and mean temperature had positive significant effect on population density along the first year of study (2013), related correlation coefficient values were 0.338* (P= 0.0144), 0.482*** (P=0.0003) and 0.359** (P=0.0037), respectively. Plus, same results were observed also along second year of study (2014), that related correlation coefficient values were 0.566*** (P=0.0000), 0.520*** (P=0.0001) and 0.561*** (P=0.0000), respectively. While mean relative humidity had negative significant effect on it along the two tested years (2013-2014), which related correlation coefficient values were -0.371** (P= 0.0067) and -0.390** (P=0.0043), respectively.

Finally, we can conclude that the significant effect of tested climatic factors is obvious along a year, not can be observed in specific seasons. Results of combined effects of the four selected climatic factors showed that those factors were responsible as a group for 34.09% (F= 8.274***, P=0.0001) on population density of TLM males, during 2013 and the same results was observed in next year (2014) that those factors were responsible as a group for 35.76% (F= 8.908***, P=0.0001) on population density of TLM males.

Estimation Numbers and Durations of Annual Generations of TLM:-

Results of using two different mains of calculation for annual generation of TLM were shown in Tables (1) and (2) and graphically illustrated in Figures (2a and 2b), obtained data declared that *Tuta absoluta* has eleven generation along year. The longest generation duration observed in winter and autumn, while the shortest were in spring and summer seasons.

Estimation annual generation depending on thermal constant and day degree:-

Under climate conditions of 2013 and 2014, number, duration and approximated dates of annual generations were estimated depending on values of threshold of development (zero of development) (t_0) and Thermal constant (C) of *T. absoluta* to develop from egg to adult (8°C and 460 thermal units, respectively) according to Barrientos *et al.*, (1998), and presented in Table (1). These results revealed that *T. absoluta* had 11 field generations on solanaceae plants along both two experimental years. These generations and their duration could be detected as follows. The first and second generation were longest (52 and 38 days, respectively in 2013) or (44 and 41, respectively in 2014) that occurred in winter season. The first one began from end of December to Mid-February nearly, while the second one stared from Mid-February till the last week of March.

Table 1: Number and duration of Annual generations for TLM along two consecutive years (2013-2014) in El-Behera Governorate, estimated depending on thermal constant and day degree according to Richmond (1983).

Number and duration of annual generation in 2013				Number and duration of annual generation in 2014			
No. Generation^{sea}	Approximated date of occurrence		Generation Duration	No. Generation^{sea}	Approximated date of occurrence		Generation Duration
	From	To			From	To	
G1^{w}	25-Dec-12	15-Feb-2013	52	G1^{w}	28-Dec-13	10-Feb-2014	44
G2^{w}	16-Feb	26-Mar	38	G2^{w}	11-Feb	24-Mar	41
G3^{sp}	27-Mar	29-Apr	33	G3^{sp}	25-Mar	28-Apr	34
G4^{sp}	30-Apr	27-May	27	G4^{sp}	29-Apr	25-May	26
G5^{sp}	28-May	26-Jun	29	G5^{sp}	26-May	22-Jun	27
G6^{su}	27-Jun	21-Jul	25	G6^{su}	23-Jun	18-Jul	25
G7^{su}	22-Jul	16-Aug	25	G7^{su}	19-Jul	13-Aug	25
G8^{su}	17-Aug	12-Sep	26	G8^{su}	14-Aug	08-Sep	25
G9^{su-au}	13-Sep	11-Oct	28	G9^{su-au}	09-Sep	06-Oct	27
G10^{au}	12-Oct	10-Nov	29	G10^{au}	07-Oct	04-Nov	28
G11^{au}	11-Nov	16-Dec	35	G11^{au}	05-Nov	07-Dec	32

Abbreviation: No. (Number), G (Generation), sea (Season), w (Winter), sp (Spring), su (Summer), au (Autumn)

Table 2: Number, duration and male mean numbers of Annual generations for TLM along two consecutive years (2013-2014) in El-Behera Governorate, estimated according to Audemard and milaire (1975) and Iacob (1977).

Number and duration of annual generation in 2013					Number and duration of annual generation in 2014				
No. Generation^{sea}	Approximated date of occurrence		Generation Duration (+0 : 12 days)	Male mean number/ generation	No. Generation^{sea}	Approximated date of occurrence		Generation Duration (+0 : 12 days)	Male mean number/ generation
	From (-0 : 6 days earlier)	To (+0 : 6 days later)				From (-0 : 6 days earlier)	To (+0 : 6 days later)		
G1^{w}	25-Dec-2012	12-Feb-2013	49	131.08	G1^{w}	28-Dec-13	08-Feb-2014	42	148.57
G2^{w}	19-Feb	26-Mar	35	254.83	G2^{w}	15-Feb	22-Mar	35	311.22
G3^{sp}	02-Apr	30-Apr	28	437.93	G3^{sp}	29-Mar	26-Apr	28	303.60
G4^{sp}	07-May	28-May	21	740.83	G4^{sp}	03-May	24-May	21	708.83
G5^{sp}	04-Jun	25-Jun	21	422.58	G5^{sp}	31-May	21-Jun	21	833.58
G6^{su}	02-Jul	23-Jul	21	278.17	G6^{su}	28-Jun	19-Jul	21	929.83
G7^{su}	30-Jul	20-Aug	21	157.25	G7^{su}	26-Jul	16-Aug	21	436.25
G8^{su}	27-Aug	17-Sep	21	363.25	G8^{su}	23-Aug	13-Sep	21	369.08
G9^{su-au}	24-Sep	15-Oct	21	189.67	G9^{su-au}	20-Sep	11-Oct	21	364.08
G10^{au}	22-Oct	12-Nov	21	163.67	G10^{au}	18-Oct	08-Nov	21	265.42
G11^{au}	19-Nov	17-Dec	28	158.52	G11^{au}	15-Nov	20-Dec	35	209.50

Abbreviation: No. (Number), G (Generation), sea (Season), w (Winter), sp (Spring), su (Summer), au (Autumn)

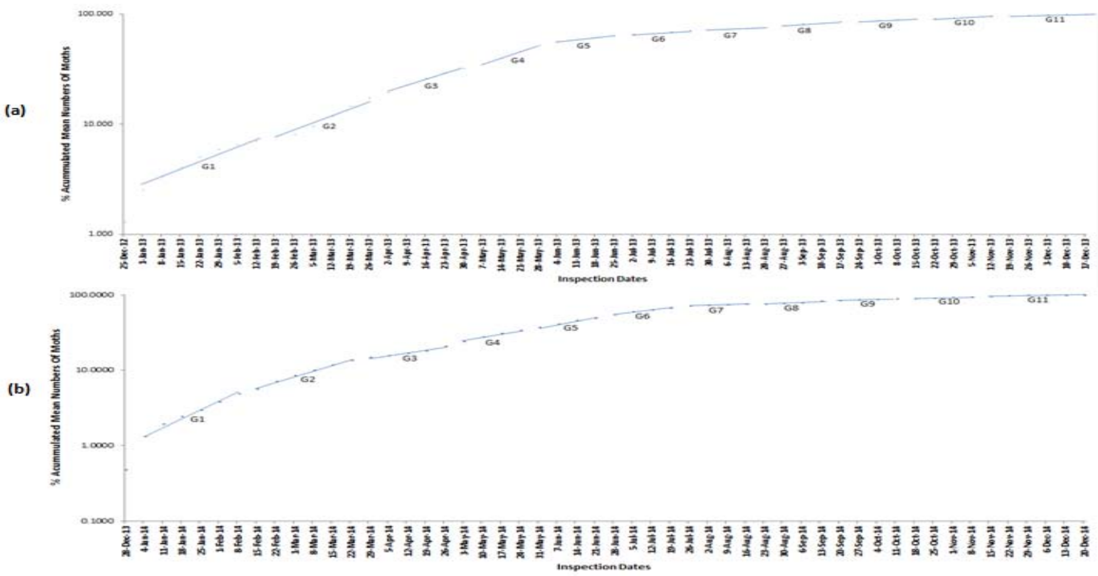

Fig. 2: Numbers of annual generations of *T. absoluta* male moths along two consecutive years (2013-2014) at (a) Abo-homos and (b) Ety-Elbaroud districts, respectively in El-Behera Governorate.

Spring season had three generations with moderated generation durations that ranged from 26 to 34 days. The third generation (the first generation of spring) started from end of March and extended to near end of April, the fourth (second generation of spring) extended from near end of April to last week of May then the fifth generation (third generation of spring) started from last week of May to last third of June.

Summer season had more than three generation that the last generation completed in next season (autumn). The main three generation of summer had lowest duration that ranged from 25-26 days. The sixth generation (first generation of summer) extended from last week of June till the third week of July, the seventh generation (second generation of summer) started from beginning of fourth week of July till Mid-august, then the Eighth generation (third generation of summer) started from beginning of second half of August to near Mid-September.

Ninth generation was overlapped generation that occurred in last month of summer and continues till beginning of autumn especially in first third of October; duration generation ranged 27-28 days. Finally, autumn season had two main generations with moderated duration generation, that tenth generation (first generation of autumn) lasted 28-29 days and occurred from the second week of October to first third of November. While the eleventh generation (second generation of autumn) was longer than previous one that lasted 32-35 days from first third of November to near the second week of December.

Estimation annual generation according to Audemard and milaire (1975) and Jacob (1977):

Seasonal fluctuation of TLM males in El-Behera Governorate was recorded during two consecutive years (2013-2014). The population activity was expected to be consist of several consecutive and overlapping. So, formula suggested by Audemard and Millaire (1975) and Iacob (1977) was applied.

Obtained data are presented in Table (2) and graphically illustrated in Figures (2a) and (2b).These results revealed that number and duration of TLM male generations coincide and agree with obtained results by applying day degree theory. To avoiding the time gapping among separated generation that calculated depending weekly mean numbers records, 0 to 12 days may be added to all generation duration values.

So eleven annual generations were observed also along a year in both years of study, moreover dates and duration of all estimated generations were paralleled also with obtained results of applying of day degree. On the other hand male mean numbers in all recorded generation were estimated. All obtained data reflected that the first TLM male generation of winter seasons was the longest but with lowest mean number of population density of males (131.08 - 148.57 male/ generation in 2013 and 2014 respectively), while the second generation was shorter than previous one but with more population (254.83–311.22 male/generation in 2013 and 2014 respectively).

The three generations of spring which each of them longed from 21-28 days (+ 0: 12 days) had abundant numbers of males especially the fourth generation (second generation of spring), that its mean number of males population were 740.83 and 708.83 male/ generation in both years respectively. So the fourth generation should be concerned in TLM successive control and matting disturbance. The same observation of population abundant were recorded also in summer generation which had nearly equal duration 21 days (+ 0 : 12 days) in the three generation, with exception in the second years that numbers of males peaks sharply in the sixth generation (the first generation of summer) 929.83 male/ generation then decreased again in the next two generations, which had moderate numbers of males 436.25 and 369.08 male/ generation, respectively.

The eighth generation was observed as starting main point of population decreasing that male numbers decreased gradually in next generations till the end of autumn or may be extended in first generation of next year. Ninth generation, considered as overlapped generation between summer and autumn season, longed to 21 days (+ 0 :12 days) and had moderated mean numbers of male 189.67 and 364.08 male/generation for both years, respectively. Autumn generations (tenth and eleventh generation) had nearly low to moderated mean numbers of males that the last generation was with longer generation duration but with fewer in male population than the tenth generation. So from pervious obtained results we can conclude that duration of first and eleventh generations were nearly longest but the lowest in TLM male population mean numbers.

In the laboratory (at a constant temperature of 25°C and 75 % R.H.), *T. absoluta*completes a generation in 28.7 days. Moreover, under the field conditions in Chile, *T. absoluta*could complete seven to eight generations per year Vargas, (1970). Average temperature in a greenhouse with tomato production is about 20°C. Using the same DD calculation method as mentioned above, it is estimated that *T. absoluta*can have 9 generations in a greenhouse with a year round tomato production EPPO (2005). The rate of development is based on the accumulation of heat measured in physiological rather than chronological time. Population of the *Tutaabsoluta* in Qena governorate gave 13 generations while in El-Beheira, Giza and Fayoum governorates gave 11,12 and 12 generations respectively under current climate conditions. In future climatic conditions (in 2050 and 2100) number of TLM generation will increase to 12 and 13 generation, respectively in El-Behera governorate. Numbers of generation will increased with same rates in rest governorates Abolmaaty *et al.,* (2010). In Baltiem district, Kafrel-Sheikh Governorate, Egypt, male moths was increased gradually to reach the reliable occurrence of the 1st generation during the last week of March in spring plantation and first week of May in summer plantation. The peak of this generation was recorded on March, 26th and May, 3rd. After this period the reliable occurrence of the 2nd generation, the pest took place in the first week of April and first May to reach its peak on April, 4th and May, 8th khider *et al.,* (2013).

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ARABIC SUMMERY

الاجيال السنوية والديناميكية العددية لفراشات صانعة انفاق اوراق الطماطم توتا ابسليوتا (رتبة حرشفية الاجنحة– رتُيبة جلشييديا) فى محافظة البحيرة بمصر.

رضا محمد منصور طبيخة [1] - عبد الناصر توفيق حسن[2]
1- قسم وقاية النبات – كلية الزراعة – جامعة دمنهور.
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تعتبر مصر واحدة من اهم الدول المنتجة الطماطم على مستوى العالم وذلك لملائمة ظروفها المناخية لنمو نباتات الطماطم على مدار السنة وخلال ثلاث عروات زراعية متتالية (شتاء وخريف وصيف) وتصاب هذه النباتات. بفراشات نافقات اوراق الطماطم على مدار العام حيث بلغت معدلات الاصابة بها ما يقرب من 70٪ في محافظة البحيرة خلال عام 2011. وبالتالى تهدف الدراسة الحالية القاء بعض الضوء على الديناميكية العددية لعشائر ذكور فراشة نافقات اوراق الطماطم على مدار عامين متتالين (2013-2014) وعلى امتداد المواسم المختلفة وذلك باستخدام المصائد الفرمونية الجنسية بحقول محافظة البحيرة. بالإضافة إلى ذلك دراسة تأثير العوامل المناخية السائدة والتى منها درجات الحرارة القصوى والدنيا والرطوبة النسبية على الوفرة العددية لذكور الفراشة.وعلاوة على ذلك وبشكل اساسى تقدير تعداد ومدة الاجيال السنوية والكثافة العددية لذكورالفراشات خلال كل جيل. ومن خلال تطبيق اثنين من اكثر طرق تقدير عدد ومدة اجيال الحشرات شيوعا مثل طريقة حساب الوحدات الحرارية اليومية التراكمية وقيم الثابت الحرارى للحشرة، والطريقة التى اقترحت بواسطة Audemard و Millaire سنة (1975) و Iacop سنة 1977. وقد اشارت النتائج الى ان الكثافة العددية لذكور فراشة صانعة انفاق الطماطم تختلف من موسم إلى آخر. حيث اعلى تعداد لذكور لوحظ خلال الربيع يليه فصل الصيف، اما تعداد الذكور خلال فصلى الخريف والشتاء كانت اقل حيث أنه لا توجد فروق ذات دلالة إحصائية بين تلك الموسمين الاخرين. ومن ناحية اخرى كان للعوامل المناخية المختبرة تأثيرات واضحة على الكثافة العددية على مدار العام حيث كان تاثيرها مجتمعت على الكثافة العددية للعشيرة بنسبة 34.09٪ و 35.76٪ فى كلا سنتى التجربة على التوالى. ومن خلال الطرق المستخدمة لحساب عدد الاجيال امكن رصد إحدى عشرة جيل للفراشة سنويا فى كلا سنتى الدراسة الحقلية. واظهرت الطرق المستخدمة فى تقدير مدة وعدد اجيال تماثل فى مدد وفترات الاجيال المتماثلة. حيث لوحظ انا الجيل الاول والجيل الحادى عشر هم اطول الاجيال مدتا ولكنهما الاقل كثافة فى تعداد ذكور الفراشات. كما اظهرت الدراسة ان الجيل التاسع جيل متداخل ما بين موسم الصيف والخريف. واخيرا كان لكل من مواسم الربيع والصيف والخريف ثلاث اجيال كلا على حدى.