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Assessment the Damage on Sugar Beet Plants Caused by the Infestion with Beet Fly, *Pegomyia mixta* (Vill) in Sharkia Governorate

Aml Z. N. Al-Habshy; S. A. M. Amer and A. A. Abd – Elsamed
Plant Protection Research Institute, Agric. Res. Center Dokii, Giza, Egypt.

ABSTRACT

The present work was conducted during two successive seasons 2016 / 2017 and 2017/2018 in Diarb – Nigm district, Sharkia Governorate, Egypt to study assessment the damage of yield of sugar beet to infestation of *Pegomyia mixta* (Vill). The results showed that, the relationship between the yield of sugar beet and infestation of *P. mixta* was negative correlation i.e.; the increasing larval infestation caused the decreasing yield vice versa. The economic threshold level for *P. mixta* was 3.7 larvae /plant and the economic injury level was 4.1 larvae / plant in the first season, while, in the second season, the economic threshold level for *P. mixta* was 3.9 larvae / plant and while, in the second season the economic injury level was 4.0 larvae / plant.

Keywords: Sugar beet *(Beta vulgaris* L.), larvae for *Pegomyia mixta* (Vill), economic threshold level, economic injury level and yield

INTRODUCTION

Sugar beet *(Beta vulgaris* L.) is one of the most important sugar crops in the world. The Egyptian government encourages sugar beet growers to increase the cultivated area with sugar beet for decreasing the gap between sugar production by sugar cane and consumption. Sugar beet quality is of great economic importance. Several numbers of insects attack this crop caused considerable damage in its yield, as *Pegomyia mixta* (Vill).

In Egypt Guirguis (1985), Bassyouny (1993 and 1998), Abou-Attia (1999), Helal (2004), El-khouly (2006) and Fouad (2011) found that fly beet *P. mixta* was one of the most serious and abundant species causing damage in sugar beet plants . Zaghloul *et al.* (2015) Experiments were conducted in a private farm cultivated with sugar beet crop for the two successive seasons of 2013/2014 and 2014/2015 to determine the economic damage threshold levels of *P. mixta* under field conditions in Nobaria region, El-Behaira Governorate, Egypt. The results showed that the relationship between the yield of sugar beet and the infestation of sugar beet fly, *P.mixta* was negative, which is means that an increase in larvae numbers caused a decrease in roots yield and vice-versa.

Therefore, the current study aimed to determine the economic injury level and the economic threshold for *P. mixta.*

MATERIALS AND METHODS

This experiment was conducted in a field cultivated with sugar beet at Diarb – Nigm district, Sharkia Governorate, during the two successive seasons, 2016 / 2017 and 2017/2018 to determine the economic damage threshold level of *P. mixta* under field condition. The experimental design was split plot in all growing season, sugar beet plants. An area of about fed, was divided into three replicates were used for each treatment cultivated on the 2nd week of chosen randomly. The chosen plants were labeled and left to natural infestation. All plot received the same agricultural practices during the course of this experiment with no chemical control treatments were applied during the investigation period. The 20 labeled plants were investigated weekly sample date 3rd week January to 2nd week June and the numbers of living larvae per each plant was counted. The yield of each plant was assessed and weighted. Then, the yield of each plant in kilogram was estimated.

Data were subjected to statistical analysis of assessment damage threshold under field conditions according to (Hosny *et al*. 1972, Salem and Zaki. 1985, Sherief. 2009 and Al-Habashy. 2014).

Values corresponding calculation of yield per plant were represented by straight line equation:

$$\hat{Y} = a + bx \quad \textbf{(Golden, 1960)}$$

Where: $\hat{Y}$ **= expected yield, a = y intercept, a constant representing, b = slope of the regression line , x = the number of *P. mixta* (x – x`) and designing regression line by Chi - χ^2 were assessed to calculate the economic injury level.**

$$\chi^2 = \frac{(\sum ai \times pi) - (\sum ai \times p`)}{P` \times q`}$$

$$pi = \frac{Ai}{R}$$

n = number of replicate
ai = mean number of larvae R= size of sample

$$P` = \frac{\sum pi}{n} \qquad q` = 1 - p`$$

RESULTS AND DISCUSSION

The first appearance of *P. mixta* larvae on 3rd week of January with 20 and 19 larvae / plants for the two seasons, respectively. The seasonal fluctuations of *P. mixta* indicated that it has two peaks during the two seasons. The first peak was noticed on 4th week of February during 2016 / 2017 and 1st week of March during 2017/2018 with total number of 114 and 119 larvae / 20 plants, respectively. The second peak was occurred on 3rd week and 4th week of April in both of the first and second seasons with total number of 125 and 114 larvae / 20 plants for the two seasons, respectively.

Bassyouny (1993) who showed that *P. mixta* larvae recorded on sugar beet plants in December then, increased gradually until reached its peak in March. Abou-Attia (1999) showed that *P. mixta* larvae population has two peaks of abundance on sugar beet plants. Helal (2004) indicated that *P. mixta* population gradually increased until it reached its highest density in the March and April. In this respect, El-khouly (2006) found that the reliable occurrence of *P. mixta* individuals occurred in November was gradually increased forming distinct peak in March. Amin *et al.* (2008) indicated that the population density of *P. mixta* fluctuated and recorded two peaks; the first was in early March, while the second was in the first week of April under field conditions at Kafr El-Sheikh Governorate. Sherief (2013) showed that the sugar beet fly *P.mixta* started appear on the plants on the

1st week of December. Two peaks of eggs and larvae were found on sugar beet plant in March and April. Zaghloul *et al.* (2015) indicated that in both seasons, *P.mixta* larvae registered two seasonal peaks of abundance that occurred in February and March. Amany (2017) found that population density of *P. mixta* was low in all sugar beet plantations of both years of study, except in the third (October) plantation of the first season that had 20.58 larvae 125 sugar beet plants. In 2015/ 16 season, the third plantation had the highest *P. mixta* population density during February and March. In the second season, the third plantation had slight increase in the population density of the fly, by mid-March, and throughout April.

Table 1. Nnumber of *P. mixta* larvae / sample infested sugar beet plants under field conditions at Diarb – Nigm district, Sharkia governorate and weight of plant roots during 2016 / 2017 season.

Inspection date		Number of larvae / plant																				Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Jan.	3rd	1	0	0	3	0	0	1	2	2	0	1	0	0	2	5	0	0	0	0	3	20
	4th	0	0	3	1	0	2	2	2	4	3	3	0	1	2	1	0	1	2	2	0	29
Feb.	1st	3	2	2	2	3	0	0	3	1	2	5	3	0	1	2	3	3	0	2	2	39
	2nd	2	2	2	4	0	5	4	0	2	1	1	2	2	2	2	2	0	1	0	1	35
	3rd	0	1	8	8	6	7	6	3	3	4	5	2	5	2	1	9	4	12	2	0	88
	4th	5	0	3	5	3	13	3	9	11	10	1	6	10	2	3	17	3	3	2	5	114
Mar.	1st	3	2	9	3	0	9	6	5	9	6	3	3	4	0	5	5	2	6	0	4	84
	2nd	9	3	0	0	0	6	0	6	2	3	5	4	0	0	5	3	0	4	2	1	53
	3rd	2	0	1	1	2	3	3	2	5	0	5	12	1	2	5	2	6	4	4	2	62
	4th	4	0	0	2	2	0	0	1	0	4	4	5	3	3	0	14	14	7	9	15	87
April	1st	11	9	3	4	2	2	1	3	3	4	0	0	6	3	2	5	4	3	1	3	69
	2nd	3	3	0	0	6	9	3	3	4	5	3	3	10	5	3	2	0	1	2	0	65
	3rd	8	3	1	9	5	12	5	6	12	12	0	9	12	4	4	12	1	2	2	6	125
	4th	3	0	0	5	3	6	3	12	3	4	1	5	5	5	3	9	9	3	3	6	88
May.	1st	3	2	4	3	10	5	9	3	4	6	3	4	5	9	0	5	5	2	1	0	83
	2nd	1	2	2	3	3	4	5	2	0	3	3	0	1	2	2	3	0	0	3	0	39
	3rd	0	9	0	1	3	3	1	0	0	0	1	2	12	3	3	2	0	0	3	0	43
	4th	1	2	1	2	3	3	0	0	3	6	0	2	4	1	2	1	0	2	3	3	39
June	1st	0	0	6	3	3	3	0	0	2	1	0	0	1	1	2	0	0	0	1	2	25
	2nd	1	0	0	1	1	0	2	3	0	0	0	0	0	0	0	0	1	3	3	3	18
Total		60	40	45	60	55	92	54	65	70	74	44	62	82	49	50	94	53	55	45	56	
Mean		3.0	2.0	2.25	3.0	2.75	4.6	2.7	3.25	3.5	3.7	2.2	3.1	4.1	2.45	2.5	4.7	2.65	2.75	2.25	2.8	
Yield (kg)		1.9	3.5	2.9	1.87	2.1	1.2	2.25	1.8	1.75	1.67	3.2	1.85	1.5	2.51	2.47	1.0	2.31	2.2	2.7	1.95	

Table 2. Nnumber of *P. mixta* larvae / sample infested sugar beet plants under field conditions at Diarb – Nigm district, Sharkia governorate and weight of plant roots during 2017 / 2018 season.

Inspection date		Number of larvae / plant																				Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Jan.	3rd	1	0	2	0	2	2	1	2	0	2	3	0	0	2	0	0	0	0	2	0	19
	4th	0	1	2	2	3	3	2	4	3	1	2	1	1	2	0	3	3	0	4	0	37
Feb.	1st	2	2	1	0	2	1	2	5	2	2	3	3	4	3	1	0	3	1	2	1	40
	2nd	1	2	2	4	2	0	0	3	3	6	0	0	5	4	3	0	0	2	2	0	39
	3rd	12	5	3	1	2	3	0	4	3	9	2	2	3	9	4	1	1	2	2	0	68
	4th	5	9	2	2	6	4	3	8	0	2	3	2	3	9	6	3	3	3	3	0	76
Mar.	1st	3	5	9	2	13	10	5	12	5	6	6	3	3	12	6	6	5	5	3	0	119
	2nd	0	1	3	1	4	3	2	5	6	2	3	1	2	6	3	3	9	2	1	2	59
	3rd	1	0	0	2	3	0	0	3	9	2	12	3	9	1	5	5	4	1	5	0	65
	4th	0	1	2	3	4	4	1	5	2	12	3	1	2	2	0	12	3	0	1	2	60
April	1st	3	2	1	4	6	6	4	5	5	0	8	5	2	1	3	6	0	2	1	5	69
	2nd	2	4	4	1	7	4	9	4	3	6	3	4	2	4	0	0	3	1	2	9	72
	3rd	8	0	3	3	3	6	12	3	0	3	1	12	5	1	3	3	0	2	0	6	74
	4th	3	3	9	3	12	9	6	10	5	9	6	2	3	9	5	5	2	8	2	3	114
May.	1st	3	3	4	1	5	12	6	4	3	3	2	3	0	5	4	3	3	0	1	0	65
	2nd	0	0	12	12	4	5	0	3	0	0	1	2	0	6	7	3	1	2	3	3	64
	3rd	1	2	8	3	6	0	2	1	2	2	3	0	0	1	2	1	0	2	1	0	37
	4th	0	0	2	0	3	2	3	6	0	0	1	2	3	3	0	0	0	0	3	3	31
June	1st	3	9	3	0	1	2	3	3	0	0	0	0	0	0	0	0	1	1	3	2	31
	2nd	0	0	0	0	5	2	0	0	3	3	0	0	1	0	0	0	0	0	0	0	14
Total		48	49	72	44	93	78	61	90	54	70	62	46	48	80	52	54	41	34	41	36	
Mean		2.4	2.45	3.6	2.2	4.65	3.9	3.05	4.5	2.7	3.5	3.1	2.3	2.4	4.0	2.6	2.7	2.05	1.7	2.05	1.8	
Yield (kg)		2.75	2.45	1.64	3.5	0.9	1.6	1.9	1.3	2.22	1.7	1.85	3.33	2.8	1.52	2.3	2.0	3.6	3.95	3.84	3.9	

Data obtained in Table (3) and Fig. (1) showed that during the first season up to 3.7 larvae / plant, the value of χ^2 (15.58) indicated that insignificant reduction occurred in yield from 1.75 to 1.67 kg / plant as a result of increasing the number of larvae / plant from 3.5 to 3.7, while at number of 4.1 larvae / plant, the χ^2 value became significant (32.53). In other words, when number of larvae / plant reached to 4.1 significant drop in yield occurred and the value before 3.7

could be considered as economic threshold level. While, the relationship between the yield and the infestation was negative as the first season with a coefficient r = - 0.9196 and coefficient regression b =- 0.7531.

Table 3. Economic threshold and injury levels of *P. mixta* larvae under natural infestation during the season 2016 / 2017 at Sharkia Governorate.

Sample No.	a.i	Y yield	Y expected	R	Pi= ai/R	aixpi	χ^2=(Σaixpi-(Σaixp`)/p`x q`	χ^2 Table 5%
1	2	3.5	2.89	3	0.667	1.333	0.00	3.84
2	2.2	3.2	2.74	3	0.733	1.613	0.03	5.99
3	2.25	2.9	2.71	3	0.750	1.688	0.06	7.82
4	2.25	2.7	2.71	3	0.750	1.688	0.07	9.49
5	2.45	2.51	2.56	3	0.817	2.001	0.18	11.07
6	2.5	2.47	2.52	3	0.833	2.083	0.30	12.59
7	2.65	2.31	2.40	3	0.883	2.341	0.55	14.07
8	2.7	2.25	2.37	3	0.900	2.430	0.82	15.51
9	2.75	2.2	2.33	3	0.917	2.521	1.13	16.92
10	2.75	2.1	2.33	3	0.917	2.521	1.40	18.31
11	2.8	1.95	2.29	3	0.933	2.613	1.73	19.68
12	3	1.9	2.14	3	1.000	3.000	2.47	21.03
13	3	1.87	2.14	3	1.000	3.000	3.19	22.36
14	3.1	1.85	2.07	3	1.033	3.203	4.23	23.69
15	3.25	1.8	1.95	3	1.083	3.521	5.92	25.00
16	3.5	1.75	1.76	3	1.167	4.083	9.35	26.30
17	3.7	1.67	1.61	3	1.233	4.563	15.58	27.59
18	4.1	1.5	1.31	3	1.367	5.603	32.53	28.87
19	4.6	1.2	0.94	3	1.533	7.053	109.81	30.14
20	4.7	1	0.86	3	1.567	7.363	-889.44	31.41

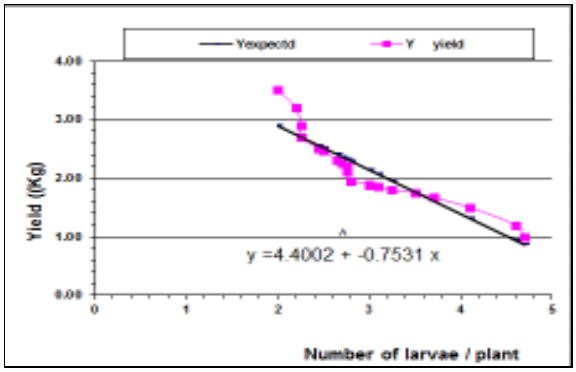

Fig. 1. The regression line between yield and number of *P. mixta* larvae during 2016 / 2017 season.

Results obtained in Table (4) and Fig (2) revealed that during the second season up to 3.9 larvae / plant, the value of χ^2 (19.11) indicated that insignificant reduction occurred in yield from 1.64 to 1.6 kg / plant as a results of increasing the number of larvae / plant from 3.6 to 3.9, while at number of 4.0 larvae / plant, the χ^2 value became significant (29.80). In other words, when number of larvae / plant reached to 4.0, significant drop in yield occurred and the value before 3.9 could be considered as economic threshold level. While, the relationship between the yield and the infestation was negative as the previous season with a coefficient r = - 0.9239 and coefficient regression b =- 1.0033.

Table 4. Economic threshold and injury levels of *P. mixta* larvae under natural infestation during the season 2017 / 2018 at Sharkia Governorate.

Sample No.	a.i	Y yield	Y expected	R	Pi = ai/R	aixpi	χ^2= (Σaixpi-(Σaixp`)/p`x q`	χ^2 Table 5%
1	1.7	3.95	3.64	3	0.567	0.963	0.00	3.84
2	1.8	3.9	3.54	3	0.600	1.080	0.01	5.99
3	2.05	3.84	3.29	3	0.683	1.401	0.09	7.82
4	2.05	3.6	3.29	3	0.683	1.401	0.14	9.49
5	2.2	3.5	3.14	3	0.733	1.613	0.25	11.07
6	2.3	3.33	3.04	3	0.767	1.763	0.40	12.59
7	2.4	2.8	2.94	3	0.800	1.920	0.61	14.07
8	2.4	2.75	2.94	3	0.800	1.920	0.77	15.51
9	2.45	2.45	2.89	3	0.817	2.001	0.96	16.92
10	2.6	2.3	2.74	3	0.867	2.253	1.30	18.31
11	2.7	2.22	2.64	3	0.900	2.430	1.76	19.68
12	2.7	2.0	2.64	3	0.900	2.430	2.18	21.03
13	3.05	1.9	2.28	3	1.017	3.101	3.38	22.36
14	3.1	1.85	2.23	3	1.033	3.203	4.71	23.69
15	3.5	1.7	1.83	3	1.167	4.083	7.81	25.00
16	3.6	1.64	1.73	3	1.200	4.320	11.83	26.30
17	3.9	1.6	1.43	3	1.300	5.070	19.11	27.59
18	4.0	1.52	1.33	3	1.333	5.333	29.80	28.87
19	4.5	1.3	0.83	3	1.500	6.750	57.56	30.14
20	4.65	0.9	0.68	3	1.550	7.208	128.93	31.41

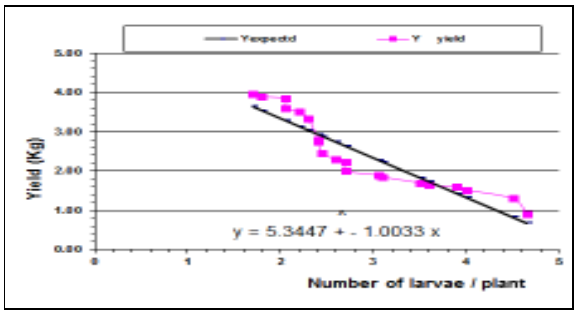

Fig. 2. The regression line between yield and number of *P. mixta* larvae during 2017 / 2018 season.

Bassyouny (1998) showed that theoretical injury level of *P. mixta* larvae on six plant ages from 1 to 6 month old were 12.5, 13.1, 24.3, 28.9, 52.4 and 118.6 larvae/plant .

Ebieda (1998) stated that the highest percentage of sugar beet infested leaves by beet fly, *P. mixta* per plant was 72.73 % decreased leaves (50.32 %), gross (29.40 %), root (23.15 %) and theoretical sugar yield (15.92 %). On the contrary, it increased root: leaves ratio (54.98 %), percentage of sucrose (9.72) T.S.S. % (9.58) and percentage of root/gross yield (8.97). The injury levels of *P. mixta* were 24.24, 12.12, 42.42, 12.12, 24.24 and 24.24 for root, leaves, sugar, gross yield, root, leaves ratio and percentage of root/gross yield, respectively.

Hussein (2005) recorded that the theoretical economic injury levels of *P. mixta* were calculated in this manner at three dates 1st Jan., 1st Feb. and 1st Mar. They were 17.05, 21.29, and 70.0 in season (2002/2003) and 13.0, 66.0, and 86.0 larvae/plant, in season (2003/2004), respectively.

Fouad (2011) who mentioned that the damage threshold (D.T.) with the mean of (23.5 larvae / plant) and the X^2 calculated equal (32.48) and the economic injury level (43.99) in the first season, while, the damage threshold (D.T = 29.55) at 0.05 levels when, the one plant received 24.50 larvae and the economic injury level equal 25.00 larvae / plant when the calculated X^2 was (36.12). in the second season. Zaghloul *et al.* (2015) showed that the determined economic threshold level for *P.mixta* was 19 larvae / plant and the economic injury level was 22 larvae / plant in the first season. But the values were 21larvae / plant and 22 larvae / plant, in respect, in the second season.

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تقدير الضرر على نباتات بنجر السكر بسبب الإصابة بذبابة البنجر في محافظة الشرقية

أمل زكريا نورا لدين الحبشي ، سعيد عبدالفتاح محمود عامر و عبدالله على عبدالصمد

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقي – جيزة- مصر

أجريت الدراسة في خلال موسمين متتاليين 2016 /2017 و 2017 / 2018 في منطقة ديرب نجم محافظة الشرقية - مصر لتقدير الخسارة لمحصول بنجر السكر نتيجة الإصابة بذبابة البنجر. النتائج اوضحت ان العلاقة بين محصول بنجر السكر والإصابة بذبابة البنجر علاقة عكسية بزيادة الاصابة اليرقية يسبب نقص فى المحصول والعكس بالعكس. حيث أظهرت النتائج ان الحد الاقتصادى الحرج لذبابة البنجر كان 3.7 يرقة / نبات ومستوى الضرر الاقتصادى كان 4.1 يرقة / نبات فى الموسم الاول بينما فى الموسم الثانى الحد الاقتصادى الحرج لذبابة البنجر كان 3.9 يرقة / نبات ومستوى الضرر الاقتصادى كان 4 يرقة / نبات