Journal of Plant Protection and Pathology

Journal homepage: www.jppp.mans.edu.eg
Available online at: www.jppp.journals.ekb.eg

Impact of Sowing Dates and *Nasonia vitripennis* (Hymenoptera: Pteromalidae) as a New Identified Parasitoid of the Sugar Beet Fly, *Pegomyia Mixta*

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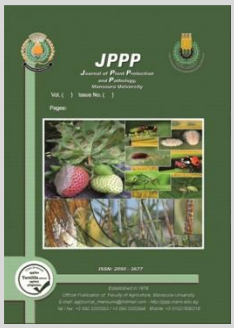

ABSTRACT

Sugar beet, *Beta Vulgaris* L. is a strategic crop of sugar industry in Egypt. Sugar-beet fly, *Pegomyia mixta* Vill. (Diptera: Anthomyiidae), is considered to be the most serious insect pest attacking sugar-beet all over the world. The intensive use of chemical insecticides led to suppress the role of parasitoids in sugar beet fields. Thus, this work was undertaken at the experimental farm of Sakha Agricultural Research Station – kafr Elsheikh Governorate during two successive seasons 2019/ 2020 and 2020/ 2021, to examine the influence of agricultural and biological control methos in reducing populations of *P. mixta.* Results proved that the third plantation date had the highest populations of *P. mixta* larvae compared with the first and second plantation dates during the two seasons of the study. As far as we know, the larval-pupal parasitoid, *Nasonia vitripennis* (Walker) is identified for the first time from *P. mixta* larvae in Egyptian sugar beet fields. Percentages of larval parasitism of *P. mixta* that caused by *N. vitripennis* were 38.23, 36.76 and 35.77% in the first, second, and third plantation dates, respectively in 2019/2020 season. While, they were were 48.27, 56.94 and 32.74%, respectively in 2020/2021 season. In Integrated Pest Management programs, *N.vitripennis* and sowing dates might be taken in consideration for reducing populations of *P. mixta*.

Keywords: Agricultural and biological control, Integrated Pest Management, larva-pupal parasitoids, sugar beet

INTRODUCTION

Sugar beet, *Beta Vulgaris* L. is a strategic crop of sugar industry in Egypt. This crop comes in the second rank after sugarcae in its importace as a sugar crop. It is cultivated in 608.6 thousand feddans with an average yield of about 18.5 tons/ feddan in 2018/2019 (Annual report of sugar crops council, 2020). Recently, the gap between sugar production and consumption estimated to be 5000 tons (Afifi, 2001). Acorrdingly, the current policy of the Egyptain ministry of agriculture is to increase the cultivated area and to maximize yield production of sugar beet. The importance of this crop is not only to produce sugar but also to use its top parts in feeding animals due to the high nutritive value of the sugar beet canopy.

The sugar beet fly, *Pegomyia mixta* Vill. (Diptera: Anthomyiidae), is considered to be the most serious insect pest attacking sugar beet all over the world including Egypt (Abdel - Moniem, 2014; AL- Habshy, 2018; Awadalla *et al.* 2018). The yield losses by this insect pest reached up to 40% (Salama *et al.* 1991). Abo-Saied (1998) estimated the leaf consumption by an individual larva of all instars to be 23.6 cm^2 (about 25 % of leaf area). Further, Metwally *et al.* (1987) recorded the reductions in root weight and sugar content by *P. mixta* to be 31.50% and 40.50% respectively.

The intensive use of chemical insecticides led to suppress the role of parasitoids in sugar beet fields. In contrast, biological control approach is considered as a main component of the Integrated Pest Management programs (IPM). Many reseachers have reported the efficiency of insect parasitoids in regulating populations of sugar beet insects (Hassanein *et al.*, 1993; Awadalla, 1997; El- Serwy, 2008; Mousa, 2005; Bazazo *et al.* 2017). They found that the larval-pupal parasitoid *Opius nitidulator* (Nees) (Hymenoptera: Braconidae) seems to be an important biocontrol agent in decreasing populations of *P. mixta*. Percentages of parasitism by this parasitoid ranged between 3.2 to 56.50%.

Khalifa (2018) recorded that *P. mixta*, populations were low in the first and second plantation dates, but high in the third ones. Sowing dates are fundamental component in IPM programs against sugar beet insects.In Egypt, several studies have examined the influence of different sugar beet cultivars, sowing dates, several of foliar, mineral, and biofertlizers on sugar beet traits (Ismail and Abo El-Ghait, 2005; Osman, 2005; Ismail *et al.*, 2006 and Abdel-Razek, 2006). However, few data are available regarding their influence sugar beet pests. Therefore, the objectives of this study were to estimate the suitable sowing date for minmising infestation by the sugar beet fly and the role of parasitoids in reducing populations of *P. mixta*.

MATERIALS AND METHODS

The current study was done at the experimental farm at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate for two successive Seasons; 2019 / 2020 and 2020 / 2021. The experimental area was about one and half feddan. The first half was planted on 15th August, the second half was cultivated on 15th September, and the third one was sowing on 15th October in both seasons. Sugar beet

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DOI: 10.21608/jppp.2021.206308

variety, Karam was sown in three plantation dates, and all cultural practices were followed as recommended, but without any insecticide applications. Every half was divided into thre replicates. Each sample consisted of 30 plants that were collected randomly (10 plants / replicate).

Numbers of larvae and infested plants were visually counted. Afterwards, larvae were put into Petri dishes (9 cm^2 in diameter) with filter paper and a piece of cotton staturated with water The larvae were fed with pieces of sugar beet leaves and these leveas replaced daily till pupation. Larvae werekept under laboratory conditions (25 ±2 C, 65 ± 5% R.H.). Afterwards, the pupae were transferred into another Pertri dishes till emergency (Adult or parasitoids). The parasitoids were recorded daily and counted and preservered in 75% ethyl alcohol.

Percentages of parasilism were calculated every sampling date according to the following formula:

% Parasitism= number of parasitoids / number of larva × 100

Parasitoids were identified through the department of insect taxonomy at the plant Protection Research Institute, Agricultural Research Center, Egypt.

Statistical analysis :

Data were subjected to analysis of Variance (ANOVA) and means were compared using Duncan's Multiple Range Test (1955) and Least Significant Differences (LSD) at 5% probability level.

RESULTS AND DISCUSSION

Tables (1 and 2) indicate that the third plantation had the highest populations of *P. mixta* larvae and numbers of infested plants with this insect in comparison with the first and second plantations during the two seasons 2019/2020 and 2020/2021.

In 2019/2020, means of *P. mixta* larvae were 11:33, 22.66 and 36.33 for the three cultivation dates, respectively, whereas, means of infested plants were 6.00, 11.00 and 15.66 in the three cultivation dates, respectively. In 2020/2021 season, means of *P. mixta* larvae were. 9.66, 24.00 and 37.66 in the three culvation dates, respectively. While, means of infested plants were 5.00, 10.66 and 17.00 in the three cultivation dates, respectively.

Statistical analysis proved that significant differences among the three cultivation dates throughout the two seasons.

A similar results were obtained by Awadalla (1997) who indicated that the larval populations of *P. mixta* were high in beginning of March. Abo-Saied Ahmed (1998) concluded that the third plantations were severely affected by this insect. Also, El- Khouly (2006) detected *P.mixta* larvae from November, with a progressive increase towards the end of the season. Thus, it is recommended to cultivate sugar beet plants in the first and second plantations to avoid the highest infestations of *P. mixta*.

Table 1. Mean number of *P. mixta* larvae and its infested plants acoording to different planting date during 2019/2020 season.

date	1st cultivation				2nd cultivation				3rd cultivation			
	Larvae		Infested plants		Larvae		Infested plants		Larvae		Infested plants	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean
15/11/2019	2	0.66	1	0.33	-	-	-	-	-	-	-	-
30/11	3	1.00	2	0.66	-	-	-	-	-	-	-	-
15/12	6	2.00	2	0.66	8	2.66	3	1.00	-	-	-	-
30/12	7	2.33	3	1.00	8	2.66	4	1.33	-	-	-	-
15/1/2020	7	2.33	5	1.66	10	3.33	6	2.00	9	3.00	5	1.66
30/1	9	3.00	5	1.66	10	3.33	6	2.00	9	3.00	6	2.00
15/2	-	-	-	-	14	4.66	7	2.33	15	5.00	8	2.66
29/2	-	-	-	-	18	6.00	7	2.33	18	6.00	8	2.66
15/3	-	-	-	-	-	-	-	-	26	8.66	10	3.33
30/3	-	-	-	-	-	-	-	-	32	10.66	10	3.33
Total	34	11.33	18	6.00	68	22.66	33	11.00	109	36.33	47	15.66
L.S.D 0.05% Value	6.10 (Larvae)								5.19 (Infested plants)			

Table 2. Mean number of *P. mixta* larvae and its infested plants acoording to different planting date during 2020/2021 season.

date	1st Cultivation				2nd Cultivation				3rd Cultivation			
	Larvae		Infested plants		Larvae		Infested plants		Larvae		Infested plants	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean
14/11/2020	1	0.33	1	0.33	-	-	-	-	-	-	-	-
29/11	2	0.66	1	0.33	-	-	-	-	-	-	-	-
14/12	3	1.00	3	1.00	6	2.00	2	0.66	-	-	-	-
28/12	5	1.66	3	1.00	7	2.33	3	1.00	-	-	-	-
13/1/2021	8	2.66	3	1.00	12	4.00	5	1.66	8	2.66	6	2.00
28/1	10	3.33	4	1.33	12	4.00	6	2.00	9	3.00	6	2.00
14/2	-	-	-	-	15	5.00	8	2.66	16	5.33	9	3.00
29/2	-	-	-	-	20	6.66	8	2.66	20	6.66	10	3.33
14/3	-	-	-	-	-	-	-	-	27	9.00	10	3.33
30/3	-	-	-	-	-	-	-	-	33	11.00	10	3.33
Total	29	9.66	15	5.00	72	24.00	32	10.66	113	37.66	51	17.00
L.S.D 0.05% Value	70.10 (Larvae)								6.02 (Infested plants)			

Tables (3 and 4) shows the percentages of larval-pupal parasitism in *P.mixta* population that caused by *N.vitripennis* were 38.23, 36.76 and 35.77% in the first, second, and third sowing date, respectively in 2019/2020. In

the second season (2020/2021), they were 48.27, 56.94 and 32.74% in the first, second, and third sowing date, respectively.

In the first season, parasitism (%) ranged between 0.00 and 44.44%; 25.00 and 44.44% and 22.22 and 42.30% in the first, second, and third sowing date, respectively. In the second season (2020/2021), parasitism% ranged between 40.00 and 100 %; 50.00 and 83.33%; and 30.00 and 40.74% in the first, second, and third sowing date, respectively.

Table 3. The percentage of parasitism caused by larval-pupal *parasitoid N. vitripennis* on the sugar beet fly *P. mixta* during 2019/2020 season.

Date	1st Cultivation				2nd Cultivation				3rd Cultivation			
	No. Larvae	No. pupae	No. Parasitoid	Parasitism	No. Larvae	No. pupae	No. Parasitoid	Parasitism	No. Larvae	No. pupae	No. Parasitoid	Parasitism
15/11/2019	2	2	0	0.00	-	-	-	-	-	-	-	-
30/11	3	3	1	33.33	-	-	-	-	-	-	-	-
15/12	6	5	2	33.33	8	6	2	25.00	-	-	-	-
30/12	7	5	3	42.85	8	6	3	37.50	-	-	-	-
15/1/2020	7	7	3	42.85	10	8	3	30.00	9	7	2	22.22
30/1	9	7	4	44.44	10	8	4	40.00	9	8	3	33.33
15/2	-	-	-	-	14	12	5	35.71	15	13	4	26.66
29/2	-	-	-	-	18	15	8	44.44	18	16	6	33.33
15/3	-	-	-	-	-	-	-	-	26	23	11	42.30
30/3	-	-	-	-	-	-	-	-	32	29	13	40.62
Total	34	29	13	38.23	68	55	25	36.76	109	96	39	35.77

Table 4. The percentage of parasitism caused by larval-pupal *parasitoid N. vitripennis* on the sugar beet fly *P. mixta* during 2020/2021 season.

Date	1st Cultivation				2nd Cultivation				3rd Cultivation			
	No. Larvae	No. pupae	No. Parasitoid	Parasitism	No. Larvae	No. pupae	No. Parasitoid	Parasitism	No. Larvae	No. pupae	No. Parasitoid	Parasitism
14/11/2020	1	1	1	100.00	-	-	-	-	-	-	-	-
29/11	2	1	1	50.00	-	-	-	-	-	-	-	-
14/12	3	3	2	66.66	6	6	5	83.33	-	-	-	-
28/12	5	5	2	40.00	7	6	4	57.14	-	-	-	-
13/1/2021	8	7	4	50.00	12	11	6	50.00	8	8	3	37.50
28/1	10	9	4	40.00	12	11	6	50.00	9	8	3	33.33
14/2	-	-	-	-	15	13	10	66.66	16	15	6	37.50
29/2	-	-	-	-	20	18	10	50.00	20	18	6	30.00
14/3	-	-	-	-	-	-	-	-	27	26	11	40.74
30/3	-	-	-	-	-	-	-	-	33	31	13	39.39
Total	29	26	14	48.27	72	65	41	56.94	113	106	37	32.74

Eshuis van der Voet (1975) recorded that 48.8 % of *Protocalliphora* spp. pupae were infested by *N.vitripennis* in in Holland, while in the USA, 20.1 % of this species pupae found to be parasitized by the same wasp (Gold *et al.*, 1989). The parasitization of *N. vitripennis* reported was 42.1% in *Protocalliphora azurea* pupae and 15.8% in *Protocalliphora falcozi* pupae (Peters, 2006).

In such concern, Raychoudhury *et al.* (2010) modicated that the hymemopterous parasitoid, *N. vitripennis* an important parasitoid against Diptera in North America. Duan *et al.* (2020) proved that *N. vitripennis* play a vital role in controlling flies in agroecosystems.

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تأثير مواعيد الزراعة والطفيل *Nasonia vitripennis* كأحد الطفيليات الجديدة في مكافحة ذبابة البنجر.

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يعتبر بنجر السكر أحد المحاصيل الاستراتيجية الصناعية الهامة في مصر. يهدد هذا المحصول بالعديد من الآفات الحشرية من أهمها ذبابة البنجر. الاستخدام المفرط للمبيدات الكيماوية يقلل دور الطفيليات الحشرية في حقول بنجر السكر. لذلك، أجري هذا البحث في المزرعة البحثية لمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ – خلال موسمي 2020/2019م و 2021/2020م. أثبتت النتائج ما يلي: عدد اليرقات لذبابة البنجر وكذلك عدد النباتات المصابة أعلي في العروة الثالثة عن الثانية والأولي خلال الموسمين. أيضاً، كان المتوسط العام للتطفل طوال الموسم هو 38,23، 36,76 و35,77% للثلاث عروات خلال 2020/2019م علي التوالي بينما كانت القيم خلال موسم 2021/2020م هي 48,27، 56,94 و 32,74% للثلاث عروات وذلك بسبب الطفيل اليرقي – العذراء *Nasonia vitripennis* علي التوالي . تعتبر هذه الدراسة هي أول بحث عن هذا الطفيل في حقول بنجر السكر المصرية. في النهاية، يعتبر الطفيل *Nasonia vitripennis* ومواعيد الزراعة عوامل هامة جداً في برنامج المكافحة المتكاملة لهذه الآفة الخطيرة.