DIAPAUSE AND PARASITISM OF THE SUGAR BEET LEAFMINER, *PEGOMYA MIXTA* VILLENEUVE (DIPTERA: ANTHOMYIIDAE), PUPAE REARED FROM CERTAIN CHENOPODIACEOUS HOST PLANTS AT GIZA

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Abstract

Leaves infested by the sugar beet leafminer, *Pegomya mixta* Villeneuve (Diptera: Anthomyiidae) were collected from untreated sugar beet, *Beta vulgaris* L., spinach, *Spinacia oleracea* L., goosefoot, *Chenopodium murale* L. and wild beet *Beta vulgaris* var. *perennis* during the period from November, 2004 to April, 2005 and with Chard, *Beta vulgaris* var. *cicla* L. and mangold, *Beta vulgaris* var. *vulgaris* during the same period in 2005 and 2006 in the farm of the Agric. Exp. Sta., at Giza. Rate and incidence of diapause and parasitism and emergence of flies and parasitoids were determined. The overall mean of diapause was higher 49.3% (2004-2005) opposed to 38.5% (2005- 2006). Parasitism followed the same trend with 45.6% versus to 42.1% in the same seasons. Rate and incidence of diapause and parasitism were highly variable among puparia reared from the different chenopodiaceous host plants. The prevalence of higher general rates of diapause (67, 39.6 and 29.3%) and parasitism (77.3, 41.1 and 40.3%) were recorded on puparia reared from wild beet, goosefoot and sugar beet, whereas 55.1% (diapause) and 34.5% (parasitism) were attained on spinach puparia. Rate of diapause ranged between (0- 36.9%) and (10.6- 42.5%) on pupae developed from infested leaves of sugar beet and goosefoot in 2004- 2005 and 2005- 2006, but decreased from 64.6 to 45.7% and from 67.6 to 64.7% for those reared from spinach and wild beet in the same period. However, parasitism ranged between (31.9- 37.2%), (38.7- 64.9%) and (52.9- 83.1%) on parasitized puparia collected from spinach, goosefoot and wild beet in 2005- 2006 and 2004- 2005, but increased from 39.1% to 40.6% on sugar beet puparia from the first to the second season one. In both seasons, puparia went into aestivation (summer diapause) during February- April, but 1.3% entered hibernation (overwinter diapause) during November- January in 2005- 2006. Aestivated puparia started at rates of 21.9 and 41.8% in February, increased to 27.6% and slightly decreased to 37.5% in March and reached the highest rates 84.8 and 70.7% in April of 2005 and 2006, respectively. Synchronization was found between the timing of the highest percentages of emerged flies about (92 and 91%) and parasitoids (91 and 79%) in November of 2005 and 2006. The huge numbers of emerged parasitoids occurred with the high rates of parasitism 78.9 and 62.8% in November, 2004 and 2005. Such synchronization was found in 2004- 2005 active season, but was lost in the second one. In April of 2005, the highest

percentages of emerged parasitoids and flies were 70.8 and 43.2%, but were 34.2 and 49.4% in January and April in 2006. To prevent and promote parasitoids, insecticides must be entirely avoided, agricultural practices i. e. deeply plowing, destruction alternative host weeds, hand pick and destroying infested mined leaves weekly before the larvae drop to the soil and dropping kerosene into water irrigation in a rate of 30 liter / feddan (4200 m^2) reduce the population size of *P. mixta* and largely solving the likelihood and severity of leafminers problems in sugar beets.

INTRODUCTION

The sugar beet leafminer, *Pegomya mixta* Villeneuve (Diptera: Anthomyiidae), attacks sugar beet, *Beta vulgaris* L., spinach, *Spinacia oleracea* L., chard, *Beta vulgaris* var. *cicla* L., mangold, *Beta vulgaris* var. *vulgaris* and many weeds including goosefoot, *Chenopodium murale* L. and wild beet, *Beta vulgaris* var. *perennis* at Giza in Egypt. The activity period of the flies extending from mid November to the end of May and had two overlapping generations in a year (El-Saeady and Shaheen, 1987). Three pupal parasitoids, *Opius nitidulator* (Nees) (Braconidae), *Pachycrepoideus vindemmiae* (Rondani) (Pteromalidae) and *Phygadeuon* sp. (Ichneumonidae) were recorded. Both healthy and parasitized puparia by the braconid parasitoid entered diapause during the growing season (Hafez *et al.,* 1970 , El-Serwy, 2007 a and 2007 b). Several authors contributed to parasitism of *O. nitidulator* on active puparia (Ewais, 1990, El-Agamy *et al.*, 1994, Zawrah, 2000). To avoid insecticide application, the repellent oils of butyl acetate and mustard as well as the mangold , *B. vulgaris* var. *vulgaris* as trapping plants were used against the beet leafminer, *Pegomyia betae* Curtis and the spinach leafminer, *Pegomyia hyoscyami* (Panzer) in sugar beet fields (Metzger and Trier, 1973, Marei, 2004). *P. mixta* is one of eight *P. hyoscyami* species complex. Two of these, the beet and the spinach leafminers are now considered as one species *P. hyoscyami* (Steyskal, 1977). Both species infested spinach, *S. oleracea*, beets, sugar beets, swiss chard and mangels (*B. vulgaris*), *Dianthus* sp., *Datura metel* L. and several weeds including *Arctium lappa* L., *Chenopodium album* L. and *Atriplex bastata* (L.) Gray (Chillcott, 1959). Puparia overwinter in the soil and emerge as adults in late May to early June and can produce up to three generations per year (Gratwick, 1992). In order to achieve a sustainable control of this polyphagous pest, the level of the fly population must be decreased at the beginning of the sugar beet growing season. Elaboration studies in the present work were carried out on diapause, parasitism and emerged adults of host and parasitoids among puparia reared from some chenopodiaceous host plants as the sources of the new infestation and parasitism.

MATERIALS AND METHODS

Untreated plants of sugar beet, *Beta vulgaris* L. and mangold, *Beta vulgaris* var. *vulgars* as root crops, spinach, *Spinacia oleracea* L and chard, *Beta vulgaris* var. *cicla* L, as leaveed vegetables and goosefoot, *Chenopodium murale* L. and wild beet, *Beta vulgaris* var. *perennis* as wild weeds were chosen from the farm of Agric. Exp. Sta., at Giza.

To determine the number and size of the collected samples from the infested chenopodiaceous plants by the beet fly, weekly inspections were made during the growing seasons. Seven and nine samples were collected from sugar beet fields from December 26, 2004 and January 2, 2006 to March 27, 2005 and April 10, 2006, respectively. Whereas, the taken samples 9, 7 and 4 were obtained from infested goosefoot, spinach and wild beet plants from November 21, 2004 and February 13 or 20, 2005 to April 24 and 17, 2005, respectively. Twelve and eleven samples were collected from infested goosefoot and spinach from November 14 and 21, 2005 to April 10, 2006. However, 5 and 3 samples were taken from infested chard and mangold from November 21, 2005 to January 30, 2006. A sample was taken from infested wild beet on February 20, 2006.

On each collection date, the infested leaves were visually examined and the mined areas were placed into separated circular plastic containers (50 x 10 cm) provided with a sandy layer at the bottom. The pupae were collected and placed into petri dishes, 10 cm diameter each. The dried leaves were kept in plastic sacs fitted with a rubber band. Daily inspection was made and the emerged adults of flies and parasitoids were collected, identified and recorded. At the end of emergence season, puparia were dissected and healthy (emerged or failed emerged flies) or parasitized pupae (emerged parasitoids from pores or failed emerged parasitoids) were counted.

RESULTS AND DISCUSSION

1- Diapause

The majority of full grown larvae of the sugar beet fly *P. mixta* pupate in the soil, rarely in mines of the infested leaves and went into aestivation (summer diapause) in rates of 98.7% - 100%, except 1.3% entered hibernation (overwinter diapause). During the growing seasons of sugar beet in this study, diapause rates of puparia reared from the different chenopodiaceous host plants highly fluctuated. The overall mean was 49.3% (2004- 2005) and 38.5% (2005- 2006). In both seasons, the highest rates 67.0 and 55.1% were attained on puparia reared from wild beet and spinach, respectively followed in the descending order as 39.6% on goosefoot and 29.3% on sugar beet (Table 1). It increased from 0 to 36.9% on sugar beet and from

10.6 to 42.5% on goosefoot, but abruptly declined from 64.6 to 45.7% and from 67.6 to 64.7% on spinach and wild beet, respectively from 2004- 2005 to 2005- 2006 seasons. Puparia reared from sugar beet and mangold not entered diapause in the first and the second seasons, respectively whereas 4.1% of puparia reared from chard went into diapause in the second season (Table 1).

1-1 Incidence of diapause

In 2004- 2005, aestivated puparia reared from spinach, wild beet and goosefoot began in rates of 25.6, 61.7 and 81.3% in mid February and early or mid April, respectively (Table 2). It increased gradually reaching 96.1 and 86.4% on early and mid April, respectively but abruptly declined to 42.9% a week later. In November of 2005, less than 1% of the puparia reared from goosefoot entered hibernation at the third week, increased to 8.3% after three weeks (Table 3). However, puparia of chard, spinach and sugar beet hibernated in high rates of 32, 27.3 and 83.3% at the third and the fourth weeks of December and early January and declined to 9.1, 12 and 50% after two weeks, but extended a week for spinach puparia, respectively (Table 3). At mid February of 2006, puparia reared from sugar beet and goosefoot went into aestivation in rates of 42.9 and 43.7%, respectively whereas 54.9 and 64.7% were attained a week later on those reared from spinach and wild beet, respectively (Table 3). Aestivated puparia of goosefoot and spinach decreased to 32 and 25% at early March, increased progressively reached higher rates of 83.3 and 97.8% after four and five weeks, respectively, but abruptly declined to 47.4% after a week on goosefoot puparia. Aestivated puparia of sugar beet increased to 52.4% at early March, but drastically lowered to 14.3% after five weeks.

These results indicate that, puparia reared from different chenopodiaceous host plants varied in diapause rate. According to larval feeding, diapaused puparia can be assigned into three descending levels: high rates ranged between (39.6- 67%) on goosefoot and wild beet [weeds], medium rates (4.1- 55.1%) on chard and spinach [leaved vegetables] and low rates (0- 29.3%) on mangold and sugar beet [root crops]. Larval feeding may be a role in the behavior of diapaused puparia. In France, females of *P. betae* and *P. hyoscyami* preferred sugar beet than *Chenopodium* host plants under field and choice conditions where larvae pupated in the soil and leaves, only that entered the soil underwent diapause (D'Aguilar and Missonnier, 1957). Diapaused puparia reared from sugar beet varied according to location with a rate of 29.3% in the present study at Giza, but ranged between 21.6- 41.8% at Dakahliya and Kafr El-Sheikh Governorates (El-Serwy, 2007 b). It is clearly appeared that, *P. mixta* pupae entered hibernation (winter diapause) in a few numbers during Novernber- January, whereas the majority went into aestivation (summer diapause) from February to the end of sugar beet growing season. In China, the same behavior was found on the

leaf-mining fly *Pegomyia bicolor* Wied. where summer diapause induced by long day length and mild temperature and winter diapause induced mainly by low temperatures, especially in the 10 days after pupation (Xue *et al.*, 2001).

2- Parasitism

Data in Table (1) show that the overall mean of the total parasitism was 43%. During the growing season the total parasitism of *P. mixta* fluctuated from 45.6% (2004- 2005) to 42.1% (2005- 2006). Parasitism was markedly varied with chenopodiaceous host plant, 77.3, 41.1, 40.3 and 34.5% in case of wild beet, goosefoot, sugar beet and spinach, respectively. In 2004- 2005, parasitism rates of 37.2, 64.9 and 83.1% were recorded on puparia of spinach, goosefoot and wild beet, they abruptly decreased to 31.9, 38.7 and 52.9% in 2005- 2006, respectively, but lightly increased from 39.1% to 40.6% on those of sugar beet. High rates of 88.2 and 80.6% were recorded on active parasitized puparia of mangold and chard, but about 4% of chard puparia went into diapause.

2-1 Incidence of parasitism

Parasitic activity by *O. nitidulator* began in rates of 42.1, 64.3 and 15.9% at the third week of November, late December and mid February on puparia of goosefoot, sugar beet and spinach in 2004- 2005 season, respectively (Table 2). It increased to 81.6, 83.3 and 72.1% at early March, but abruptly declined to 25% at late March on sugar beet puparia as well as 68.8 and 41.7% on those of goosefoot and spinach, three weeks later, respectively. Parasitized puparia of the wild beet followed a similar trend which decreased from 100% to 77.2% during early March-mid April. In 2005- 2006, parasitism began in a high rate of about 82% at mid November on puparia reared from goosefoot and one week later on those of chard and mangold, respectively, whereas this figure was recorded after five weeks on spinach. The initial rate was 100% recorded at early January on parasitized puparia of sugar beet (Table 3). In early March of 2006, the parasitism declined to 4.4 and 10.7% on puparia from spinach and goosefoot, respectively as well as to 12.3% two weeks later on sugar beet puparia. Then, the parasitism increased progressively reaching high rates of 58, 86 and 100% after 5, 4 and 3 weeks, respectively. It decreased to 63.6%, but increased to 100% at early and late January on puparia from chard and mangold, respectively (Table 3). In the third week of February, a rate of 52.9% parasitism was recorded on puparia from the wild beet.

Aforementioned results show that, the parasitism was highly fluctuated in rate and incidence over the term of this study. The highest rates were about 88 and 81% on puparia of mangold and chard followed in the order of prevalence by that reared from the wild beet (77.3%), goosefeet (41.1%), sugar beet (40.3%) and spinach 34.5%. The parasitism decreased about 5, 26 and 30% on puparia of spinach,

goosefoot and wild beet, respectively from 2004- 2005 to 2005- 2006, but slightly increased less than 2% on the puparia of sugar beet in the same period. As a result, parasitized puparia from sugar beet was markedly higher about 29% at Giza opposed to 19 and 20% at Dakahliya and Kafr El-Sheikh, respectively (El-Serwy, 2007 b). Parasitized puparia of sugar beet began in a high rate of 64.3% in December of 2004, declined to 21.3% in January 2005 and increased again to 42% in March (Table 2). In January 2006, a rate of 74.3% was attained, but declined to 54.7% in February and 25.7% in March and increased again to 44.7% in April. The initial rates of goosefoot parasitized puparia ranged 42.1- 46.9% in November of 2004 and 2005, increased to 80- 100% in January, but declined to 67.9- 18.3% in March, whereas high rates of 78.2- 83% were observed in April of 2005 and 2006. Competition between *O. nitidulator* and *P. vindemmiae* resulted in an obvious decrease in parasitism by *O. nitidulator* mainly in March and partially in April. It reported that parasitic activity by the pteromalid parasitoid resulted in high rates about 77 and 69% on puparia reared from sugar beet in March of 2005 and 2006, whereas ranged between about 72- 97% in March and April of 2005, but was about 88% in April, 2006 on puparia reared from goosefoot at Giza (El- Serwy, 2007 a). Spinach parasitized puparia had no an obvious incident trend. It began in low rate 15.9% in February, increased to 58.7% in March, but declined to 27.7% in April, 2005. In December of 2005, the initial rate was 31.1%, decreased to 10.1% in March and reaching 51.1 % in the next month in 2006. Generally increasing parasitism in April may be due to the low level of the host population. Babushkina (1996) reported that parasitism on *P. betae* by *O. nitidulator* increased in warm and dry summers which retarded more on the host.

3- Emergence of adults:

3-1 Flies: the total number of emerged flies were 492 and 1591 represented 54.4 and 57.9% of the total number of emerged flies and parasitoids in 2004- 2005 and 2005- 2006 seasons, respectively (Table 1). Of these, 227 and 1017 emerged from the active puparia represented 64.1 and 63.9% of all flies emerged from active and diapause puparia, respectively. In 2005- 2006, the total number of emerged flies from aestivated and hibernated puparia were 559 and 15 in percentages of about 97 and 3%, respectively .

In 2004- 2005 active season, flies emergence started in mid December and late January from puparia of goosefoot and sugar beet and continued until mid May and the third week of April and peaked at the third and the second weeks of April, respectively (Table 4). Huge numbers were emerged from spinach puparia at mid March and continued until early May. In mid December of 2005, flies reared from mangold, chard and spinach began its emergence in relatively high numbers and continued till early and late February as well as early May in 2006, respectively (Table

4). Three peaks in the population of flies reared from spinach occurring in early January, late March and three weeks later. It emerged from goosefoot a week earlier and emergence continued until early May with three peaks in mid December as well as mid and late March. Emergence from sugar beet puparia beginning in early January and ending at mid March with a distinct peak in late February.

The flies first emerged from spinach aestivated puparia in late October in 2005 and a week early in 2006 and emergence continued until mid January and the third week of December with a distinct peak in the second and the first weeks of November in 2005 and 2006, respectively (Table 6). Flies reared from sugar beet and goosefoot emerged at the first and the second weeks of November and emergence continued until late December with a distinct peak during the third week of November in 2006. Individual numbers were emerged from chard puparia during late November- early December in 2006, whereas emergence from wild beet puparia occurred during the first half of November (2005) and in the second and the third weeks in November (2006). In the third week of November of 2006, majority of flies emerged from hibernated puparia and emergence continued until early December.

3-2 Parasitoids: the total number of emerged parasitoids were 413 and 1159 represented 45.6% and 42.1% of the total number of emerged flies and parasitoids in 2004- 2005 and 2005- 2006 seasons, respectively (Table 1). Of these, 232 and 675 were emerged from the active puparia represented 56.2% and 58.2% of the total emerged parasitoids from active and diapause puparia, respectively. In 2005- 2006, the total number of emerged parasitoids from aestivated and hibernated puparia were 462 and 22 emerged in percentages of 95.5 and 4.5%, respectively.

In mid December of 2005, parasitoids emerged from active puparia reared from chard, mangold and goosefoot and peaked in the next week where its emergence continued until the second and the third weeks of March and late April with a second peak in their population occurring in the third week of January and two months later for wasps emerged from goosefoot parasitized puparia, respectively (Table 5). In late December of 2004, parasitoids emerged from goosefoot parasitized puparia and emergence continued until mid May with a distinct peak during early April. Wasps emerged from sugar beet parasitized puparia in early February of 2005 and a week later in 2006 and continued until the third week of April and two weeks later with a distinct peak during early April in both years. Parasitoids emerged from spinach parasitized puparia at mid January in 2006 and the third week of March in 2005 and continued until the third week of April and early May with a peak during early February and April in 2006 and 2005, respectively. The emergence period of parasitoids of wild beet parasitized puparia beginning in early April and ending in the third week of May with a distinct peak in mid April in 2005.

In 2005- 2006 aestivation season, parasitoids emergence began in the third and the fourth weeks of October and mid November from puparia reared from spinach, wild beet and goosefoot and emergencies continued until the third week of January, early December and late November with a distinct peak in their population occurring in mid November (Table 6). In 2006- 2007, parasitoids emerged from goosefoot aestivated puparia in late October 2006 and two weeks later from sugar beet and spinach puparia where emergence ending in late and mid December, but the parasitoids emerged from spinach parasitized puparia extended until the third week of January with a distinct peak in late November, respectively. Individual number of parasitoids emerged from chard puparia during early November- early December. The parasitoids emerged from sugar beet and chard hibernated parasitized puparia in the third week of November and continued until mid December in 2006

Percentage of progress of emergence of hosts or parasitoids shows the progress of emergence during the season. It showed a similar trend of emerged flies and parasitoids from diapause puparia in both seasons. The highest percentages of flies 91.7 and 91.1% and parasitoids 90.6 and 78.9% were emerged from diapaused puparia during November in 2005 and 2006 (Table 6). Such synchronization between the flies and parasitoids emerged from active puparia was found in 2004- 2005 active season , but lost in the second one. In April of 2005, the highest percentages of emerged parasitoids and flies were 70.8 and 43.2%, but were 34.2 and 49.4% in January and April in 2006 (Tables 4 and 5).

These results indicate that the emergent periods of flies and parasitoids lasted 21 and 20 weeks in both active seasons, whereas ranged 10- 11 weeks and 12- 13 weeks for those emerged from diapaused puparia in the second and the first diapause seasons, respectively (Tables 4 and 5). but its emergence periods from aestivated puparia shortened to 10 and 12 weeks in 2006- 2007 and Flies emerged earlier than parasitoids from active and diapause puparia in both seasons, except in the first diapause season. The first emergence of flies from active goosefoot puparia started at early and mid December, whereas parasitoids emerged 1 and 2 weeks later in 2005 and 2004. In 2005- 2006 diapause season, parasitoids and flies emerged from spinach puparia in the third and the fourth weeks of October, whereas in the 2006- 2007 flies emerged from puparia of the same host plant on the third week of October and parasitoids emerged a week later from goosefoot puparia (Table 6). In the third week of November of 2006, flies and parasitoids emerged from hibernated puparia 5 and 3 weeks earlier than aestivated one, emergence periods continued until the first and the second weeks of December. The longest hibernation period lasted a year, whereas the shortest period was 7 months on puparia entered aestivation in April. Synchronization was found between the timing of the highest percentages of the emerged flies and

parasitoids from active and diapaused puparia in both seasons, but lost in the second active season. The emerged flies about (92 and 91%) and parasitoids (91 and 79%) were recorded in November of 2005 and 2006, respectively. In both seasons, majority (> 91%) of flies emerged in November. Hafez, *et al.*, (1970) reported that catches of *P. hyoscyami* (= *P. mixta*) reached its peak in November 79% and December 82.6%.

In conclusion, healthy puparia of *P. mixta* and parasitized with *O. nitidulator* went into aestivation (summer diapause) during February- April in 2005 and 2006, whereas less than 2% entered hibernation (overwinter diapause) during November-January in the second season. Diapause and parasitism were higher in 2004- 2005 than 2005- 2006. It was highly variable in rate and incidence among puparia reared from the different chenopodiaceous host plants. The highest overall means of diapause in order of prevalence were: 47.1, 41 and 25.4% on puparia collected from leaved vegetables (spinach & chard), weeds (goosefoot & wild beet) and root crops (sugar beet & mangold) host plants. The corresponding total rates of parasitism were 46.6% 42.9 and 41.8% on parasitized puparia of root crops, weeds and leaved vegetables, diapused parasitized puparia represented about 44, 45 and 30%, respectively. It is apparently that puparia reared from mangold plants entered diapause in low rate and received the highest parasitism. Mangold reported as trapping plants for the beet leafminer *P. hyoscami* (= *P. mixta*) in sugar beet fields (Marei, 2004). Synchronization was found between the timing of the highest percentages of emerged flies and parasitoids from diapaused puparia in November of 2005 and 2006. Such high numbers of emerged parasitoids occupied with the high rates of parasitism at the beginning of the sugar beet growing season..

As a result of this study, the full grown larvae of *P. mixta* on chenopodiaceous plants pupated in the soil and puparia entered hibernation three months earlier than aestivated. one. Majority of flies (> 91%) and parasitoids (> 82%) emerged from diapaused puparia during November laying the eggs of the first generation and high rates of parasitism on the pupated full grown larvae took place. To prevent and promote these parasitoids, insecticides must be entirely avoided and reduce the population size of the emerged flies. Deeply plowing, destruction alternative host weeds, hand pick and destroying infested mined leaves before the larvae drop to the soil must be carried weekly and dropping kerosene in a rate of 30 liter / feddan (4200 m^2) into water irrigation may reduce the likelihood and severity of leafminers problems in sugar beets.

Table 1. Total no. of collected alive pupae and emergencies of *Pegomya mixta* and *Opius nitidulator* adults from active and diapaused puparia reared from six host plants during 2004- 2005 and 2005- 2006 seasons.

Host plant	Season	Total no. of collected alive pupae	No. of adults emerged from						Total no. of parasitized pupae (emerged parasitoids)	Parasitism %
			Active puparia			Diapaused puparia				
			Flies	Paras-itoids	%	Flies	Paras-itoids	%		
Sugar beet	2004-2005	92	56	36	100	0	0	0.0	36	39.1
	2005-2006	355	151	73	63.1	60	71	36.9	144	40.6
	Total	447	207	109		60	71		180	
	Mean %		46.3	24.4	70.7	13.4	15.9	29.3		40.3
Goosefoot	2004-2005	151	50	85	89.4	3	13	10.6	98	64.9
	2005-2006	1489	550	306	57.5	363	270	42.5	576	38.7
	Total	1640	600	391		366	283		674	
	Mean %		36.6	23.8	60.4	22.3	17.3	39.6		41.1
Spinach	2004-2005	591	116	93	35.4	255	127	64.6	220	37.2
	2005-2006	599	261	64	54.3	147	127	45.7	191	31.9
	Total	1190	377	157		402	254		411	
	Mean %		31.7	13.2	44.9	33.8	21.3	55.1		34.5
Wild beet	2004-2005	71	5	18	32.4	7	41	67.6	59	83.1
	2005-2006	17	6	0		2	9	64.7	9	52.9
	Total	88	11	18	35.3	9	50		68	
	Mean %		12.5	20.5	33.0	10.2	56.8	67.0		77.3
Chard	2005-2006	222	41	172	95.9	2	7	4.1	179	80.6
Mangold	2005-2006	68	8	60	100	0	0	0.0	60	88.2
Total	2004-2005	905	227	232	50.7	265	181	49.3	413	45.6
	2005-2006	2750	1017	675	61.5	574	484	38.5	1159	42.1
Grand total		3655	1244	907		839	665		1572	
Overall mean %			34.1	24.8	58.9	22.9	18.2	41.1		43.0

Table 2. Total no. of collected alive puparia and emerged adults of *Pegomya mixta* and *Opius nitidulator* from active and diapaused puparia reared from four host plants during November- April in 2004- 2005 season.

Host plant	Date of collection		Total no. of collected alive pupae	No. of adults emerged from					Total no. of parasitised pupae	Parasitism %	Monthly parasitism
				Active pupae		Diapaused pupae					
	Month	Day		Flies	Paras-itoids	Flies	Paras-itoids	%			
Sugar beet	December	26	14	5	9	0	0	0.0	9	64.3	64.3
	January	9	13	7	6	0	0	0.0	6	46.2	21.3
		23	15	15	0	0	0	0.0	0	0.0	
	March	6	18	3	15	0	0	0.0	15	83.3	42.0
		13	10	8	2	0	0	0.0	2	20.0	
		20	6	6	0	0	0	0.0	0	0.0	
		27	16	12	4	0	0	0.0	4	25.0	
Goosefoot	Novembe	21	19	11	8	0	0	0.0	8	42.1	42.1
	December	26	7	1	6	0	0	0.0	6	85.7	85.7
	January	9	5	1	4	0	0	0.0	4	80.0	80.0
	February	13	13	8	5	0	0	0.0	5	38.5	38.5
	March	6	38	7	31	0	0	0.0	31	81.6	67.9
		13	9	9	0	0	0	0.0	0	0.0	
		20	37	11	26	0	0	0.0	26	70.3	
	April	17	16	2	1	3	10	81.3	11	68.8	78.2
		24	7	0	4	0	3	42.9	7	100	
Spinach	February	13	82	56	5	13	8	25.6	13	15.9	15.9
	March	6	86	6	48	18	14	37.2	62	72.1	58.7
		13	59	12	13	23	11	57.6	24	40.7	
		20	68	12	26	17	13	44.1	39	57.3	
	April	3	106	22	1	63	20	78.3	21	19.8	27.7
		10	178	7	0	115	56	96.1	56	31.5	
		17	12	1	0	6	5	91.7	5	41.7	
Wild beet	February	20	1	1	0	0	0	0.0	0	0.0	0.0
	March	6	1	0	1	0	0	0.0	1	100	100
	April	10	47	4	14	2	27	61.7	41	87.2	84.1
		17	22	0	3	5	14	86.4	17	77.2	

Table 3. Total no. of collected alive puparia and emerged adults of *Pegomya mixta* and *Opius nitidulator* from active and diapaused puparia reared from six host plants during November- April in 2005- 2006 season.

Host plant	Date of collection		Total no. of collected alive pupae	No. of adults emerged from:					Total no. of parasitized pupae	Parasitism %	Monthly parasitism
				Active pupae		Diapaused pupae					
	Month	Day		Flies	Paras-itoids	Flies	Paras-itoids	%			
Sugar beet	January	2	6	0	1	0	5	83.3	6	100	74.3
		16	22	5	6	1	10	50.0	16	72.7	
		30	7	3	4	0	0	0.0	4	57.1	
	February	13	42	12	12	9	9	42.9	21	50.0	54.7
		27	22	7	6	1	8	40.9	14	63.6	
	March	6	63	14	15	11	22	52.4	37	58.7	25.7
		20	155	107	6	29	13	27.1	19	12.3	
	April	3	31	2	17	9	3	38.7	20	64.5	44.7
		10	7	1	6	0	1	14.3	7	100	
Goosefoot	November	14	11	2	9	0	0	0.0	9	81.8	46.9
		21	151	83	67	1	0	0.7	67	44.4	
	December	12	24	9	13	2	0	8.3	13	54.2	44.1
		19	9	7	2	0	0	0.0	2	22.2	
		26	1	1	0	0	0	0.0	0	0.0	
	January	30	8	0	8	0	0	0.0	8	100	100
	February	13	215	69	52	79	15	43.7	67	31.2	30.3
		20	502	187	120	165	30	38.8	150	29.9	
	March	6	197	124	10	52	11	32.0	21	10.7	18.3
		20	130	40	6	51	33	64.6	39	30.0	
	April	3	222	19	18	12	173	83.3	191	86.0	23.0
		10	19	9	1	1	8	47.4	9	47.4	
Spinach	November	21	5	5	0	0	0	0.0	0	0.0	0.0
	December	5	6	6	0	0	0	0.0	0	0.0	31.1
		19	17	3	14	0	0	0.0	14	82.4	
		26	22	16	0	6	0	27.3	0	0.0	
	January	16	25	18	4	3	0	12.0	4	16.0	18.5
		30	2	1	1	0	0	0.0	1	50.0	
	February	20	51	14	9	21	7	54.9	16	31.4	31.3
	March	6	136	101	1	29	5	25.0	6	4.4	10.1
		20	71	41	4	15	11	36.6	15	21.1	
	April	3	83	53	30	0	0	0.0	30	36.1	51.1
		10	181	3	1	73	104	97.8	105	58.0	
Chard	November	21	119	22	97	0	0	0.0	97	81.5	81.5
	December	5	66	12	54	0	0	0.0	54	81.8	82.4
		19	25	2	15	2	6	32.0	21	84.0	
	January	2	11	4	6	0	1	9.1	7	63.6	58.3
		30	1	1	0	0	0	0.0	0	0.0	
Man-gold	November	21	34	6	28	0	0	0.0	28	82.4	82.4
	December	12	33	2	31	0	0	0.0	31	93.9	93.9
	January	30	1	0	1	0	0	0.0	1	100	100
Wild beet	February	20	17	6	0	2	9	64.7	9	52.9	52.9

Table 4. Weekly no. of flies emerged from active puparia reared from six host plants during December- May in 2004- 2005 and 2005- 2006 active seasons.

Emergence weeks		No. of emerged flies during:													
		2004- 2005						2005- 2006							
Month	Week	Sugar beet	Goos-efoot	Spinach	Wild beet	Total	% Progress	Sugar beet	Goos-efoot	Spinach	Chard	Man-gold	Wild beet	Total	% Progress
December	1 st	0	0	0	0	0	4.9	0	2	0	0	0	0	2	9.3
	2 nd	0	1	0	0	1		0	44	5	19	5	0	73	
	3 rd	0	9	0	0	9		0	7	0	0	0	0	7	
	4 th	0	1	0	0	1		0	2	5	5	1	0	13	
January	1 st	0	0	0	0	0	2.6	5	8	25	7	0	0	45	10.9
	2 nd	0	0	0	0	0		0	5	4	3	1	0	13	
	3 rd	0	0	0	0	0		3	23	6	1	0	0	33	
	4 th	5	1	0	0	6		10	4	4	2	0	0	20	
February	1 st	1	1	0	0	2	10.1	9	1	0	2	1	0	13	14.1
	2 nd	4	0	0	0	4		0	1	17	0	0	0	18	
	3 rd	13	0	0	0	13		12	1	1	0	0	0	14	
	4 th	4	0	0	0	4		96	0	0	2	0	0	98	
March	1 st	0	0	0	0	0	35.7	14	58	0	0	0	6	78	49.4
	2 nd	0	5	46	1	52		2	118	11	0	0	0	131	
	3 rd	1	6	15	0	22		0	84	5	0	0	0	89	
	4 th	2	4	1	0	7		0	120	84	0	0	0	204	
April	1 st	8	0	13	4	25	43.2	0	36	35	0	0	0	71	15.7
	2 nd	15	9	0	0	24		0	9	8	0	0	0	17	
	3 rd	3	11	21	0	35		0	16	49	0	0	0	65	
	4 th	0	0	14	0	14		0	6	1	0	0	0	7	
May	1 st	0	0	6	0	6	3.5	0	5	1	0	0	0	6	0.6
	2 nd	0	2	0	0	2		0	0	0	0	0	0	0	
Total		56	50	116	5	227		151	550	261	41	8	6	1017	

Table 5. Weekly no. of parasitoids emerged from active *Pegomya mixta* puparia reared from six host plants during two successive seasons.

Emergence weeks		2004- 2005						2005- 2006						
Month	Week	Sugar beet	Goos-efoot	Spinach	Wild beet	Total	% progress	Sugar beet	Goos-efoot	Spinach	Chard	Man-gold	Total	% progress
December	2 nd	0	0	0	0	0	1.7	0	19	0	1	1	21	16.2
	3 rd	0	0	0	0	0		0	37	0	26	7	70	
	4 th	0	4	0	0	4		0	5	0	11	2	18	
January	1 st	0	3	0	0	3	1.7	0	4	0	18	5	27	34.2
	2 nd	0	1	0	0	1		0	17	1	26	14	58	
	3 rd	0	0	0	0	0		0	27	8	52	29	116	
	4 th	0	0	0	0	0		0	5	5	20	0	30	
February	1 st	6	4	0	0	10	8.4	0	3	12	9	0	24	9.0
	2 nd	2	1	0	0	3		4	0	4	5	1	14	
	3 rd	4	0	0	0	4		2	0	8	0	0	10	
	4 th	0	3	0	0	3		11	0	1	1	0	13	
March	1 st	2	1	0	0	3	11.9	0	0	0	2	0	2	23.9
	2 nd	1	1	0	0	2		3	11	4	1	0	19	
	3 rd	0	2	3	0	5		7	95	3	0	1	106	
	4 th	7	6	5	0	18		5	26	3	0	0	34	
April	1 st	9	23	39	1	72	70.8	22	17	4	0	0	43	16.6
	2 nd	3	5	19	13	40		4	13	0	0	0	17	
	3 rd	2	17	17	1	37		11	10	11	0	0	32	
	4 th	0	9	9	0	18		3	17	0	0	0	20	
May	1 st	0	0	1	0	1	5.5	1	0	0	0	0	1	0.1
	2 nd	0	5	0	2	7		0	0	0	0	0	0	
	3 rd	0	0	0	1	1		0	0	0	0	0	0	
Total		36	85	93	18	232		73	306	64	172	60	675	

Table 6. Weekly no. of flies and parasitoids emerged from diapaused *Pegomya mixta* puparia reared from five host plants during two successive seasons.

Emergence weeks		2005- 2006					2006- 2007						
		No. of flies											
Month	Week	Goos-efoot	Spinach	Wild beet	Total	% progress	Sugar beet	Goose foot	Spinach	Chard	Wild beet	Total	% progress
October	3 rd	0	0	0	0	4.2	0	0	1	0	0	1	2.6
	4 th	0	11	0	11		0	0	14	0	0	14	
November	1 st	1	73	2	76	91.7	1	0	115	0	0	116	91.1
	2 nd	1	106	5	112		2	11	10	0	1	24	
	3 rd	1	32	0	33		39	301	4	0	1	345	
	4 th	0	22	0	22		11	25	1	1	0	38	
December	1 st	0	1	0	1	0.7	2	16	0	1	0	19	6.3
	2 nd	0	1	0	1		4	7	1	0	0	12	
	3 rd	0	0	0	0		0	2	1	0	0	3	
	4 th	0	0	0	0		1	1	0	0	0	2	
January	1 st	0	8	0	8	3.4	0	0	0	0	0	0	0.0
	2 nd	0	1	0	1		0	0	0	0	0	0	
Total		3	255	7	235		60	363	147	2	2	574	
No. of parasitoids													
October	3 rd	0	2	0	2	5.5	0	0	0	0	0	0	0.2
	4 th	0	6	2	8		0	1	0	0	0	1	
November	1 st	0	39	3	42	90.6	0	3	0	1	0	3	78.9
	2 nd	10	46	15	71		1	27	8	3	0	36	
	3 rd	1	20	13	34		14	71	27	1	0	112	
	4 th	2	8	7	17		38	126	59	3	0	224	
December	1 st	0	2	1	3	2.8	13	34	23	1	0	73	19.4
	2 nd	0	1	0	1		5	7	2	0	0	17	
	3 rd	0	0	0	0		0	0	1	0	0	1	
	4 th	0	1	0	1		0	1	0	0	0	1	
January	1 st	0	0	0	0	1.1	0	0	1	0	0	1	1.5
	2 nd	0	1	0	1		0	0	4	0	0	4	
	3 rd	0	1	0	1		0	0	2	0	0	2	
Total		13	127	41	181		71	270	127	9	0	477	

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السكون والتطفل فى عذارى صانعة أنفاق أوراق البنجر *Pegomya mixta* Villeneuve على بعض عوائل العائلة السوسبية المختلفة في الجيزة

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درس معدل و سير السكون والتطفل لصانعة أنفاق أوراق البنجر *Pegomya mixta* من رتبة ذات الجناحين وعائلة Anthomyiidae على نباتات بنجر السكر ،السبانخ ،السلق البرى والزربيح غير معاملة بالمبيدات جمعت خلال الفترة من نوفمبر ٢٠٠٤ الى أبريل ٢٠٠٥ ومع كلا من السلق وبنجر المائدة خلال نفس الفترة في عامي ٢٠٠٥ و٢٠٠٦ من مزرعة محطة التجارب الزراعية بالجيزة. تشير النتائج المتحصل عليها الى ارتفاع المتوسط الكلى للسكون الى ٤٩،٣% في موسم ٢٠٠٤- ٢٠٠٥ في مقابل ٣٨،٥% في ٢٠٠٥- ٢٠٠٦ وكذلك التطفل الى ٤٥،٦% على عكس ٤٢،١% ، على التوالي. كما اختلف معدل وسير السكون والتطفل وبدرجة عالية بين العذارى المرباة على عوائل العائلة السوسبية المختلفة . وجد أن أعلا المتوسطات العامة للسكون تبعا لترتيبها التنازلى : ٦٧ ، ٣٩،٦ ، ٢٩،٣ % على العذارى المرباة على السلق البرى ، الزربيح و بنجر السكر حيث تتوافق مع معدلات التطفل وهى ٧٧،٣ ، ٤١،١ و ٤٠،٣% ، بينما بلغ معدل السكون ٥٥،١% و التطفل ٣٤،٥% على العذارى المرباة على السبانخ. تراوحت معدلات السكون مابين ٠- ٣٦،٩% و ١٠،٦- ٤٢،٥% ، على العذارى التي تم جمعها من بنجر السكر و الزربيح في موسمي ٢٠٠٤- ٢٠٠٥ و ٢٠٠٥- ٢٠٠٦، لكنها انخفضت من ٦٤،٦% الى ٤٥،٧% ومن ٦٧،٦% الى ٦٤،٧% على تلك المرباة على السبانخ والسلق البرى في نفس الفترة. أما معدلات التطفل فتراوحت مابين ٣١،٩- ٣٧،٢% و ٣٨،٧- ٦٤،٩% وكذلك ٥٢،٩- ٨٣،١% على العذارى المتطفل عليها والتي تم جمعها من السبانخ ، الزربيح والسلق البرى في موسمي ٢٠٠٥- ٢٠٠٦ و ٢٠٠٤- ٢٠٠٥، لكنها ازدادت من ٣٩،١ الى ٤٠،٦% على العذارى المرباة على بنجر السكر من الموسم الأول الى الموسم الثاني. في كلا الموسمين، تدخل العذارى في بيات صيفى خلال فبراير – أبريل، لكن ١،٣% تدخل في بيات شتوي خلال نوفمبر – يناير في موسم ٢٠٠٥ – ٢٠٠٦ . بلغت معدلات الدخول في البيات الصيفي ٢١،٩ ، ٤١،٨% في فبراير وازدادت الى ٢٧،٦% بينما انخفضت قليلا الى ٣٧،٥% في مارس ووصلت اعلا معدلاتها ٨٤،٨ و ٧٠،٧% في أبريل في كلا من عامي ٢٠٠٥ و٢٠٠٦، بنفس الترتيب. وجد تزامن بين توقيت خروج أعلا نسب حوالي ٩٢ و ٩١% للذباب و ٩١ و ٧٩% للطفيليات في نوفمبر من عامي ٢٠٠٥ و ٢٠٠٦، على التوالي. وتتوافق تلك الأعداد العالية الخارجة من الطفيليات مع معدلات التطفل المرتفعة ٧٨،٩ و ٦٢،٨% في نوفمبر من عامي ٢٠٠٤ و ٢٠٠٥. وجد هذا التزامن في موسم النشاط ٢٠٠٤- ٢٠٠٥ ولكنة فقد في الموسم الثاني. بلغت أعلا النسب المؤوية لخروج الطفيليات والذباب ٧٠،٨ و ٤٣،٢% في أبريل من عام ٢٠٠٥ وكذلك ٣٤،٢ و ٤٩،٤% في فبراير وابريل من عام ٢٠٠٦. لحفظ وإدامة تلك الطفيليات ينبغي تفادى الاستخدام الكلى للمبيدات وخفض أعداد الذباب الخارجة باستخدام بعض العمليات الزراعية مثل الحرث العميق، وتدمير العوائل البديلة كالحشائش وجمع الأوراق المصابة يدويا قبل خروج اليرقات للتعذير بالتربة وتدميرها وعلى فترات أسبوعية. كذلك تنقيط الكيروسين بمعدل ٣٠ لتر / فدان إلى ماء الري ربما تقلل من تأرجح وشدة مشاكل صانعات أنفاق الأوراق في بنجر السكر.