Egypt. J. Plant Prot. Res. Inst. (2023), 6 (4): 526 –535

Egyptian Journal of Plant Protection Research Institute

www.ejppri.eg.net

Efficacy of resistant varieties and the parasitoid *Aphidius colemani* (Hymenoptera:Aphidiidae) in integrated pest management (IPM) to *Myzus persicae* (Hemiptera: Aphididae) in Egyptian sugar beet fields

Ekram, A. Abdou[1]; Bazazo, K.G.I.[2] and Taha, R.A.[1]

[1]*Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.*

[2]*Plant protection Res. Dept., Sugar Crops Res. Inst., Agric. Res. Center.*

ARTICLE INFO

Article History

Received: 26/ 10/2023

Accepted: 28/12/2023

Keywords

Resistant, *Aphidius colemani* , *Myzus persicae* , sugar beet and control.

.

Abstract

This work was undertaken at the experimental farm of Sakha Agricultural Research Station during 2021/2022 and 2022/2023 seasons. For investigating the role of resistant varieties and *Aphidius colemani* Viereck (Hymenoptera:Aphidiidae) parasitoid in Integrated Pest Management (IPM) of *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) in sugar beet fields. Results indicate that significant difference among the three varieties (LP17B4011, FD18B4018 and FD17B4010) in the numbers of aphid populations and infested plants with this aphid throughout the two seasons LP17B4011 variety more resistant than FD18B4011 and FD17B4010 ones. Mean ±SE (Mean number of aphids and infested plants) were 0.807±0.01 and 0.471± 0.0 to LP17B4011 and 1.425± 0.02 and 0.614± 0.03 to FD 18B4018. Also ,7.661±1.2 and 2.377± 1.01to FD17B4010 during 2021/2022.While, (0.330 ± 0.01 and 0.235± 0.02), (0.567± 0.01and 0.520± 0.01), (9.044± 2.11 and 2.710 ± 1.03) for the three cultivars, respectively in 2022/2023. In such concern, the parasitism efficiency of *A. colemani* against *M. persicae* on the three varieties was 47.05 ,36.66 and 34.78 % to the three varieties, respectively in 2021/2022. Moreover, 57.14, 39.39 and 36.84 % for three varieties respectively in 2022/2023. Consequently, planting the resistant variety + *A. colmani* parasitoids are very important and efficient elements in IPM of *M. persicae* in sugar beet fields.

Introduction

Sugar beets, *Beta vulgaris* L. (Family: Chenopodiaceae) is counted as one of the most important sugar crops worldwide. In Egypt, it is the first vital sugar crop before sugarcane for sugar production. The Egyptian agriculture policy depends on reducing the gap between sugar production and consumption by encouraging the farmer to increase the cultivated area of sugar beet (Bazazo, 2010). In 2022/2023 season, the total area planted with sugar beet reached 700 thousand feddan in Egypt which produce more than 2.3 million tons of sugar (Anonymous, 2023a). Sugar beet is liable to be attacked by many destructive insect pests during the whole season. These insects cause dangerous economic losses and reduce sugar roots and sugar percentage (Hawila, 2021). Aphids are among the most important crop pets worldwide (Bonnemain, 2010) and Fifty species are of economic importance (Turpeau *et al.,* 2013). *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) affects plant growth and the storage of sugars (Simpson, 2012) directly by sucking plant sap and indirectly by transmitting plant viruses. The beet yellow virus and the beet yellow viruses and the beet mild yellow viruses can cause yield losses of up to 50%, and 35%respectively (Albittar *et al*., 2016). *M. persicae*, known as the green peach aphid, green fly, or the peach potato aphid, is a small green aphid belonging to the order: Hemiptera. It is the most significant aphid pest of sugarcane causing the decrease in growth, shrivelling of the leaves and death of virus tissues. It also acts as a vector for the transport of plant viruses (Capinera, 2005). Also, *M. persicae* is difficult to kill with contact insecticides because it is often under the leaves, or in sheltered areas of plants. In such concern, Muska (2007) in the Czech Republic, reported that aphids belong to the most important pests of sugar beet. The green peach aphid, *M. persicae* causes damage by sucking and transmission of viruses disease. Also, Albittar *et al.* (2016) in Blegium, showed that *M. persicae* causes damage to sugar beet crop. This insect is responsible for losses in yield and transmission of viral disease. In Egyptian fields, Sherief *et al*. (2013) found that *M. persicae* recorded one peak of abundance in the first season. It was recorded in 2nd week of February and represented by 2945 individuals /50 plant.

While, in the second season (2009 /2010), also one peak of abundance was recorded in 3rd week of February and represented by 3089 insects /50 plants. Al-Habshy *et al.* (2014) recorded that the seasonal abundance of *M. persicae* by two peaks. The first one occurred in the 2nd week of December with 275 and 316 insects /samples for the two seasons, respectively. The second one was observed on the 4th week of January represented by 417 and 548 individuals/samples for the two seasons, respectively. Moreover, El-Dessouki (2019) found that aphid population was very high on sugar beet plants of Mid-November, followed by Mid-October .and finally by Mid-August plantation. Resistant varieties of insects as an approach of insect control offers many advantages. Resistant crop varieties provide an inherent control that involves no expense nor environmental pollution problems and is generally compatible with other methods of insect management (Jayaraj and Ulthamasamy, 1990).

Also, Sharma and Ortiz (2002) reported that crop varieties capable of resisting insect damage will play vital role in reducing crop losses and protecting the environment. Host plant resistance is an economical and environmentally friendly method of insect control. In addition, Francis *et al*. (2022) investigated that breeding for new resistant/tolerant sugar beet genotypes is also an important way to protect sugar beets from yellowing viruses. Parasitoid wasps (Hymenoptera:Aphidiidae) occupy the same stratum and are specialized on one or several aphid host species (Sigsgaard, 2003). *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae) is an excellent searcher on can locate small colonies of aphids when populations are low.

The female wasps search for nymph or adult aphids by sensing the odor of infested plants and the aphids `s honey- dew secretion. Using her ovipositor the female will insert an egg inside the aphid host and when the egg hatches the larvae begin to eat the aphid causing its death. A new adult emerges through the exit hole at the back of the mummy (Anonymous, 2023b). Based on that, this paper aims to investigate the pivotal role of resistant varieties and parasitoids in Integrated Pest Management (IPM) to *M. persicae* in Egyptian sugar beet.

The present work aims to study the role of resistant varieties and *A. colemani* parasitoid in Integrated Pest Management (IPM) of *M.* ***persicae*** in sugar beet fields.

Materials and methods

The current study was done at the experiment farm of Sakha Agriculture Research Station during two successive seasons,2021/2022 and 2022/2023. These sugar beet varieties (Lp17B4011, FD18B4018 and FD17B4010) were planted on 20th September and 22nd September for the two seasons, respectively. The area of each variety was 63 $m^{2,}$ divided into 3 replicates, each replicate was measured $21m^2$. The experimental plots received normal cultural practices, but without insecticides spraying the number of larvae and infested plants was recorded by visual examination in the field. Every sample date 15 plants randomly were inspected (5 plants /replicates). A completely randomized block design was used. Concerning the percentage of parasitism, infested leaves with aphids were cut by small scissors, from 15 plants /every variety.

After that, these leaves were put into paper bags in the field and transported to the laboratory. Infested leaves were enclosed in petri- dishes (9cm $^{2)}$ under laboratory conditions (25± 2 °C and 60-70 % RH.). The merged parasitoids and parasitism percentage were calculated for every sampling date. Percentage of parasitism Par. % = (No. of parasitoids ⁄No. of Nymph) X 100, the parasitoids Figure (1) was identified through identification insect unit (IIU). Plant Protection Research Institute, Agriculture Research center, Giza.

Statistical analysis was performed using analysis of variance (ANOVA) technique by means of $^{((}$SPSS$^{))}$ computer software package. The treatment means were compared using Duncan's multiple range test Duncan (1955).

Figure (1): ***Aphidius colemani*** **parasitoid.**

Results and discussion

1. Vulnerability of the three sugar beet varieties to *Myzus persicae* infestations:

Data in Tables (1 and 2) show significant differences among the three varieties of *M. persicae* infestation. Means ±SE of *M. persicae* individuals (Nymphs+ adult) were 0.807± 0.01,1.425 ± 0.02 and 7.660 ±1.12 for LP 17B4011, FD18B4018 and FD17B4010, respectively. Moreover, the Means ±SE of infested sugar beet plant numbers were 0.471±0.01,0.614±0.03 and 2.377±1.01 for the three varieties, respectively during the first seasons 2021 /2022. While, in the second season (2022/2023) (Table 2) the value of means ± SE (Number of aphid individuals) were 0.330 ±0.01, 0.567±0.03 and 9.044 for the three varieties, respectively. In addition to, means ± SE of infested sugar beet plant numbers were 0.235±0.02, 0.520±0.01 and 2.710 ± 1.03 to the three varieties, respectively.

Throughout the two seasons ,2022/2023. Number of aphid individuals ranged between (0.33 to 1.00), (0.66 to 2.33) and (1.66 to 18.66) to the three varieties, respectively. whereas the number of infested plants with aphids ranged between (0.33 to 0.66), (0.33 to 1.00) and

(0.66 to 4.66) for the three varieties, respectively in the first seasons (2021/2022). In the second season,2022/2023 (Table 2) indicates that number of aphid individuals ranging between (0.00 to. 0.66), (0.33 to 1.00) and (2.00 to 20.66) for the three varieties respectively. While the number of infested plants with aphids ranged between (0.00 to 0.33) and (0.33 to 1.00) and (0.66 to 4.66) to the three varieties, respectively. These findings demonstrate that LP17B4011 is a more resistant variety as compared to FD18B4018 and FD17B4010.

In 2021/2022 season (Table 1) shows that the highest mean of *M. persicae* number was recorded on 1st March. with 1.33 individuals/5plants ,while the lowest means were noticed on 10th December and 10th April with 0.33 and 0.33 individuals /5 plants, respectively for the resistance variety LP17B4011.Also, the mean of infested plants with *M. persicae* was recorded on 10th and 30th December, 20th March and 10th April with 0.33 plants/5 plants , While, the highest mean was recorded on 20th January ,10th February and 1st March with 0.66 plants/5plants to the same variety. Concerning the second variety FD18B4018, the highest mean of aphids was recorded on 10 April with 2.33 individuals /5 plants Whereas, the lowest mean was monitored on 10th December with 0.66 individuals/5 plants. Moreover, the highest mean of infested plants was obtained on 10th and 30th December with 0.33plants /5 plants.

As the third variety FD17B4010, the highest mean of *M. persicae* population was recorded on 10th April with 18.66 individuals/5 plants. The lowest mean was taken on 10th December with 1.66 individuals/5 plants. In addition, the highest mean of infested plants was recorded on 10th April with 4.66 plants /5 plants. The lowest mean was indicated on 10th December with 0.66 plants /5 plants. In 2022/2023 season (Table 2) shows that the highest mean of *M. persicae* number was seen on 2nd and 22nd March with 0.66 individuals/5 plants, whilst the lowest mean recorded on 19th January, 11th February and 11th April with 0.33 individuals /5 plants. Also, the highest mean infested plants with *M. persicae* were, recorded on 19th Junuary,11th February, 2nd March, 22nd March and 11th April with 0.33 plants /5 plants for the resistant variety LP17B4011. Regarding the second variety FD18B4018, the highest mean of aphids number was recorded on 11th February with 1.00 individuals/5 plants.

Whereas the lowest mean was obtained on 11th December 22nd March and 11th April with 0.33 individuals /5 plants. Also, the lowest mean of infested plants was recorded on 11th December, 31st December, 19th January and 11th February with 0.33 plants /5 plants. The third variety FD17B4010, the highest mean of *M. persicae* number was recorded on 11th April with 20.66 individuals /5 plants. Moreover, the lowest mean was noticed on 11th December with 2.00 individuals /5 plants. Also, the highest mean of infested plants was recorded on 11th April with 4.66 plants/5plants, the lowest mean was obtained on 11th December with 0.66 plant/5 plants.

Table (1): Mean of aphid populations and infested plants to the three cultivars throughout 2021/2022 season.

Sampling dates	Varieties					
	L P 17B4011		F D18B4018		F D17B4010	
	Mean No. of aphids	Mean of infested plants	Mean No. of aphids	Mean of infested plants	Mean No. of aphids	Mean of infested plants
10 Dec.	0.33	0.33	0.66	0.33	1.66	0.66
30 Dec.	0.66	0.33	1.00	0.33	2.33	1.00
20 Jan.	1.00	0.66	1.00	0.66	3.00	1.33
10 Feb.	1.00	0.66	1.33	0.66	4.33	2.00
1 Mar.	1.33	0.66	2.00	1.00	10.00	2.66
20 Mar.	1.00	0.33	1.66	0.66	13.66	4.33
10 Apr.	0.33	0.33	2.33	0.66	18.66	4.66
Mean ±SE	0.807[a]±0.01	0.471[a]±0.01	1.425[a]±0.02	0.614[a]±0.03	7.661[b]±1.12	2.377[b]±1.01

Means followed by different letters are significantly differences at level 5% of probability.

Table (2): Mean of aphid populations and injured plants for the three Varieties during 2022/2023 season.

Sampling dates	Varieties					
	L P 17B4011		F D18B4018		F D17B4010	
	Mean No. of aphids	Mean of infested plants	Mean No. of aphids	Mean of infested plants	Mean No. of aphids	Mean of infested plants
11 Dec.	0.00	0.00	0.33	0.33	2.00	0.66
31 Dec.	0.00	0.00	0.66	0.33	2.66	1.00
19 Jan.	0.33	0.33	0.66	0.33	3.66	1.33
11 Feb.	0.33	0.33	1.00	0.33	5.33	1.66
2 Mar.	0.66	0.33	0.66	0.66	12.00	2.33
22 Mar.	0.66	0.33	0.33	0.66	17.00	4.00
11 Apr.	0.33	0.33	0.33	1.00	20.66	4.66
Mean ±SE	0.330[a]±0.01	0.235[a]±0.02	0.567[a]±0.03	0.520[a]±0.01	9.044[b]±2.11	2.710[b]±1.03

Many authors indicate the importance of resistance varieties against aphids, consequently increasing sugar beet yield. Francis *et al*. (2022) indicated that breeding for new resistant/tolerant sugar beet genotypes is also an important way of protecting sugar beet from aphids and yellowing Viruses. Beet Yellow Virus (BYV)and beet mild yellowing Virus (BMYV)are responsible for reducing sugar beet yield by 50%. Moreover, Heathcote (1962) clarified that crops differ in their susceptibility to *M. persicae*, but it is an actively growing plant, or the youngest plant tissue, that most often harbors large aphid populations.

Also, Abou El-Kassem (2010) recorded that the resistant varieties, Oscarpoly and Farida are higher in root and sugar yield than susceptible varieties. Moreover, Abbas (2018) reported that Meralda variety is more resistant to insects than the Mirage variety. Consequently, the yield of pyramids was higher than Zinagri. In another study, Biancardi *et al*. (2010) noticed that sugar beet is an economically important crop, providing about 25% of the sugar supply, mainly in Europe. This highly productive sector is especially threatened by insect pests such as aphids which are vectors of economically important phytoviruses. that means most of these viruses are transmitted from plant to plant by aphids.

The development of sugar beet varieties with aphids and virus resistance and or tolerance has a huge potential to reduce aphids and the harm caused by transmitted viruses. In addition, Jayaraj and Uthamasamy (1990) proved that plant resistance as an approach to pest management offers many advantages. Crop varieties that are resistant provide an inherent control that involves no expense nor environmental pollution problems and is generally compatible with other methods of insect control.

Growing insect resistance crops is now highly valued in pest management programs. In addition, Harrington *et al*. (2009) concluded that aphid-borne viruses have the potential to cause major economic losses in the UK sugar beet crop. Sugar beet yellow diseases are caused by three viruses. Beet Yellow Viruses (BYV) is a Closter virus, which has a semi-persistent relationship with its vectors. It resides on the stylets of the vector and in the phloem of the host plants. Beet mild yellowing viruses (BMVY) and Bee chlorosis viruses (BCHV) are Luteo viruses. All three viruses can only be transmitted by colonizing species. *M. persicae* is the most important vector.

2. Importance of the parasitoid, *Aphidius colemani* in reducing *Myzus persica*e population in the field:

Data in Tables (3 and 4) demonstrated that the parasitoid, *A.colemani* plays a vital role in suppressing *M. persicae* number during the two seasons in the three varieties of sugar beet. The percentage of parasitism was higher in the resistance variety (LP17B4011) than in the susceptible varieties, FD18B4018 and FD17B4010 throughout the two seasons. In 2021/2022 season, the percentages of parasitism during the season were 47.05,36.66 and 34.78% to the three varieties, respectively.

The Percentage of parasitism ranged between (0.00 to 75.0), (0.00 to 66.66) and (31.70 to 42.85%) for the three varieties, respectively. In the second season 2022/2023, the percentage of parasitism during the whole season was 57.14,39.39 and 36.84% for the three cultivars, respectively. The percentage of parasitism ranged between (0.00 to 100.0), (0.00 to 66.66) and (0.00 to 45.16%) to the three varieties, respectively. The highest percentage of parasitism recorded on 1st March with 75.0%, While the lowest percentage recorded on 20th January and on 20th March with 33.33% for LP17B4011variety regarding FD18B4018 variety, the highest percentage of parasitism recorded on 20th January with 66.66%, whereas the lowest percentage recorded on 10th February with 25.0% for FD17B4010 variety, the highest percentage of parasitism noticed on 30th December with 42.85%, whilst the lowest percentage recorded on 1st March with 23.33%.

The highest percentage of parasitism was recorded on 19th June and 11th April with 100.0%, while the lowest percentage was recorded on 2nd and 22nd March with 50% for LP17B4011 variety. As FD18B4018 variety, the highest percentage of parasitism was monitored on 11th April at 66.66% whereas the lowest percentage recorded on 11th February with 20.0%. In such concern the third variety FD17B4010, the highest percentage of parasitism on 11th April at 45.16%, while the lowest percentage of parasitism showed on 19th January at 27.27%. Numerous authors investigated that parasitoids are a good element in reducing sugar beet insects under the threshold injury level (Bazazo, 2010; Nema and Sharma, 2002; Abbasipour *et al*. 2012; Hendawy and El-Fakharany, 2017 and Khalifa, 2018).

Mcleod *et al*. (1998) reported that there is a strong association between high aphid densities and sudden population decrease following the appearance of wasp parasitoids. For example, green peach aphid, *M. persicae* infesting spring -harvested spinach (The same family of sugar beet in

USA, is suppressed late in the growing season.

Also, Tamaki *et al*. (1981) found that the wasp parasitoid, *Diaeretiella rapae* (McIntosh) (Hymenoptera: Braconidae) was more effective against aphid species. Hundreds of natural enemies have been recorded. Such as parasitic wasps (Hymenoptera: Braconidae) on *M. persicae*. In such concern, Sigsgaard (2003) indicated that several groups of natural enemies may limit aphid population. Parasitoid wasps (Hymenoptera: Aphidiidae) occupy the same stratum and are specialized on one or several aphid host species. Schmidt *et al.* (2003) clarified that the experimental manipulation showed that both groups of enemies are able to reduce aphids population growth. The effect of flying predators plus parasitoids were stronger than that of the ground-dwelling predators.

Biological Pest Control is becoming increasingly important, as public opinion is in favor of reduced insecticide applications and environmentally sound. Moreover, Jalali and Singh (1993) reported there are several potential parasitoids in nature that are important mortality factors of major pests such as aphids species. Albittar *et al.* (2016) concluded that the parasitoid, *A. colemani* is a good parasitoid for the biological control against *M. persicae* in sugar beet fields. In Europe, it is estimated that aphids on sugar beet are responsible for an annual loss of 2 million tons. Biological Control is considered a good alternative and the use of aphids parasitoids is promising. In another study, Kolaib (1991) reported that the rate of parasitism caused by *D. rapae* parasitoids on aphids reached a mean of 96.4%. Mezani *et al.* (2021) demonstrated that *A. colemani* was an important parasitoid against aphid species. Anonymous (2023b) reported that *A.colemani* is a good parasitoid for controlling *M. persicae* population.

Very good search behavior that allows them to detect and parasitize developing aphid hot spots at low prey density. Also, easily disperses throughout the crop. Lastly, Ballal and Verghese (2015) reported that with increasing hazards due to insecticides, the only answer to mitigating these harmful effects is the use of safe alternatives. Amongst them, the use of parasitoids as biological control agents is the most effective, environmentally sound, and cost-effective pest management approach to control insects. It is anticipated that biological control will play an increasingly important role in *(IPM) program.

Table (3): Parasitism efficiency of *Aphidius colemani* against *Myzus persicae persicae* on the three varieties, 2021/2022 season.

Inspection Dates	Varieties								
	L P 17B4011			F D18B4018			F D17B4010		
	No. of A.	No. of P.	Para. %	No. of A.	No. of P.	Para. %	No. of A.	No. of P.	Para. %
10 Dec.	1	0	0.00	2	0	0.00	5	2	40.0
30 Dec.	2	1	50.0	3	0	0.00	7	3	42.85
20 Jan.	3	1	33.33	3	2	0.66	9	3	33.33
10 Feb..	3	2	66.66	4	1	25.0	13	5	38.46
1 March	4	3	75.00	6	2	33.33	30	7	23.33
20 March	3	1	33.33	5	3	60.0	41	13	31.70
10 Apr.	1	0	0.00	7	3	42.85	56	23	41.07
Para. efficiency	17	8	47.05	30	11	36.66	161	56	34.78

A. Aphids P.= Parasitiods Para. = Parasitism

Table (4): Parasitism efficiency of *Aphidius colemani* against *Myzus persicae persicae* on the three varieties, 2022/2023 season.

Inspection Dates	Varieties								
	L P 17B4011			F D18B4018			F D17B4010		
	No. of A.	No. of P.	Para. %	No. of A.	No. of P.	Para. %	No. of A.	No. of P.	Para. %
11 Dec.	0	0	0.00	3	1	33.33	6	0	0.0
31 Dec.	0	0	0.00	4	1	25.0	8	3	37.5
19 Jan.	1	1	100.0	4	0	0.00	11	3	27.27
11 Feb.	1	0	0.00	5	1	20.0	16	5	31.25
2 March	2	1	50.0	5	3	60.0	36	12	33.33
22 March	2	1	50.0	6	3	50.0	51	19	37.25
11 Apr.	1	1	100.0	6	4	66.66	62	28	45.16
Para. efficiency	7	4	57.14	33	13	39.39	190	70	36.84

A. Aphids P.= Parasitiods Para. = Parasitism

References

Abbas, N. (2018): Integrated control of sugar beet pests M. Sc. Thesis, Fac. Agric., Kafr El- Sheikh University.

Abbasipour, H.; Basij, M.; Mahmoudv, M. and Masnadi-Yasdinejad, A. (2012): First of the parasitoid wasp, *Diadegma pusio* (Hymenoptera: Ichneumonidae) from Iran. Research Gate, 32(2):127-128.

Abou El-Kassem, A. (2010): Ecological and biological studies on some insects of sugar beet plants at Kafr El-Sheikh Governorate. Ph.D. Thesis, Fac. of Agric., Mansoura University.

Albittar, L.; Ismail, M.; Bragard, C. and Hance, T. (2016): Host plants and aphid hosts influence the selection behavior of three aphid parasitoids (Hymenoptera: Braconidae: Aphidiinae). Eur. J. Entomol., 113:516-522.

Al-Habshy, A.; Abd-Elsamed, A. and Mohamed, O. (2014): Ecological studies on certain piercing sucking pests infesting sugar beet crops and then associated natural enemies in Sharkia Governorate. J. Plant Prot. and Path., Mansoura Univ., 5(6) :659-672.

Anonymous (2023a): Annual Report of 2022, sugar crops council, Ministry of Agriculture and L and Reclamation, Arab Republic of Egypt (In Arabic).

Anonymous (2023b): *Aphidius colemani*. http://m plant products .com.

Ballal, C. and Verghese, A. (2015): Role of parasitoids and predators in the management of insect pests. A.K. Chakravarthy (ed.), New Horizons in Insect Science: Towards Sustainable Pest Management.

Bazazo, K. G. (2010): Studies on some insect pests and natural enemies in sugar beet fields at Kafr El-Sheikh region. PH.D. Thesis, Fac. Agric., Tanta University.

Biancardi, E.; Mcgrath, J.; Panella, J.; Lewellen, W. and Stevanato, R. (2010): Sugar Beet .IN Root and Tuber Crops; Bradshaw, J. E. Ed.; Springer: New York, NY, U S A, pp.173-219.

Bonnemain, J. (2010): Aphids as biological models and agricultural pests. C.R. Biol., 333:461-463.

Capinera, L. (2005): Featured creatures. http: entnemdept. U f l .edu /creatures /Veg /aphid /green – Peach – aphid. htm.) University of Florida website– Department of Entomology and Nematology. University of Florida.

Duncan, B. (1955): Multiple ranges and multiple F-tests. Biometrics, 11-42.

El-Dessouki, W. (2019): Ecological studies on some sugar beet insect pests and their control. PH.D. Thesis, Fac. Agric., Cairo Al -Azhar University.

Francis, F.; Then, C.; Francis, A.; Gbangbo, Y.; lannello, L. and Ben Fekih, I. (2022): Complementary strategies for biological control of aphids and related virus transmission in sugar beet to replace neonicotinoids. Agriculture, 12: 1663.

Harrington, R.; Stevens, M.; Alderson, L.; Cox, D.; Denholm, I. and Wright, S. (2009): Complementary methods for monitoring sugar beet aphids to improve risk management of virus yellows. Redia, Vol. X. C., I I:215-217.

Hawila, H. (2021): Ecological and biological studies on the main insect pests infesting sugar beet plants and their associated natural enemies. PH.D. Thesis, Fac. Agric., Mansoura University.

Heathcote, D. (1962): The suitability of some plant hosts for the development of the peach –potato aphid, *Myzus persicae* (Sulzer). Entomologia Experimentalis et Applicata, 5(2):114-118.

Hendawy, A. and El-Fakharany, S. (2017): Parasitoids of the tortoise beetle, *Cassda vittata* Vill. (Coleoptera: Chrysomelidae) in sugar, Fodder and table beet and effect of leaf phenols on parasitoid density. Egyptian J. Biol. Pest Control, 27(2):149-154.

Jalali, S. and Singh, S. (1993): Superior strain selection of the egg parasitoid, *Trichogramma chilonis* -biological parameters. J. Biol. Control, 7:57-60.

Jayaraj, S. and Uthamasamy, S. (1990): Aspects of insect resistance in crop plants. Proc. Indian Acad. Sci. (Anim. Sci.), 99(3):211-224.

Khalifa, A. (2018): Natural enemies of certain insect pests attacking sugar beet plants at Kafr El-Shikh Governorate. J. Plant Prot. And Path., Mansoura Univ., 9(8):507-510.

Kolaib, M. (1991): The role of parasitoids and hyperpasitoids associated with cabbage aphid, *Brevicoryne brassicae* L, at Shebin EL-Kom. Egypt. J. Biol. Pest Control, 11(1):19-22.

Mcleod, P.; Steinkraus, D.; Correll, J. and Morelock, T. (1998): Prevalence of *Erynia neoaphidis* infections of green peach aphid (Homoptera: Aphididae) on spinach in the Arkansas River Valley. Environmental Entomology, 27:796-800.

Mezani, S.; Ibrahim, I. and El-Khawass, K. (2021): Foraging behavior of *Aphidius colemani* (Hymenoptera: Aphidiidae) on three aphid species (*Aphis gossypii*, *Aphis craccivora* and *Rhopalosiphum maidis*) (Homopteea :Aphididae). Al-Azher J. Agric. Rese., 46(2):175-181.

Muska, F. (2007): Damaging presence of aphids on sugar beet in Czech Republic historical summary. Until 2005. Listy-Cukrovarnicke-a-Reparske, 123(9/10):284-287.

Nema, K. and Sharma, S. (2002): Record of *Trissolcus* sp. on green stink bug Insect Environment ,8(2): 69-71.

Schmidt, M.H.; Lauer, A.; Purtauf, T.; T hies, C.; Schaefer, M. and Tscharntke, T. (2003): Relative importance of predators and Parasitoids for cereal aphid control. Proc R. Soc. lond, B., (270):1905-1909.

Sharma, H. and Ortiz, R. (2002): Host plant resistance to insects: An eco –friendly approach for pest management and environment conservation. Journal of Environmental Biology, 23:111-135.

Sherief, E.; Said, A.; Shaheen, F. and Fouad, H. (2013): Population Fluctuations of certain pests and their associated predator insects on sugar beet in Sharkia Governorate, Egypt. Egypt J. Agric. Res.,91(1):139-150.

Sigsgaard, L. (2003): A survey of aphids and aphid parasitoids in cereal fields in Denmark, and the parasitoids role in biological control. Journal of Applied Entomology, 126(2-3):101- 107.

Simpson, K.; Jackson, G. and Grace, J. (2012): The response of aphids to plant water stress-the case of *Myzus persicae* and *Brassica oleracea* Var. capitata. Entomol. Exp. Appl., 142:191-202.

Tamaki, G.; Annis, B. and Weiss, M. (1981): Response of natural enemies to the green peach aphid in different plant cultures. Environmental Entomology ,10 (3):3775-3778.

Turpeau, E.; Hulle, E. and Chaubet, B. (2013): Encyclop, Aphid .URL:https://www 6.inra.Fr/ encyclopedie -Pucerons.