Egypt. J. Plant Prot. Res. Inst. (2020), 3 (1): 248 - 256

Egyptian Journal of Plant Protection Research Institute

www.ejppri.eg.net

Population dynamics of the cabbage aphid *Brevicornae brassicae* (Hemiptera: Aphididae) infesting canola in El-Minia Governorate

Mohamed, A. A. Abdel-Rahman[1]; Salman, A. M. A. [2] and Asmaa, Salah El-Din Syaid[1]

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

[2]*Plant Protection Department, Faculty of Agricultural, Sohag University.*

ARTICLE INFO

Article History

Received: 30/ 1/ 2020

Accepted: 29/ 3/2020

Keywords

Cabbage aphid, Brevicornae *brassicae*, canola, population dynamics, El-Minia Governorate and Egypt.

Abstract:

The present studies were carried out throughout the period from 2016-2017 to 2017-2018. The main objectives were studying population dynamics of the cabbage aphid *Brevicornae brassicae* L. (Hemiptera: Aphididae) infesting canola in Malawi, El-Minia Governorate. Data showed that the migration of aphid from the overwintering site into canola field occurred after about 26 days (nearly during the second week of December). Maximum population density of the cabbage aphid occurred after about 97 days. Therefore, the peak of abundance could expect around the end of February and the beginning of March. The population then vanished from the canola field in 122 days (toward the end of March). Also, the present results indicated that the number of cabbage aphid was significantly higher in the second season 2018 than that of first 2017. The differences in levels of infesting between the seasons might be attributed to the differences in weather factors (temperature and relative humidity) and / or the effect of the common natural enemies in each season.

Introduction

The cabbage aphid *Brevicoryne brassicae* (L.) (Hemiptera: Aphididae), a pest on many cruciferous crops is distributed throughout all the temperate and warm temperate regions of the world. This aphid is considered one of the most damaging and consistently present pests on cabbage crops (Theunissen, 1989). *B. brassicae* causes direct damage, resulting from searching for food, which may induce plant deformation and indirect damage caused either by honeydew or by transmission of viruses. The cabbage aphid is a vector of 20 virus diseases in a large range of plants (Liu and Yue 2001; Lotfalizadeh, 2003; Ahmed, 2006; Almeida *et al*., 2007 and Ponti *et al*., 2008).

The present studies were oriented to obtain better knowledge about the cabbage aphid population infesting canola at Malawi area, El-Minia Governorate.

Materials and Methods

The present studies were carried during two successive growing seasons, 2016-2017 and 2017-2018. An area of about half feddan (2100m^2) was cultivated with canola plants (cultivar pactol). Plants were normally planted at

first half of November. Regular conventional agricultural practices were normally performed, and no chemical control was used during the study period. Weeds were removed by hand.

Regular samples consisted of 50 plants of canola were randomly collected and brought back in transparent polyethylene bag to the laboratory for counting aphid species and their natural enemies. Samples were taken weekly when the migration of aphids onto the crops from overwintering sites began and continued through the time till when aphid population and their natural enemies declined to low or undetectable levels. The number of aphids (nymphs and adults) and the associated natural enemies were counted and recorded at each inspection date.

Temperature (maximum and minimum) and relative humidity (maximum and minimum) were obtained from a meteorological station located at 100 m away from the experimental site in the field.

Results and Discussion

The population of the aphid species infesting canola plants was studied in the experimental farm of Malawi, El-Minia Governorate during 2016-2017 and 2017-2018 seasons. Data on the population densities of the cabbage aphid species expressed in terms weekly numbers / plant in Table (1). In 2016-2017 season, the changes in the population densities of *B. brassicae* on canola plants are presented in Table (1). Data indicate that the nymphs and adults of the pest were detected on canola plants in a relatively low level (5.60 aphids / plant) during the end week of January when the plants were in the bud stage. Thereafter, the population tended to increase gradually through February and first half of March. The maximum level (235.41 aphids / plant) was attained during first half of March when the plants were in the end of flowering stage. The number of aphids then showed a sharp decrease and approximately vanished from the field during meddle of April when the plants were in the end of ripening stage. Data in Table (1) showed that the seasonal abundance of the cabbage aphid during 2017- 2018 season. The aphid started to appear on canola plants in extremely low numbers (0.56 aphid / plant) during meddle of December when the canola plants were in the seedling stage. Its population reached a peak of 2510.34 aphids / plant during the third week of February when the plants were in the flowering stage. The populations continued in relatively high numbers in the next month and vanished from the field during meddle of April when the plants were in ripening stage. In general, the cabbage aphid appeared in the period lasted from the third week of December up to meddle of April with a peak number during the middle of February when the plants were in the flowering stage.

It could be generally concluded that the population of the pest appeared with a few numbers during the third week of December. In this time the plants were in the seedling stage coincided with a plant age of 59 days, temperature ranged from 4.80 to 23.38°C, relative humidity ranged from 33.00 to 100.00%. Predators and mummies were recorded in low density during this phase. The data revealed also that the population of cabbage aphid increased markedly by the progress of canola plant growth toward flowering stage and the maximum population densities of aphids occurred when the plants were in the third week of February. In this point plant age was in an average of 122 days. This period (third

week of February) however, coincided with a maximum temperature ranged from 18.08 to 20.74°C, maximum RH. ranged from 99.85 to 100.00%. These conditions seem to be the favorable range for the reproduction and multiplication of the cabbage aphid. However, the rapid increase in the population of aphid in this period might be related to suitability of the host plant. The data however showed a decline in the aphid population during the end of April. This period coincided with the end of ripening growth stage of canola plants. The prevailing maximum temperature ranged from 23.37 to 30.57°C, the relative humidity ranged from 93.42 to 100.00%, however, the number of predators and mummified aphids progressively increased to exhibit a peak as the aphid populations declined. However, the eventual decline of aphid populations later in the growing season results from a combination of rapid drop in the suitability of the crop in this time, accompanied by much alate emigration and the action of the natural enemies of aphids (Tables, 2 and 3).

The relationship between incidence of the cabbage aphid infesting canola plants and selected abiotic and biotic factors were statistically analyzed using multiple regression analysis. The selected abiotic factors were air temperatures and relative humidity; and three biotic factors i.e. plant age (in days), number of predators and mummified in relation to the population of *B. brassicae* during 2016-2017 (Table,2) and 2017-2018 (Table,3) growing seasons. The present results indicate that the number of cabbage aphid was significantly higher in the second season 2017- 2018, than that of 2016-2017 season. The differences in levels of infesting between the seasons might be attributed to the differences in weather factors (temperature, relative humidity) and / or the effect of the common natural enemies in each season.

2.1. Biotic factors

2.1.1. Plant age

Data in Tables (4 and 5) showed that plant age has a coefficient of determination of about 28.21% out of 72.40% and 22.15% out of the total efficiency 66.89%. This evidence indicated that about 28.21% and 22.15% of the variability of the infestation was due to plant age under the studied variables (7 variables). Also, Tables (4 and 5) showed that the rating sort of the plant age cams in number one.

2.1.2. Predators

Data in Tables (4 and 5) showed that predators seemed to be responsible for about 7.82% during 2017 season and 10.24 during 2018 season in the changes *B. brassica* population. Predators came in the rating sort in number four and two.

2.2. Abiotic factors

2.2.1. Air temperature and humidity

It was found that the effect of maximum and minimum temperature on the infestation of canola plants by *B. brassicae* has a coefficient of determination of about 6.24% and 11.25% out of 72.40% during 2016-2017 season and 9.32 and 5.31% out of 66.89% during 2017-2018 season of the total efficiency (7 variables). The rating sort of the maximum and minimum temperature came in number five and two (2016-2017) and three and six (2017-2018) (Tables 4 and 5).

The maximum and minimum relative humidity was found to be responsible for 9.04% and 3.62% during 2017 and 7.22 and 4.34 during 2017-2018 seasons of the variability of number of cabbage peach aphid infesting canola, respectively.

Canola is one of the newly introduced oil crops in Egypt to contribute in reducing oil shortage; especially it could be cultivated in soils affected by salinity. Rapeseed has a bright future in Egypt because of its ability to grow in the new reclaimed lands under wide soil variation as drought and salinity as revealed by some Egyptian (Kandil *et al*., 1996). The pests inhabiting canola plants in certain countries of the world i. e. India, Pakistan, USSR, China, Italy, Canada, Poland, Bulgaria, UK, Australia, Turkia, Germany, Brazil, North America, USA, Denmark, Estonia, South Africa and Egypt, illustrated that the main pests of canola plants are certain species of insects belonging to different orders (Lamb., 1989). Various authors in certain parts of the world i. e. Warner *et al.,* 2000; Carcamo *et al.,* 2001; Mosiane *et al.,* 2003; Hansen, 2004 and Pontoppidan *et al*., 2005, discussed pests inhabiting canola from an economic viewpoint. The cabbage aphid is distributed throughout all the temperate and warm temperate regions of the world. This aphid was considered one of the most damaging and consistently present pests on cabbage crops (Theunissen, 1989). *B. brassicae* caused direct damage, resulting from searching for food, which may induce plant deformation (Oatman and Platner, 1969), and indirect damage caused either by honeydew or by transmission of viruses. The cabbage aphid was a vector of 20 virus diseases in a large range of plants (Chan *et al.*, 1991).

The cabbage aphid, *B. brassicae* is a polyphagous sap sucking pest of canola throughout the world causing a significant problem in the field followed by economic losses (Ahmed, 1980; Pontoppidan *et al.*, 2003 and Mohamed, 2011). Pontoppidan *et al.*, (2003) reported that cabbage aphid is specialized on cruciferous plants and constitutes a worldwide problem with a substantial negative impact on agriculture and horticulture. When aphids form dense colonies on developing flowers, yield losses of up to 70% have been reported if infestations are left untreated. They added that canola should be sown as early as practical within the sowing window to avoid both yield and oil penalties induced by a contribution of aphid population density and fluctuation: The cabbage aphid infestations can occur at two stages of canola crop cycle; during autumn / winter establishment stage and again during spring when the crop is in flowering and pudding (Aslam *et al*., 2007) studied population abundance of cabbage aphid, *B. brassicae* and mustard aphid, *L. erysimi* on Sultan Raya variety of Indian mustard, *Brassica juncea* L. in Pakistan. In Egypt, cabbage aphid, *B. brassicae* is known to be the most abundant and destructive species of aphididae on canola crop during the flowering and podding stage (Sayed and Teilep, 2013; Mahmoud and Shebl, 2014; Mahmoud and Osman, 2015 and Abu Omira, 2017). At Ismailia, the mean population of aphid demonstrated that the greatest numbers of aphid among dates of observations were 6.85 and 4.53 individuals/plant which were recorded on the 2nd week of April and on the 1st week of March, whereas, the minimum populations of aphids were 0.21 and 0.25 individuals/plant that were recorded on the 2nd week of February and on the 1st week of May (Sayed and Teilep, 2013). Mohamed (2016) reported that, *B. brassicae* seems to be the most important economic pest infesting canola as indicated by the highest value of dominance and abundance degrees (81.82 and 100%). The peak of abundance was around the end of February and the beginning of March.

Table (1): Population fluctuation of *Brevicornae brassicae* infesting canola plants, Malawi, El-Minia Governorate, 2016-2017 and 2017-2018 seasons.

Sampling date	Growth stage	Mean no individuals / plant		
		2016-2017	2017-2018	Average
Dec. 4	Seedling	0.00	0.00	0.00
11	Seedling	0.00	0.56	0.28
18	Seedling	0.00	3.24	1.62
25	Rosette	0.00	6.32	3.16
Jan. 1	Rosette	0.00	19.25	9.625
8	Rosette	0.00	75.84	37.92
15	Rosette	0.00	160.24	80.12
22	Rosette	0.00	382.64	191.32
29	Bud	5.60	632.65	319.12
Feb. 5	Bud	14.72	665.24	339.98
12	Flower	26.00	1055.26	540.63
19	Flower	28.15	2510.34	1269.24
26	Flower	73.83	1820.24	947.03
March 5	Flower	102.65	730.12	416.38
12	Flower	235.41	520.64	378.02
19	Ripening	163.49	300.25	231.87
26	Ripening	165.80	165.25	165.52
April, 2	Ripening	87.55	80.44	83.99
9	Ripening	36.87	25.00	30.93
16	Ripening	0.00	0.00	0.00
Total	---	940.07	9153.52	10093.59
Mean	---	9.31	90.68	100

Table (2): Population of Brevicornae brassicae infesting canola in relation to some factors (abiotic and biotic) Malawi, El-Minia Governorate, 2016-2017.

Sampling date	Mean no aphids / plant	Plant age (days)	Temp. (°C)			R.H. (%)			Predators	Parasitoids
			Max.	Min.	Avg.	Max.	Min.	Avg.		
Dec. 4	0.00	45	24.34	8.54	16.44	100.00	37.57	47.21	0.00	0.00
11	0.56	52	21.10	7.44	14.27	95.85	33.28	31.28	0.00	0.00
18	3.24	59	23.37	7.97	15.67	100.00	34.00	33.00	0.28	0.00
25	6.32	66	23.51	10.30	16.90	100.00	39.71	30.14	1.52	0.00
Jan. 1	19.25	73	19.35	6.61	12.98	100.00	49.57	25.21	5.17	0.00
8	75.84	80	20.40	5.55	12.97	100.00	41.57	29.21	3.40	0.00
15	160.24	87	22.38	2.74	12.56	100.00	35.57	32.21	5.06	0.00
22	382.64	94	20.08	3.90	11.99	100.00	40.28	29.85	6.40	0.00
29	632.65	101	17.70	4.98	11.34	100.00	40.42	29.78	8.39	0.00
Feb. 5	665.24	108	23.20	5.30	14.25	100.00	38.00	31.00	4.48	0.00
12	1055.26	115	28.51	9.67	19.09	100.00	33.14	33.42	3.92	0.00
19	2510.34	122	20.74	7.63	14.18	99.85	44.00	27.92	5.57	0.14
26	1820.24	129	26.65	11.12	18.89	100.00	30.28	34.85	5.84	0.30
March 5	730.12	136	27.35	9.77	18.56	98.00	25.28	36.35	1.69	2.19
12	520.64	143	29.37	11.80	20.58	95.00	27.00	34.00	1.24	4.16
19	300.25	150	28.38	10.34	19.36	95.57	23.00	36.28	0.49	13.17
26	165.25	157	29.32	11.01	20.17	88.14	19.00	34.57	0.34	18.50
April, 2	80.44	164	24.34	8.54	16.44	100.00	37.57	47.21	0.54	11.58
9	25.00	171	21.10	7.44	14.27	95.85	33.28	31.28	0.00	19.97
16	0.00	178	23.37	7.97	15.67	100.00	34.00	33.00	0.00	0.00

Table (3): Population of Brevicornae brassicae infesting canola in relation to some factors (abiotic and biotic) Malawi, El-Minia Governorate,2017-2018.

Sampling date	Mean no aphids/plant	Plant age (days)	Temp. (°C)			R.H. (%)			Predators	Parasitoids
			Max.	Min.	Avg.	Max.	Min.	Avg.		
Dec. 4	0.00	45	20.62	8.00	14.31	100.00	41.25	70.62	0.00	0.00
11	0.00	52	21.74	7.52	14.63	100.00	45.14	72.57	0.00	0.00
18	0.00	59	19.98	4.80	12.39	100.00	40.85	70.42	0.00	0.00
25	0.00	66	17.31	4.18	10.75	100.00	49.85	74.92	0.00	0.00
Jan. 1	0.00	73	18.42	3.60	11.01	100.00	43.57	71.78	1.28	1.00
8	0.00	80	18.12	1.50	9.81	99.85	36.42	68.14	2.00	1.00
15	0.00	87	19.27	3.21	11.24	100.00	33.57	66.78	2.10	1.00
22	0.00	94	20.31	5.10	12.70	100.00	43.42	71.71	2.87	1.00
29	5.60	101	20.52	5.27	12.90	99.71	33.85	66.78	0.04	0.14
Feb. 5	14.72	108	19.25	2.91	11.08	100.00	33.85	66.92	2.93	0.09
12	26.00	115	22.42	3.57	13.00	100.00	29.28	64.64	5.01	0.05
19	28.15	122	18.08	3.61	10.85	100.00	35.85	67.92	6.04	0.02
26	73.83	129	22.15	5.91	14.03	100.00	37.00	68.50	3.93	0.03
March 5	102.65	136	22.15	5.91	14.03	100.00	37.00	68.50	9.07	0.03
12	235.41	143	25.21	8.07	16.64	100.00	33.85	66.92	13.36	0.01
19	163.49	150	26.11	9.43	17.77	90.28	26.42	58.35	19.57	0.02
26	165.80	157	23.38	8.70	16.04	96.00	32.28	64.14	15.68	0.02
April, 2	87.55	164	25.68	9.24	17.46	96.14	26.42	61.28	15.41	0.01
9	36.87	171	28.40	9.78	19.09	90.57	21.85	56.21	7.08	0.04
16	0.00	178	30.57	9.71	20.14	93.42	19.00	56.21	0.00	0.00

Table (4): Multi factors affecting population of *Brevicornae brassicae* infesting canola plants during 2016-2017 growing season.

Factors			Simple correlation	Relative efficiency	Rating
Biotic	Plant age (days)		0.64	28.21	1
	Predators		٠,٦١	7.82	4
	Parasitoids		٠,٧٢	6.22	6
Abiotic	Air temp. (ºC)	Max.	0.65	6.24	5
		Min.	0.55	11.25	2
	R. H (%)	Max.	0.91	9.04	3
		Min.	0.42	3.62	7
Co-efficient			72.40		

Table (5): Multi factors affecting population of *Brevicornae brassicae* infesting canola plants during 2017-2018 growing season.

Factors			Simple correlation	Relative efficiency	Rating
Biotic	Plant age (days)		0.67	22.15	1
	Predator		٠,٦٥	10.24	2
	Parasitoids		٠,٥٥	٨,٣١	4
Abiotic	Air temp. (ºC)	Max.	0.71	9.32	3
		Min.	0.52	5.31	6
	R. H (%)	Max.	0.72	7.22	5
		Min.	0.49	4.34	7
Co-efficient			66.89		

References

Abu Omira, H. Th. M. M. (2017): Studies on certain insect pests infesting canola and their control in Assiut governorate. M. Sc. thesis, Coll. Agric., Assiut University.

Ahmed, A. Z. A. (1980): Survey and population studies on certain insects occurring in the field of four important oil crops in Egypt. M.Sc. Thesis, Fac., Agric., Cairo University.

Ahmed, A.R.A. (2006): Studies on insects associated with canola plant *Brassica napus* L. (Rapeseed) in Sohag governorate. M.Sc. thesis, Coll. Agric., Minia University.

Almeida, G. D.; Pratissoli, D.; Polanczyk, R. A.; Holtz, A. M., and Vicentini, V.B. (2007): Determination of the medium lethal concentration (LC_{50}) of *Beauveria bassiana* for the control of *Brevicoryne brassicae.* Idesla., 25 (2): 69-72.

Aslam, M.; Razaq, M.; Ahmed, F. and Mirza, Y.H. (2007): Population abundance of aphids (*Brevicoryne brassicae* L. and *Lepiaphis erysimi* (Kalt.)) on Indian mustard (*Brassica juncea* L.). African Crop Science Conference Proceedings, (8): 935-938.

Carcamo, H.; Dosdall, L.; Dolinski, M.; Olfert, O. and Byers, J.R. (2001): The cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae). Journal of the Entomological Society of British Columbia, 98: 201-210.

Chan, C.K.; Forbes, A.R. and Raworth, D.A. (1991): Aphid-transmitted viruses and their vectors of the world. Agric. Canada Res. Branch Tech. Bull., 3E: pp 216.

Hansen, L.M. (2004): Economic damage threshold model for pollen beetles (*Meligethes aeneus* F) in spring oilseed rape (*Brassicae napus* L.) crops. Denmark. Crop Protection, 23: 43-46.

Kandil, A. A.; El-Mohandes, S. I. and Mahrous, N.M. (1996): Heterosis in intervarietal crosses of oilseed rape "canola" (*Brassica napus* L.). Proc. 7th conf. Agron. Fac. Of Agric. Mansoura Univ., 11: 471-476.

Lamb, R. (1989): Entomology of oil seed crops. Ann. Rev. Entomol., 34: 211-223.

Liu, T.X. and Yue, B. (2001): Comparison of some life history parameters between alate and apterous forms of turnip aphid (Homoptera: Aphididae) on cabbage under constant temperatures. Florida Entomologist, 84(2): 239-242.

Lotfalizadeh, H. (2003): Parasitoids of cabbage aphid, *Brevicoryne brassicae* (L.) (Hom: Aphididae) in Moghan Region. Agricultural Science (Tabriz), 12 (1): 15-25.

Mahmoud, M. F. and Shebl, M. (2014): Insect fauna of canola and phenology of the diamondback moth, *Plutella xylostella* L. (Lepidoptera: Plutellidae) as a key pest. REDIA, Journal of Zoology, 97: 125-132.

Mahmoud, M.F. and Osman, M.A.M. (2015): Management of cabbage aphid, *Brevicoryne brassicae* L. on canola crop using neonicotinoids seed treatment and salicylic acid. Journal of Phytopathology and Pest Management, 2(3): 9-17.

Mohamed S.M.A., (2016): Studies of certain factors affecting the abundance of some aphids and thrips in Assiut Governorate. MSc. Thesis Faculty of Agriculture Assiut University.

Mohamed, A.H.M. (2011): Studies on aphid species (Homoptera: Aphididae) infesting canola plant and their natural enemies in Assiut city. M. Sc. Thesis, Fac. Sci., Assiut University.

Mosiane, S.M.; Kfir, R. and Villet, M.H. (2003): Seasonal phenology of the diamond back moth, *Plutella xylostella* (L), (Lepidoptera: Plutellidae), and its parasitoids on canola, *Brassica napus* (L.), in Gauteng Province, South Africa. African Entomology, 11(2): 277-285.

Oatman, E.R. and Platner, G.R. (1969): An ecological study of insect populations on cabbage in southern California. Hilgardia, 40: 1- 40.

Ponti, L.; Altieri, M. A. and Gutierrez, A. P. (2008): Compost enhances parasitization of *Brevicoryne brassicae* (L.) *by Diaeretiella rapae* (M'Intosh) in broccoli under different levels of crop diversification and plant competition. Cultivating the future based on science. Volume 1: Organic Crop Production. Proceedings of the Second Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR), held at the 16th IFOAM Organic World Conference in Cooperation with the International Federation of Organic Agriculture Movements (IFOAM) and the Consorzio ModenaBio in Modena, Italy, 18-20 June, 2008.236-239.

Pontoppidan, B.; Hopkins, R.; Rask, L. and Meijer, J. (2003): Infestation by cabbage aphid (*Brevicoryne brassicae*) on oilseed rape (*Brassica napus*) causes a long-lasting induction of the myrosinase system. Entomologia Experimentalis et Applicata, 109: 1, 55-62.

Pontoppidan, B.; Hopkins, R.; Rask, L. and Meijer, J. (2005): Differential wound induction of the myrosinase system in oilseed rape (*Brassica napus*): contrasting insect damage with mechanical damage. Sweden. Plant Science, 168(3): 715-722.

Sayed, A.M.M. and Teilep, W.M.A. (2013): Role of natural enemies, climatic factors and performance genotypes on regulating pests and establishment of canola in Egypt. The Journal of Basic and Applied Zoology, 66 (1): 18-26.

Theunissen, N. (1989): Integrated control of aphids on field-grown vegetables. In: Aphids, their biology, natural enemies and control. Vol C. (Eds.: A.K. Minks, P. Harrewijn), pp. 285 - 289.

Warner, D.J.; Allen, L.; Williams, J.; Ferguson, A.W. and Williams, I.H. (2000): Pest-predator spatial relationships in winter rape: implications for integrated crop management. UK. Pest Management Science, 56(11): 977-982.