J. Plant Prot. and Path., Mansoura Univ., Vol.7 (6), 369– 376, 2016

Effect of Flowering Plants Surrounding Faba Bean Fields on The Phenology And Community Composition of The Cowpea Aphid *Aphis craccivora* Predators

Bayoumy, M. H.[1]; S. S. Awadalla[1]; S. B. Beleh[2] and Heba S. Abd El-Aty[2]
[1]Economic Entomology Department, Faculty of Agriculture, Mansoura University.
[2]Field Crop Insect Pest Department, Plant Protection Research Institute, Agricultural Research Center, Sakha, Egypt.

ABSTRACT

The current work was carried out in faba bean fields at Sidi-Salem district, Kafr El-Sheikh governorate during two growing seasons (2012/13 and 2013/14) to study the effect of flowering plants on phenology and community composition of the cowpea aphid, *Aphis craccivora* (Koch.) predators. In the first field, replicates were marginally surrounded with a belt of flowering plants (Coriander, *Corindrum saivum* L.), whereas in the second one did not. Population of each predator species differed from season to season and from field to other. Although, the attracted percentage of each predator species differed from season to season, *Chrysoperla carnea* (Steph.) was the only species exhibited strong attractiveness in the field with flowering plant margins and contributed with the highest fate of occurrence in flowering plots of faba bean during both plantation seasons. It contributed with 29.10 and 22.60 % of the total attracted numbers. Whereas, *Orius laevigatus* (Fiber) contributed with the lowest fate of attractiveness (13.05 and 16.36%) to flowering plants during the first and second seasons. On the other hand, *Paderus alfierii* Koch and *Coccinella undecimpunctata* L. contributed with the highest fate of attracted predators to non-flowering plant fields.

Keywords: Coriander, floral plants, population density, predator species

INTRODUCTION

The faba bean (*Vicia faba* L.) is considered an important crop in Egypt. It plays an essential role in improving the soil as it fixes nitrogen by amount of 45-552 Kg/h, which influences the following crop in a rotation. It is considered also a main source of food for the mankind and its domestic animals, where it contains a great proportion of proteins (28%) and carbohydrates (58%) in addition to many vitamins and other nutrients (Mahmoud et al., 1996).

Faba bean plants are attacked by several serious insect pests attacking faba bean crop involving the aphids. In the recent years, the yield of faba bean affected widely by aphid infestations which play a critical way in transmitting virus diseases, that cause considerable losses to the crop yield (Jackai, 1995; Mohamed and Slman, 2001; Ward et al., 2002). The cowpea aphid, *Aphis craccivora* (Koch.) (Homoptera: Aphididae) is considered as one of the most injurious insect pests attacking faba bean plants (Soliman, 2004).

The beneficial impacts of flowering plants on natural enemies have been received much attention (e.g., Zhao et al., 1992; Cowgill et al., 1995; Idris and Grafius, 1995). Conserving and stabilizing natural enemies are major prerequisites to subtend the ecological needs of these beneficials within or close to the crop (Landis et al., 2000). Flowering borders surround crop field margins could supply necessary sources and shelter for natural enemies through suffering periods of flowers absent, thus conserving high populations of these beneficials (Bugg and Waddington, 1994; Landis et al., 2000; Ahern and Brewer, 2002; Büchi, 2002; Sanchez et al., 2003; Wanner et al., 2006a, b; Isaacs et al., 2009; Hogg et al., 2011). For example, floral nectar and pollen are essential nutrients, beside the main prey, that require by predators such as; ladybeetles (Freeman Long et al., 1998; Nalepa et al., 1992; Pemberton and Vandenberg, 1993), lacewings (McEwen and Kidd, 1995; Freeman Long et al., 1998), and syrphids (Carreck and Williams, 1997; Hickman and Wratten, 1996; White et al., 1995), to improving their fecundities and longevities. Some studies demonstrated that the spider's population increased and aphid's population decreased in case of the wheat field surrounded with flowering plants (Jmhasly and Nentwig, 1995). Additionally, there are some evidences that flowering plant strips increase the alternative prey densities, and thus enhancing the bio-control impacts (Frank, 2003; El-Nabawy et al., 2015). The presence of flowering plant strips within field crop increases the killing for beneficials in crop fields. Accordingly, floral resources close to crop fields can reduce exposure of natural enemies to chemicals and improve the re-invade by these beneficials more rapidly after disappearing of chemical applications (Walton and Isaacs, 2011). Most previous studies have been focused on effect of extra- and intra-floral nectars on survival, fecundity, and flight ability of insect parasitoids (e.g., Leius, 1963; Foster and Ruesink, 1984; Jervis et al., 1993; Idris and Grafius, 1997; Carreck and Williams, 1997; Baggen and Gurr, 1998; Tooker and Hanks, 2000; Begum et al., 2004; Lee et al., 2004; Steppuhn and Wäckers, 2004; Wäckers, 2004), whereas predators received little attention. Therefore, the current work was conducted to give highlights on the effect of flowering plants, surrounded the faba bean plants, on the phenology and community composition of the cowpea aphid *A. craccivora* predators.

MATERIALS AND METHODS

The present work was applied in faba bean fields at Sidi-Salem district, Kafr El-Sheikh governorate during 2012/2013 and 2013/2014. An area of approximately 600 m^2 was divided into two plot strips, each was 300 m^2. Each plot was divided to four replicates, each was 75 m^2. In the first plot, replicates

were marginally surrounded with a belt of flowering plants (Coriander, *Corindrum saivum* L.), whereas in the second one did not. All procedures regarding timing of plantation, varieties and sampling technique was followed as recommended. Samples were taken 15 days after cultivation and continued weekly till the end of the harvesting time. Five plants from each replicate were selected randomly, monitored, and numbers of the predator species were visually recorded in the field.

Populations of predatory insects associated with cowpea aphid in faba bean fields were statistically compared between both flowering and free-flowering fields in each growing season using *t*-test. Further, populations of all observed predators were analyzed in each field type, i.e. flowering or free-flowering, in each growing season using one-way ANOVA. Prior to ANOVA, data were checked for assumptions of normality and equality of variance (Shapiro–Wilks and Levene's tests, respectively). Mean values were differentiated by the Bonferroni test ($\alpha = 0.05$).

RESULTS

1. Effect of flowering plant margins on phenology of aphid predators.

***Chrysoperla carnea* (Steph.)**

Data presented in Figure (1A) indicated that, the population of green lacewing, *C. carnea* was higher in faba bean surrounded with flowering plants than in free-flowering plants in both seasons of study. In the field of faba bean with flowering plant margins, *C. carnea* had two peaks of abundance during the first season (2012/13). The first peak (3.5 individuals / 5 plants) was recorded on 24th of January 2013 and the second peak (1.75 individuals) was on 27th of February 2013. In free flowering field, two peaks of abundance were also observed for *C. carnea*. The first peak (1 individual) was recorded on 27th of December, 2012 and the second one (1.25 individuals / 5 plants) was on 24th of January 2013.

Data represented in Figure (1B) showed that in the second year of plantation (2013/14), the population of *C. carnea* showed three peaks of abundance, in fields surrounded with flowering plants, with the highest one (3.5 individuals) on 24th of January 2014. Whereas, two periods of limited abundance were observed for *C. carnea* in the field with free-flowering plant margins with the highest abundance (1.25 individuals) recorded on 6th of February 2014.

Statistical analysis confirmed that there was a highly significant difference in the average number of *C. carnea* between faba bean fields margined with flowering plants and that free of flowers in the first and second seasons of plantation ($t = 3.39$; $P = 0.002$ and $t = 3.73$; $P = 0.001$; Table 1).

***Coccinella undecimpunctata* (L.)**

Data illustrated in Figure (2A) indicated that the population of ladybeetle, *C. undecimpunctata* was higher in the field of faba bean surrounded with flowering plant than that free of flowering plant margins in both seasons of investigation. In the field of faba bean margined with flowering plants, *C. undecimpunctata* showed three peaks of abundance during the first year (2012/13). The first peak (1.75 individuals) was recorded on 17th of January, 2013, the second peak (2.25 individuals) on 6th of February, 2013, and the third one (2.5 individuals) was on 27th of February, 2013. In faba bean field with free-flowering plant margins, two peaks of abundance were observed. The first peak (2 individuals) was recorded on 6th of February, 2013 and the second one (1.75 individuals) was recorded on 20th of February, 2013.

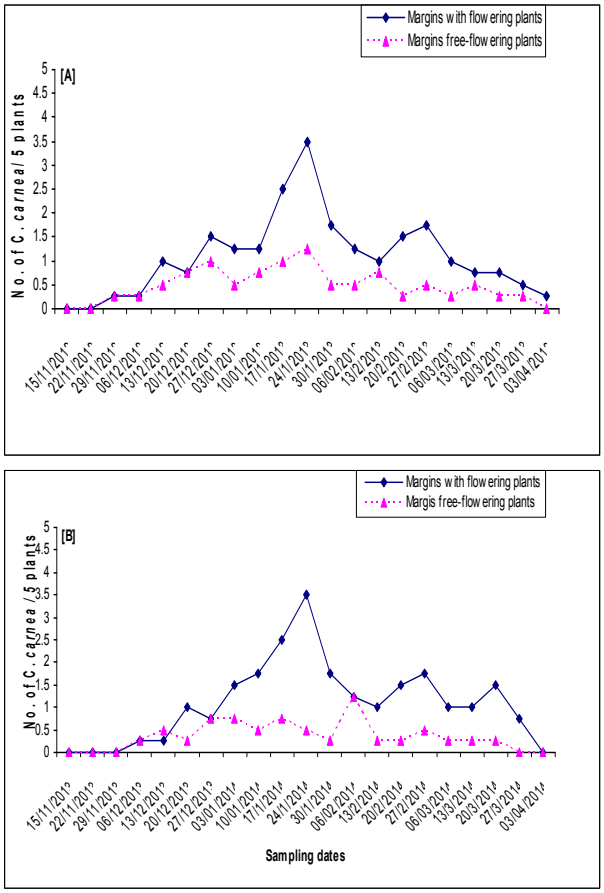

Fig. (1): Mean number of green lacewing, *C. carnea* in faba bean fields surrounded with flowering and without-flowering plants during 2012/13 (A) and 2013/14 (B) plantation seasons at Sidi-Salem district, Kafr El-Sheikh Governorate.

In the second year of plantation (2013/14), the population of *C. undecimpunctata* showed two peaks of abundance in the flowering field with the highest one (5 individuals) on the 10th of January, 2014. Whereas, two periods of limited abundance were observed for *C. undecimpunctata* in free-flowering fields with the highest abundance (2.5 individuals) on 6th March (Fig. 2B).

The average number of *C. undecimpunctata* did not significantly different between flowering and free-flowering faba bean fields in the first and second seasons of plantation ($t = 1.14$; $P = 0.25$ and $t = 1.10$; $P = 0.27$, respectively; Table 1).

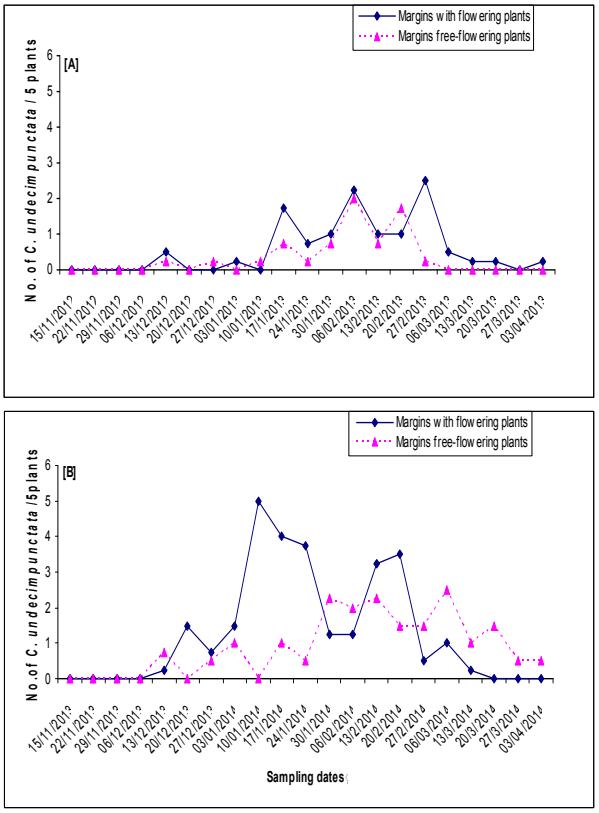

Fig. (2): Mean number of ladybeetle, *C. undecimpunctata* in faba bean fields surrounded with flowering and without-flowering plants during 2012/13 (A) and 2013/14 (B) plantation seasons at Sidi-Salem district, Kafr El-Sheikh Governorate.

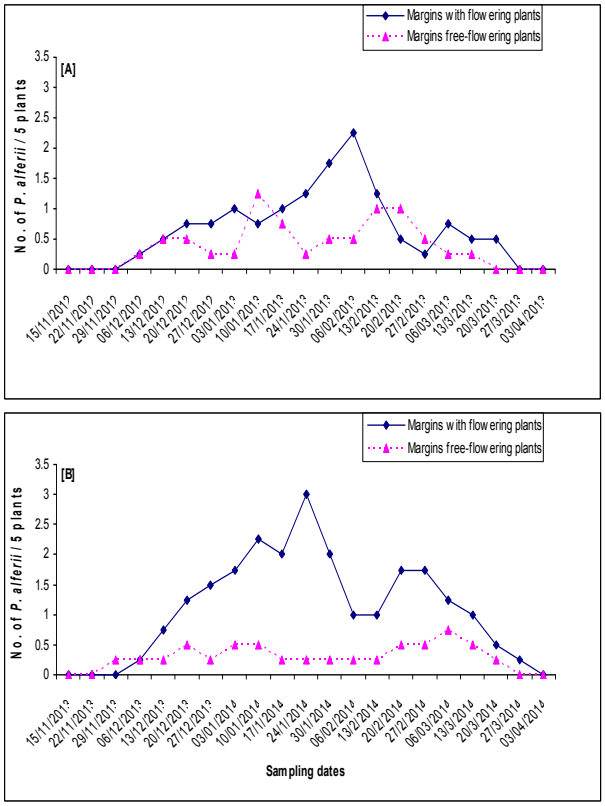

Fig. (3): Mean number of Egyptian Rove beetle, *P. alferii* in faba bean fields surrounded with flowering and without-flowering plants during 2012/13 (A) and 2013/14 (B) plantation seasons at Sidi-Salem district, Kafr El-Sheikh Governorate.

***Paederus alferii* Koch.**

Data illustrated in Figure (3 A) showed that the population of *P. alferii* was higher in the field of faba bean with flowering plant margins than that without flowering plants margins in both seasons of study. In the field with flowering plant margins, *P. alferii* showed one peak (2.25 individuals / 5 plants) of abundance during the first season on the 6th of February, 2013. In the field of faba bean without flowering plant margins, two peaks of abundance were observed for *P. alferii*. The first peak was recorded (1.25 individuals) on 10th of January, 2013 and the second one (1 individuals) on 13th of February, 2013.

In the second season of plantation, the population of *P. alferii* showed two peaks of abundance in the field surrounded with flowering plants with the highest abundance (3 individuals) on 24th of January, 2014. In free-flowering fields, two slight periods of limited abundance were observed for *P. alferii* with the highest one (0.75 individual) on 6th of March, 2014 (Fig. 3B).

The average numbers of *P. alferii* differed significantly between flowering and free-flowering fields in the second season of plantation (t = 4.19; P = 0.001), but did not in the first year (t = 1.67 1.72; P = 0.12) (Table 1).

A significant effect of flowering plants on the average numbers of S. syriacus had been obtained in the first and second seasons of plantation (t =2.47; P = 0.01), (t =2.09; P =0.04; Table 1).

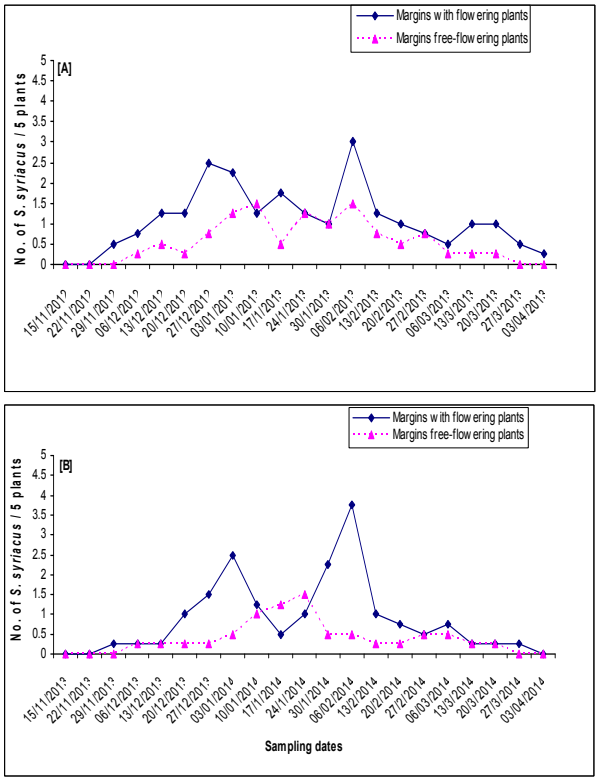

Fig. (4): Mean number of ladybeetle, *S. syriacus* in faba bean fields surrounded with flowering and without-flowering plants during 2012/13 (A) and 2013/14 (B) plantation seasons at Sidi-Salem district, Kafr El-Sheikh Governorate.

***Scymnus syriacus* Muslant**

The population of *S. syriacus* was higher on faba bean field margined with flowering plant than that without flowering plant margins of both seasons of study (Fig. 4). In the field of faba bean with flowering plant margins, *S. syriacus* had two peaks of seasonal abundance during the first season (Fig. 4A). The first peak (2.5 individuals / 5 plants) was recorded on 27th of December, 2012 and the second one (3 individuals) on 6th of February, 2013. In the field without flowering plant margins, two peaks of abundance were observed for *S. syriacus* in the first year (Fig. 4A). The first peak was recorded on 10th of January, 2013 (1.5 individuals) and the second one (1.5 individuals) on 6th of February, 2013.

The population of *S. syriacus* in the field of faba bean with flowering plant margins showed two peaks of abundance with the highest one (3.75 individuals) on 6th February 2014 of the second year (Fig. 4B). Whereas, one period of slight abundance (1.5 individuals) was observed for *S. syriacus* on 24th of January, 2014 in the field of faba bean without flowering plant margins.

***Orius laevigatus* (Fiber)**

Data illustrated in Figure (5) showed that *O. laevigatus* had the highest population in faba bean field surrounded with flowering plants compared to faba bean field without flowering plants in both seasons of study. In the field of faba bean with flowering plant margins, *O. laevigatus* had two peaks of abundance during the first year (Fig. 5A). The first (1.75 individuals / 5 plants) was recorded on 17th of January, 2013 and the second one (1 individuals) was on 27th of February, 2013. In the field of faba bean without flowering plant margins, two peaks of abundance were observed for *O. laevigatus*. The first peak (0.75 individuals) was recorded on 10th of January, 2013 and the second one (1.25 individuals) was recorded on 6th of February, 2013.

In the second season of plantation (Fig 5B), the population of *O. laevigatus* showed three peaks of abundance with the highest one (1.25 individuals) was recorded on 13th of February, 2014 in faba bean field with flowering plant margins. Whereas, three period of limited abundance were observed for *O. laevigatus* in faba bean field without flowering plant margins with the highest abundance (0.75 individuals) on 3rd of January, 2014.

Statistical analysis revealed that there were no significant and significant differences in the average numbers of *O. laevigatus* between faba bean field with and without flowering plant margins in the first and second season of plantation (t= 1.41; P = 0.16 and t = 2.17; P = 0.03, respectively; Table 1).

One-way ANOVA confirmed that there was a significant effect of flowering plant in faba bean field on mean number of adult predators visually monitored per five plants ($F_{4,104}$ = 3.48; P = 0.02), but did not in the field of faba bean without flowering plant margins ($F_{4,104}$ = 0.89; P = 0.47) in the first season of plantation (Table 3). Whereas, there was a significant effect of faba bean field without flowering plant margins on mean number of adult predators visually monitored per each replicate $F_{4,104}$ = 7.46; P = 0.001, but did not in the field of faba bean with flowering plant margins ($F_{4,104}$ = 2.41; P = 0.05) in the second season of plantation (Table 1).

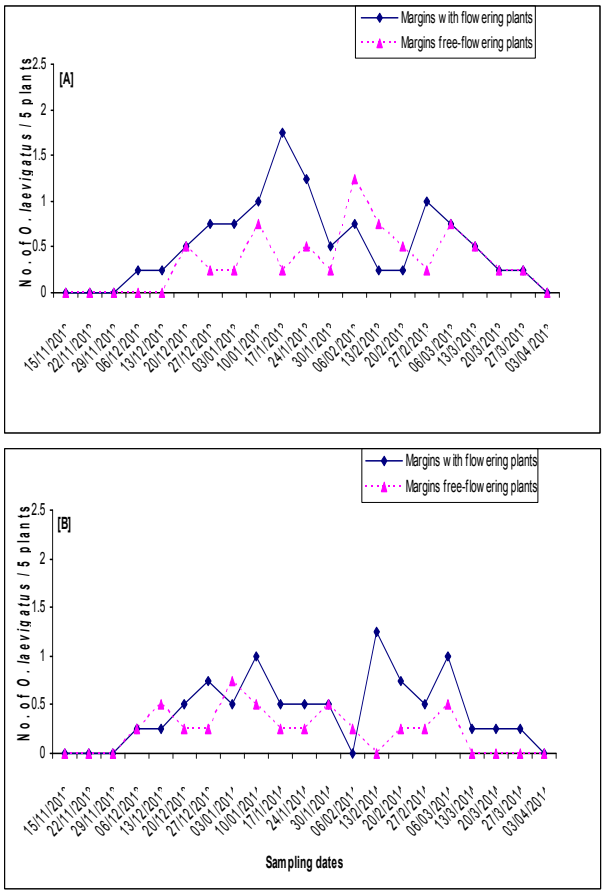

Fig. (5): Mean number of the minute pirate bug, *O. laevigatus* in faba bean fields surrounded with flowering and without-flowering plants during 2012/13 (A) and 2013/14 (B) plantation seasons at Sidi-Salem district, Kafr El-Sheikh Governorate.

Table (1): Mean number (± SE) of adult predators in both flowering and free-flowering faba bean fields infested with the cowpea aphid, *A. craccivora* at Sidi-Salem district, Kafr El-Sheikh Governorate during 2012/13 (A) and 2013/14 (B) plantation seasons.

Species	Flowering plants		Free-flowering plants		t- test		P	
	A	B	A	B	A	B	A	B
C. carnea	4.66 ± 0.75 a	4.52 ± 0.79 a	1.91 ± 0.30 a	1.38±0.28 b	3.39	3.73	0.002	0.001
C. undecimpunctata	2.83±0.66 bc	5.47 ± 1.46 a	1.38 ± 0.50 a	3.66 ± 0.73 a	1.14	1.10	0.25	0.27
P. alferii	2.57±0.53 bc	4.42 ± 0.75 a	1.52 ± 0.32 a	1.19 ± 0.17 b	1.67	4.19	0.12	0.001
S. syriacus	4.38±0.74 ab	3.47 ± 0.83 a	2.23 ± 0.43 a	1.57 ± 0.35 b	2.47	2.09	0.01	0.04
O. laevigatus	2.09 ± 0.41 c	1.71 ± 0.31 a	1.38 ± 0.28 a	0.91 ± 0.19 b	1.41	2.17	0.16	0.03

Means (± SE) bearing the different letters in each column are significantly different at the 5% probability level

2. Effect of flowering plant margins on community composition of aphid predators.

Data in Figure (6) shows the community composition of the main insect predators visually monitored in faba bean fields infested with cowpea aphid, *A. craccivora* during the first and second plantation seasons in the field of faba bean with flowering plant margins and that without flowering plant margins. Although, the visited percentage of each predator species differed from season to season and from field to field, *C. carnea* was the only species exhibited strong attractiveness in the field with flowering plant margins and represented by 22.6 and 29.10 % during the two successive seasons, 2012 /13 and 2013 / 14, respectively. While, *O. laevigatus* ranked the last category and represented by 13.05 and 8.73% during the two successive years, respectively.

In the field without flowering plant margins, the predator *P. alferii* and *C. undecimpunctata* ranked the first category and contributed with 22.57 and 42.8% during 2012 /13 and 2013 /14, while, *O. laevigatus*, contributed with the lowest fate during the two successive years, respectively (Fig. 6).

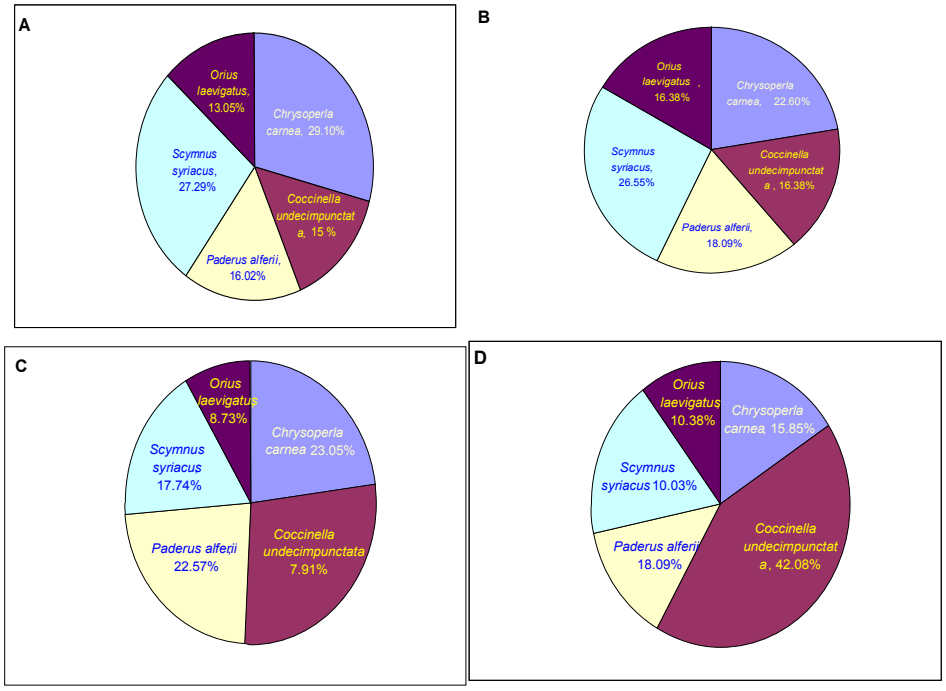

Fig. (6): Community composition of main insect predators associated with cowpea aphid, *A. craccivora* in faba bean field surrounded with flowering plant stripes during 2012/13 (A) and 2013/14 (B) and in that without flowering plant margins during 2012/13 (C) and 2013/14 (D) plantation seasons at Sidi-Salem district, Kafr El-Sheikh Governorate.

DISCUSSION

The current work was designed to test the effect of flowering plants on *A. craccivora* predator populations, inhabiting faba bean fields, by monitoring the occurrence of insect visitation over time. There are many reasons that may be responsible for boosted predator densities in the flowering plant plots; 1) flowering plants indirectly affect the predator population by increasing the various food resources (Hatley and Macmahon, 1980; Landis et al., 2000; Jonsson et al., 2008). For example, it can provide predators with alternative food resources (pollen) and some previous studies have indicated the value of pollen in the good ecosystem as an alternative food resource for raising the fecundity of linyphiid spider (Peterson et al., 2010) and longevity (Vogelei and Greissl, 1989). 2) The flowering plants may provide suitable refuges for natural enemies. Sunderland and Samu (2000) found the density of spiders can maximize by increasing suitable refuges. Malumbres-Olarte et al. (2012) reported a positive relationship between density of lycosid spiders and plant species diversity. 3) Flowering plants change the habitat composition or may optimize the density of alternative prey and this point was confirmed by Frank (2003) who found that the flowering plants strips are very important to increase the numbers of alternative prey and also, Landis et al. (2000) indicated that changing the habitat composition can increase the alternative prey of spiders.

Almost, flowering plants attracted significantly higher numbers of most *A. craccivora* predators in faba bean fields compared to control plots. Variations in numbers between fields with and without flowering strips may be a result of dramatic variations in climatic conditions between winter and summer, variations in plant materials, or provisional differences in sampling. In faba bean field, there was a significant variation between predator species in the number of adults attracted to flowering plots in both seasons of plantation

with the higher attractiveness was for green lacewing. This is a normal because the higher requirements of carbohydrates to gain angry for supporting adult reproductive success and longevity (e.g., McEwen and Kidd, 1995; Limburg and Rosenheim, 2001; Romeis et al., 2004).

Community composition percentage also revealed that *C. carnea* contributed with the highest fate of occurrence in flowering plots of faba bean during both plantation seasons. Whereas, *C. undecimpunctata* occurred highly in non-flowering plots. The impact of flower strips in fields of cabbage did not discover any differences in numbers of Coccinellidae (Kienegger and Kromp, 2001; Kienegger *et al*., 2003). Hurej *et al.,* (1998) in his study on the attractiveness of blossoming flower strips in attracting predators of *Aphis fabae* observed little presence of ladybeetles on both, flowered and control fields. The lowest occurrence of coccinellids in flowered fields may be because 1) incorporating floral resource plants into agroecosystems can increase population of natural enemies (Hickman and Wratten, 1996; Patt et al., 1997a; White *et al*., 1995), but may defeat to give an effective management of the main insect, if flowering plants does not synchronize with periods of natural enemy activity (Bowie *et al.,* 1995), if floral structure impedes natural enemies from feeding (Patt *et al*., 1997b), and/or if natural enemy slowly moves between the main crop and floral resources (Bigger and Chaney, 1998; Freeman Long *et al.,* 1998) and 2) In urban landscapes, conservation of natural enemies is alternative method for managing insects. These landscapes are poor in the qualities of resources for their natural enemies due to their floristically impoverished. It implies these habitats are freed from main requirements that are needed by beneficials (Dreistadt *et al.,* 1990; Hanks and Denno, 1993; Sperry *et al*., 2001).

REFERENSES

Ahern, R.G. and Brewer, M.J. (2002) Effect of different wheat production systems on the presence of two parasitoids (Hymenoptera: Aphelinidae; Braconidae) of the Russian wheat aphid in the North American Great Plains. Agriculture, Ecosystems, and Environment 92, 201-210.

Baggen, L.R. and G.M. Gurr (1998). The influence of food on Copidosoma koehleri (Hymenoptera: Encyrtidae), and the use of flowering plants as a habitat management tool to enhance biological control of potato moth, Phthorimaea operculella (Lepidoptera: Gelechiidae). Biol. Control 11, 9–17.

Begum, M., Gurr, G.M.,Wratten, S.D. and H.I. Nicol (2004). Flower color affects tri-trophic-level biocontrol interactions. Biol. Control 30, 584–590.

Bigger, D.S. and W.E. Chaney (1998). Effects of Iberis umbellate (Brassicaceae) on insect pests of cabbage and on potential biological control agents. Environ. Entomol. 27, 161–167.

Bowie, M.H., Wratten, S.D. and A.J. White (1995). Agronomy and phenology of "companion plants" of potential for enhancement of insect biological control. N.Z.J. Crop Hort. Sci. 23, 423–427.

Büchi, R. (2002). Mortality of pollen beetle (Meligethes spp.) larvae due to predators and parasitoids in rape fields and the effect of conservation strip. Agriculture, Ecosystems, and Environment 90, 255-263.

Bugg, R.L. and C. Waddington (1994). Using cover crops to manage arthropod pests of orchards: a review. Agriculture Ecosystems & Environment 50, 11-28.

Carreck, N.L. and I.H. Williams (1997). Observations on two commercial flower mixtures as food sources for beneficial insects in the UK. J. Agric. Sci. 128, 397– 403.

Cowgill, S.E., Wratten, S.D. and N.W. Sotherton (1995). The selective use of floral resources by the hoverfly Episyrphus balteatus (Diptera:Syrphidae) on farmland. Ann. Appl. Biol. 114, 223–231.

Dreistadt, S.H., Dahlsten, D.L. and G.W. Frankie (1990). Urban forests and insect ecology. Bioscience 40, 192–198.

El-Nabawy, E. M., K. Tsuda, and Y. Sakamaki (2015). Attractiveness of spider and insect predators and parasitoids to flowering plants. Egyptian J. Biol. Pest Control 25, 245–250.

Foster, M.A. and W.G. Ruesink (1984). Influence of flowering weeds associated with reduced tillage in corn on a black cutworm (Lepidoptera: Noctuidae) parasitoid, Meteorus rubens (Nees von Esenbeck). Environ. Entomol. 13, 664-668.

Frank, S.D. (2003). Evaluation of conservation strips as a conservation biological control technique on golfcourses. MS Thesis, University of Maryland, College Park, MD.

Freeman Long, R., Corbett, A., Lamb, C., Reberg-Horton, C., Chandler, J. and M. Stimmann (1998). Beneficial insects move from flowering plants to nearby crops. California Agriculture 52, 23–26.

Hanks, L.M. and R.F. Denno (1993). Natural enemies and plant water relations influence the distribution of an armored scale insect. Ecology 74, 1081–1091.

Hatley, C.L., and J.A. Macmahon (1980). Spider community organization: seasonal variation and the role of vegetation architecture. Environ. Entomol. 9, 632–639.

Hickman, J.M. and S. D. Wratten (1996). Use of Phacelia tanacetifolia strips to enhance biological control of aphids by hoverfly larvae in cereal Welds. J. Econ. Entomol. 89, 832–840.

Hogg, B.N., R.L. Bugg and K.M. Daane (2011). Attractiveness of common insectary and harvestable floral resources to beneficial insects. Biol. Control 56, 76-84.

Hurej, M. K., Roal, J. and J. Twardowski (1998). Attraction of aphid predators by cultivated and weedy strips. Aphids and other Homopterous Insects 6, 117-123.

Idris, A.B. and E. Grafius (1995). Wildflowers as nectar sources for Diadegma insulare (Hymenoptera: Ichneumonidae), a parasitoid of diamondback moth (Lepidoptera: Yponomeutidae). Environ. Entomol. 24, 1726–1735.

Isaacs, R., Tuell, J., Fiedler, A., Gardiner, M. and D. Landis (2009). Maximizing arthropod- mediated ecosystem services in agricultural landscapes: the role of native plants. Frontiers in Ecology and the Environment 7, 196-203.

Jackai, L.E.N. (1995). The legume pod borer Maruca testulalis, and its principal host plant, Vigna unguiculata (L.) walp. Use of selective insecticide sprays as an aid in the identification of useful levels of resistance. Crop Prot. 14 (4): 299-306.

Jervis, M.A., Kidd, N.A.C., Fitton, M.G., Huddleston, T. and H.A. Dawah (1993). Flower-visiting by hymenopteran parasitoids. J. Nat. Hist.27, 67–105.

Jmhasly, P., and W. Nentwig (1995). Habitat management in winter wheat and evaluation of subsequent spider predation on insect pests. Acta Oecol. 16, 389–403.

Jonsson, M., Wratten, S.D., Landis, D.A. and G.M. Gurr (2008). Recent advances in conservation biological control of arthropods by arthropods. Biol. Control 45, 172–175.

Kienegger, M. and Kromp, B. (2001). The effect of strips of flowers o nselected groups of beneficial insects in adjacent broccoli plots. Mitt. Dtsch. Ges. Allg. Angew. Entomol.13, 583 -586.

Kienegger, M.; Kromp, B. and A. Kahrer (2003). The effect of strips of flowers on pests and beneficial arthropods in adjacent broccoli plots. IOBC Bull. 26 (3): 61-69.

Landis, D.A.; Wratten, S.D. and G.M. Gurr (2000). Habitat management to conserve natural enemies of arthropod pests in agriculture. Annu. Rev. Entomol. 45, 175-201.

Lee, S., Kim, J., Han, J.J., Han, M.J., G. An (2004). Functional analyses of the flowering time gene OsMADS50, the putative SUPPRESSOR OF OVEREXPRESSION OF CO 1/AGAMOUS-LIKE 20 (SOC1/AGL20) orthology in rice. Plant J 38 754–764

Leius, K. (1963). Effects of pollen on fecundity and longevity of adult Scambus buolianae (Htg.) (Hymenoptera: Ichneumonidae). Can. Entomol. 95, 202–207.

Limburg, D.D. and J.A. Rosenheim (2001). Extrafloral nectar consumption and its influence on survival and development of an omnivorous predator, larval Chrysoperla plorabunda (Neuroptera: Chrysopidae). Environ. Entomol. 30, 595-604.

Mahmoud, A., Basyony, A., Hafiz, S.A. and M.M. El-Hady (1996). Determination of the nutritional value chemical composition and cooking quality in faba bean cultivars and some promising breeding lines. Report of eight Ann. Coordination Meeting Cairo, 15-19 September, 1996.

Malumbres-Olarte, J., Vink, C.J., Ross, J.G., Cruickshank, R.H. and A.M. Paterson (2012).The role of habitat complexity on spider communities in native alpine grasslands of New Zealand. Ins. Cons. Div. 6, 124–134.

McEwen, P.K. and N.A. Kidd (1995). The effects of different components of an artificial food on adult green lacewing (Chrysoperla carnea) fecundity and longevity. Entomol. Exp. Appl. 77(3): 343-346.

Mohamed, A.M. and F.A.A. Slman (2001). Susceptibility of some broad bean varieties to natural infestation with Aphis craccivora Koch and Liriomyza trifolii (Burgess) at upper Egypt. Assiut Journal of Agricultural Science 32(1): 167-173.

Nalepa, C.A., Bambara, S.B. and A.M. Burroughs (1992). Pollen and nectar feeding by Chilocorus kuwanae (Silvestri) (Coleoptera:Coccinellidae). Proc. Entomol. Soc. Wash. 94, 596–597.

Patt, J.M., Hamilton, G.C. and J.H. Lashomb (1997a). Impact of strip-insectary intercropping with flowers on conservation biological control of the Colorado potato beetle. Adv. Hort. Sci. 11, 175–181.

Patt, J.M., Hamilton, G.C. and J.H. Lashomb (1997b). Foraging success of parasitoid wasps on flowers: interplay of insect morphology, floral architecture and searching behavior. Entomol. Exp. Appl. 83, 21–30.

Pemberton, R.W. and N.J. Vandenberg (1993). Extrafloral nectar feeding by ladybird beetles (Coleoptera: Coccinellidae). Proc. Entomol. Soc. Wash. 95, 139–151.

Romeis, J., Dutton, A., and F. Bigler, F. (2004). Bacillus thuringiensis toxin (Cry1Ab) has no direct effect on larvae of the green lacewing Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae). J. Ins. Physiol. 50, 175–183.

Sanchez, J.A., Gillespir, D.R. and R.R. McGregor (2003). The effects of mullein plants (Verbascum thapsus) on the population on dynamics of Dicyphus Hesperus (Heteroptera:Miridae) in tomato greenhouses. Biol. Control 28, 313-319.

Soliman, M.H.A. (2004). Studies on main insect pests infesting cowpea plants in Sharkia Governorate. Ph.D. Thesis, Faculty of Agriculture, Zagazig University,166 pp.

Sperry, C.E., Chaney, W.R., Shao, G. and C.S. Sadof (2001). Effects of tree density, tree species diversity, and percentage of hardscape on three insect pests of honeylocust. J. Arboric. 27, 263–271.

Steppuhn, A. and F.L. Wäckers (2004). HPLC sugar analysis reveals the nutritional state and the feeding history of parasitoids. Funct. Ecol. 18, 812-819.

Sunderland, K.D. and F. Samu (2000). Effects of agricultural diversification on the abundance, distribution, and pest control potential of spiders: a review. Entomol. Exp. Appl. 95, 1 – 13.

Systat, (2008). Sigmaplot 11.0. Systat Software Inc., Chicago, USA.

Tooker, J.F. and L.M. Hanks (2000). Flowering Plant Hosts of Adult Hymenopteran Parasitoids of Central Illinois. Ann. Entomol. Soc. Am. 93(3): 580–588.

Vogelei, A., and R. Greissl (1989). Survival strategies of the crab spider Thomisus onustus Walckenaer 1806 (Chelicerata, Arachnida, Thomisidae). Oecologia 80: 513–515.

Wäckers, F.L. (2004).Assessing the suitability of flowering herbs as parasitoid food sources: Flower attractiveness and nectar accessibility. Biol. Control 29, 307-314.

Walton, N. and R. Isaacs (2011). Evaluation of flowering plant strips for support of beneficial insects in blueberry. Environ. Entomol. 40, 697-705.

Wanner, H., Gu, H. and S. Dorn (2006a). Nutritional value of floral nectar sources for flight in the parasitoid wasp, Cotesia glomerata. Physiol. Entomol. 31, 127-133.

Wanner, H., Gu, H., Gunther, D., Hein, S. and S. Dorn (2006b). Tracing spatial distribution of parasitism in fields with flowering plant strips using stable isotope marking. Biol. Control, 39, 240-247.

Ward, A., S. M., I. Denholm and N. MC. Namara (2002). Foliar insect pest management on cowpea (Vigna ungiculata (L.)Walpers) in simulated varietal mixtures. Field Crops Research. 79 (1): 53-65.

White, A.J., Wratten, S.D.; Berry, N.A. and U. Weigmann (1995). Habitat manipulation to enhance biological control of Brassica pests by hover flies (Diptera: Syrphidae). J. Econ. Entomol. 88, 1171–1176.

Zhao, J.Z.; Ayers, G.S.; Grafius, E.J. and F.W. Stehr (1992). Effects of neighboring nectar-producing plants on populations of pest Lepidoptera and their parasitoids in broccoli plantings. Great Lakes Entomologist 25, 253–258.

تـأثير النباتـات المزهـرة المحيطـة بـالفول البلـدى علـى التعداد والتكـوين المجتمعي للمفترسـات الحشـرية المصـاحبة لحشرة من البقوليات

محمد حسن بيومى[١]، سمير صالح عوض الله[١] , سعد بسيونى بليح[٢] و هبه صبحى عبد العاطى [٢]

[١] قسم الحشرات الاقتصادية – كلية الزراعة- جامعة المنصورة

[٢] معهد بحوث وقاية النباتات – مركز البحوث الزراعية- سخا

اجريت الدراسة الحالية فى حقول الفول البلدى فى منطقة سيدى سالم محافظة كفر الشيخ خلال موسمى الدراسة ٢٠١٢/٢٠١٣ و٢٠١٣/ ٢٠١٤ لدراسة تأثير النباتات الكسبرة المزهرة على التعداد والتركيب المجتمعى لمفترسات حشرة من البقوليات . احيطت حواف المكررات فى الحقل الأول بشريحة من النباتات الزهرية بينما لم يحدث ذلك فى حقل الفول الثانى. لوحظ أن تعداد كل مفترس من المفترسات محل الدراسة اختلف من موسم لموسم ومن حقل لآخر. بالرغم من أن نسبة الانجذاب لكل مفترس اختلفت من موسم إلى أخر إلا أن مفترس أسد المن الاخضر هو الوحيد الذي أظهر انجذاب قوى للحقول المحاطة حوافها بنباتات زهرية وأسهمت النباتات المزهرة فى حقول الفول في زيادة نسب تواجد مفترسات اسد المن الاخضر حيث انجذب المفترس بنسبة ٢٩.١٠ و ٢٢.٦٠ % من المجموع الكلى للأعداد المنجذبة علي التوالي، فى حين اسهمت بقة الأوريس بالنصيب الأقل من المفترسات التي انجذبت للنباتات الزهرية (١٣,٠٥ و ١٦,٣٨ %) خلال السنة الأولى والثانية على التوالى ، على الجانب الآخر أسهم مفترس الرواغة وأبو العيد ١١ نقطة بالنصيب الأعلى من المفترسات المنجذبة لحقول الفول غير المزهرة.