

(Original Article)



Survey and Population Fluctuation of Major Pests Infesting Kidney Bean Crops and its Relation with Natural Enemies in Assiut, Egypt

Gamal H.A. Hammam^{1*}; Ayman K. Abou-El-Saad¹; Alaa El-deen A.A. Salem¹ and Mahmoud Fakeer²

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

²Plant Protection Department, Faculty of Agriculture, New Valley University, Egypt.

Correspondence: ghamam29@yahoo.com

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Abstract

Field experiments were conducted at Arab El-Awamer, Abnoub, Assiut governorate, Egypt (semi-arid newly reclaimed lands) during the 2020 and 2021 growing seasons, to study some ecological aspects of main pests and their associated natural enemies inhabiting kidney bean, *Phaseolus vulgaris* L. Results recorded forty-one arthropods belong to twenty different families and ten orders injury on kidney bean plants. The main insect pest species included twenty-seven species belong to fourteen families and nine orders and natural enemies included fourteen species of nine families and seven orders. In addition, the results showed that; *Aphis* sp., *Thrips tabaci* (Lind.), *Empoasca* sp., *Nezara viridula* L., *Liriomyza* sp., *Bemisia tabaci* (Genn.) and *Tetranychus urticae* Koch were the key insect and mite pests recorded on kidney bean plants. The dominant natural enemies were *Orius* sp., *Scymnus* sp., *Chrysopa* sp., *Coccinella* sp., *Paederus alfieri* Koch, *Scolothrips* sp. and *Predaceous* mites found on kidney bean plants. *Aphis* sp. and *T. urticae* were the main pests in the highest average number of individuals followed by *Liriomyza* sp., *Empoasca* sp., *B. tabaci*, *N. viridula* and *T. tabaci* during the 2020 and 2021 growing seasons. Results also indicated that the correlation between preceding key insect pests and their natural enemies was a strong significant positive or negative correlation between of them. It can be concluded that there are major numbers of natural enemies that can play a significant role in Bio control of the key pests afflicted kidney bean plants to avoid danger to the environment with insecticides.

Keywords: *Kidney bean, Pests, Natural enemies, Survey, Bio control.*

Introduction

Leguminous plants are some of the important crops in Egypt, as well as all over the world. This crop has high protein content which reaches 20-25% in most of dry legumes, and their proteins are considered complete compared to other vegetables. Kidney bean is the most important grain legume for direct human consumption with production more than twice that of the next most important grain legume, chickpea (Gepts *et al.*, 2008). Kidney bean ranks second in export between leguminous crops, according to reports in the Egyptian Ministry of Agriculture

2003. Sandsted, 1980 found that green beans are an important source of protein 62%, fat 0.2% and carbohydrate 63%. Moreover, green beans have high value of B, A and D vitamins (Piha and Munns, 1987). Furthermore, kidney bean is cultivated in both normal and sandy areas of Egypt. Kidney beans are infested by different insect pests which cause great damage in terms of quality and quantity of pods in Egypt such as *Aphis* sp., *Thrips tabaci*, *Empoasca* sp., *Nezara viridula*, *Liriomyza* sp., *Bemisia tabaci* and *Trtranychus urticae* causing significant damage to crops and yield (Abd El-Gawad, 2008; Abo-Zaid, 2011; Saleh, 2011 and Selem *et al.*, 2016). This study aimed to survey the pests and natural enemies inhabiting kidney bean plants, study the population fluctuations of the previous major pests and their natural enemies and study the relationship between them.

Materials and Methods

Field studies were performed at Arab El-Awamer, Abnub, Assiut, Egypt (semi-arid newly reclaimed land) during 2020 and 2021 seasons. An experimental area of about 1050 m² (¼ feddan) was split into three replicas (every replica around 350 m²) and was prepared according to a complete randomized block layout and planted by kidney bean seeds (*Phaseolus vulgaris* L.) at the mid of March 2020 and 2021 and harvested in July. Sampling was taken by two different sampling methods (plant samples and sweeping net) to investigate the key insect pests that invaded kidney bean crops and their natural enemies during the stages of plant growth, about 21 days and persistent weekly over the growing season to the last week of June; Twenty-five leaves were selected weekly in the early morning randomly from every replica representing all parts of the plant through the first sampling techniques (plant samples), samples were placed in a wide plastic sack and trans located to laboratory on the same day for extraction and counting the number of every inspected insect pests and natural enemies by the aid of stereoscope microscope. The second method a sweeping net 3.5 cm diameter and 60 cm in depth of the conical fine muslin with a long wooden handle (1.60 m) has been used 25 strokes every week were implemented. Captured arthropods were trans located in wide plastic sacks to the laboratory for extraction and counting. Direct observations were used also. The relationship between the number of major insect pests and their natural enemies found on kidney bean plants. Data were statistically analyzed by using the L.S.D. and the ANOVA and simple correlation co-efficient and regression values were appreciated using (SAS Institute, 1994).

Results and Discussion

I- Survey of pests and natural enemies on kidney bean plants

Data displayed in Table (1) showed that forty-one arthropod species belong to twenty families and ten orders of incidence on kidney bean crops during 2020 and 2021 planting seasons. Eradicative pest species consist of 27 species pertaining to 14 families and 9 orders. Orders Homoptera and Lepidoptera included the most harmful species (7 species for each) listed on kidney bean plants, followed by Hemiptera (4 spp.), (Diptera & Orthoptera) (3 spp. for each), and (Acari, Thysanoptera and Coleoptera) (1 sp. for each). Natural enemies compiled 14

species of 9 families and 7 orders. Order Coleoptera included the most harmful species (5 spp.) recorded on kidney bean plants, followed by (Neuroptea, Thysanoptera and Acari) (2 spp. for each) and (Diptera, Hemiptera and Heteroptera) (1 sp. for each).

Table 1. Taxonomic list of collected arthropods from kidney bean, *Phaseolus vulgaris* (L.) in Assiut Governorate during the two seasons of 2020 and 2021

| Order | Family | Scientific name | Status |
|---------------------------------|----------------|---|----------|
| Coleoptera | Bruchidae | <i>Callosobruchus</i> spp. | Pest |
| | Coccinellidae | <i>Coccinella undecimpunctata</i> L. | Predator |
| | | <i>Coccinella septempunctata</i> L. | Predator |
| | | <i>Scymnus interruptus</i> (Goeze) | Predator |
| | | <i>Scymnus punctillum</i> (Welse) | Predator |
| | Staphylinidae | <i>Paederus alfieri</i> Koch | Predator |
| Diptera | Agromyzidae | <i>Liriomyza trifolii</i> (Becker) | Pest |
| | | <i>Liriomyza congesta</i> Burg | Pest |
| | | <i>Melanogromyza phasweoli</i> (Tryon) | Pest |
| | Syrphidae | <i>Syrphus corolla</i> Fabre | Predator |
| Hemiptera | Anthocoridae | <i>Orius</i> spp. | Predator |
| | Lygaeidae | <i>Nysius cymoides</i> (Spinola) | Pest |
| | Pentatomidae | <i>Nezara viridula</i> L. | Pest |
| | Miridae | <i>Campylomma impicete</i> (Wanger) | Pest |
| <i>Creontials pallidus</i> Remb | | Pest | |
| Heteroptera | Nabidae | <i>Nabis</i> spp. | Predator |
| Homoptera | Aleyrodidae | <i>Bemisia tabaci</i> (Genn.) | Pest |
| | | <i>Aphis craccivora</i> (Koch) | Pest |
| | | <i>Aphis gossypii</i> (Glover) | Pest |
| | | <i>Myzus persicae</i> Sulz | Pest |
| | Cicadellidae | <i>Aphis faba</i> (Scop) | Pest |
| | | <i>Empoasca decipiens</i> (Paoli) | Pest |
| | | <i>Empoasca lybica</i> de Berg | Pest |
| Lepidoptera | Noctuidae | <i>Agrotis ipsilon</i> (Huf.) | Pest |
| | | <i>Erias insulana</i> (Boisd.) | Pest |
| | | <i>Heliothis armigra</i> Hb. | Pest |
| | | <i>Spodoptera exigua</i> Hb. | Pest |
| | | <i>Spodoptera littoralis</i> Hb. | Pest |
| | Pyrilidae | <i>Etiella zinckencella</i> Treitschwe | Pest |
| | | <i>Maruca testulalis</i> (Geyer) | Pest |
| Neuroptera | Chrysopidae | <i>Chrysopa vulgaris</i> (Shon) | Predator |
| | | <i>Chrysopa carnea</i> (Steph.) | Predator |
| Orthoptera | Acarididae | <i>Alolopus strepens</i> (Latr) | Pest |
| | | <i>Schistocerca gregaria</i> (Forsk) | Pest |
| | Gryllotalpidae | <i>Gryllotalpa gryllotalpa</i> L. | Pest |
| Thysanoptera | Thripidae | <i>Thrips tabaci</i> Lind. | Pest |
| | | <i>Scolothrips longicornis</i> Priesnes | Predator |
| | | <i>Scolothrips sexmaculotus</i> | Predator |
| Acari | Tetranychidae | <i>Tetranychus urticae</i> Koch | Pest |
| | | <i>Agristemus exsertus</i> Gonzalez | Predator |
| | | <i>Phytoseiulus persimilis</i> A.H. | Predator |

Data obtained in the present study are in general agreement with those obtained by Ekram *et al.* (2019) which indicated that ten insect species, belonging to eight families and five orders according to feeding behavior on kidney bean were noticed. In addition, 12 species of predators represented by 11 families were registered during 2017 and 2018 seasons. Similar results were recorded by; Hassan *et al.*, 2013; Abd El-Karim, 2010 and Abou Attia, 2006).

II- Population fluctuation of arthropod species found on kidney bean plants

a) Main pests

The mean numbers of key pests found on kidney bean plants were displayed in Tables (2 and 3) during the two consecutive planting seasons 2020 and 2021.

In Tables (2 and 3) the mean numbers of the individuals of *Aphis* sp. (nymph and adult stages) on kidney bean plants of the 2020 and 2021 seasons appeared during first week of April in a small number of individuals (10.67 and 13.67) through the 2020 and 2021 periods, respectively. Thereafter, the population number continued to rise in the fourth week of May recording (50.00 and 52.00) during 2020 and 2021, respectively. The average numbers of *Aphis* sp. decreased relatively during June in both seasons. These results are in partial agreement with those obtained by Abdel-Samad & Al-Habshy (2013) who stated that the peak of *Aphis* sp. on broad bean plants was recorded in the 2nd week of March for the two seasons, 2011 and 2012 Similarly Abdel-Samad & Ahmed (2006) revealed that the highest rate of infestation by Aphids to broad bean plants was recorded during February and March in both seasons 2004 and 2005.

The average numbers of immature and adult stages of *Thrips tabaci* located on kidney bean plants over the 2020 and 2021 seasons, appeared in April and recorded the highest mean numbers (4.33 and 6.75) of the individuals in both growing seasons, respectively, while June recorded the least mean numbers (1.00 and 2.75) of the pest during both seasons, correspondingly. The current results are quite proportional to those acquired by Selem *et al.* (2016) ; Who revealed that the *Thrips tabaci* recorded one peak of population density during the third week of April on kidney bean plants during the 2014 and 2015 seasons. Amaar *et al.* (2014) recorded that *Thrips tabaci* one of the most common insect pests that might be present on a green bean.

The mean numbers of the individuals of *Empoasca* sp. (nymph & adult) on kidney bean plants during 2020 and 2021 seasons, appeared in the fourth week of May and recorded the highest mean numbers (31.00 & 29.00) in both growing seasons, respectively, while in June this pest recorded on a few mean numbers (0.58 & 2.42) during 2020 and 2021 seasons, respectively. The present results are in harmony with those obtained by Abdel-Samad & Al-Habshy (2013) who stated that one peak occurred in the 2nd week of March in *Empoasca* sp. recorded on broad bean plants during the 2011 and 2012 seasons, and Mahmoud *et al.* (2011) reported that *Empoasca decipiens* had two peaks during the two seasons of the study.

Table 2. Average number of main pests and natural enemies collected from kidney bean plantations during the 2020 season, Assiut governorate

| Date | Phytophagous arthropods | | | | | | | | | | Predaceous arthropods | | | | |
|---------|-------------------------|----------------------|------------------------------|----------------------------|-----------------------------|---------------------------|--------------------------------|------------------|--------------------|---------------------|-------------------------------|------------------------|------------------------|------|--|
| | <i>Aphis</i> sp. | <i>Thrips tabaci</i> | <i>Empoasca viridula</i> sp. | <i>Nezara viridula</i> sp. | <i>Liriomyza tabaci</i> sp. | <i>Bemisia tabaci</i> sp. | <i>Tetranychus urticae</i> sp. | <i>Orius</i> sp. | <i>Scymnus</i> sp. | <i>Chrysopa</i> sp. | <i>Coccinella alferii</i> sp. | <i>Scolothrips</i> sp. | <i>Predacious mite</i> | | |
| 4 | 10.67 | 0.33 | 1.00 | 1.00 | 1.67 | 1.33 | 2.00 | 2.00 | 0.00 | 1.33 | 0.66 | 0.00 | 0.67 | 0.00 | |
| 11 | 16.00 | 1.33 | 2.00 | 8.33 | 26.33 | 1.33 | 2.33 | 2.33 | 0.33 | 1.33 | 1.00 | 0.67 | 0.67 | 0.00 | |
| 18 | 29.67 | 9.67 | 4.67 | 13.00 | 3.00 | 2.33 | 5.67 | 5.67 | 0.67 | 2.33 | 1.33 | 1.00 | 0.33 | 0.67 | |
| 25 | 35.00 | 6.00 | 22.00 | 4.33 | 3.00 | 1.67 | 6.33 | 6.33 | 0.67 | 3.00 | 1.33 | 0.33 | 0.33 | 0.33 | |
| Mean | 22.83 | 4.33 | 7.42 | 6.66 | 8.50 | 1.67 | 4.10 | 4.10 | 0.42 | 2.00 | 1.08 | 0.50 | 0.50 | 0.25 | |
| 2 | 26.33 | 1.00 | 1.00 | 2.33 | 44.33 | 18.33 | 14.67 | 14.67 | 1.00 | 3.33 | 2.67 | 1.33 | 2.33 | 1.66 | |
| 9 | 31.00 | 3.33 | 4.00 | 4.00 | 10.00 | 1.00 | 16.67 | 16.67 | 1.67 | 3.33 | 3.33 | 2.00 | 1.66 | 1.33 | |
| 16 | 34.33 | 1.67 | 15.33 | 3.33 | 2.00 | 2.33 | 24.33 | 24.33 | 1.67 | 4.33 | 4.33 | 3.33 | 3.66 | 2.33 | |
| 23 | 50.00 | 2.33 | 31.00 | 3.00 | 0.66 | 0.67 | 40.67 | 40.67 | 2.67 | 6.33 | 5.33 | 5.33 | 6.00 | 4.00 | |
| 30 | 30.00 | 0.33 | 16.67 | 1.66 | 1.67 | 2.33 | 45.67 | 45.67 | 2.67 | 5.33 | 6.33 | 6.33 | 7.66 | 7.00 | |
| Mean | 34.33 | 1.73 | 13.60 | 2.86 | 11.73 | 4.93 | 28.40 | 28.40 | 1.94 | 2.73 | 4.40 | 3.66 | 4.26 | 3.26 | |
| 6 | 20.00 | 1.67 | 1.33 | 3.00 | 27.33 | 24.33 | 55.00 | 55.00 | 3.33 | 4.67 | 4.33 | 2.33 | 3.00 | 4.66 | |
| 13 | 26.67 | 1.67 | 0.33 | 3.33 | 7.67 | 6.00 | 30.67 | 30.67 | 0.67 | 2.33 | 2.33 | 1.33 | 1.33 | 3.00 | |
| 20 | 14.67 | 0.67 | 0.67 | 2.33 | 2.67 | 3.00 | 16.00 | 16.00 | 0.33 | 0.66 | 0.66 | 0.67 | 0.67 | 1.33 | |
| 27 | 9.00 | 0.00 | 0.00 | 0.33 | 3.00 | 2.00 | 6.67 | 6.67 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.67 | |
| Mean | 17.58 | 1.00 | 0.58 | 2.25 | 10.17 | 8.83 | 27.17 | 27.17 | 1.08 | 2.08 | 1.91 | 1.08 | 1.25 | 2.42 | |
| G. Mean | 24.92 | 2.35 | 7.20 | 3.92 | 10.13 | 5.14 | 19.89 | 19.89 | 1.15 | 1.82 | 2.46 | 1.75 | 2.00 | 1.98 | |
| L.S.D. | 1.58 | | | | | | | | | | 0.43 | | | | |
| 0.05 | | | | | | | | | | | | | | | |

Table 3. Mean number of main pests and natural enemies collected from kidney bean plantations during the 2021 season, Assiut Governorate

| Date | Phytophagous arthropods | | | | | | | | | | Predaceous arthropods | | | | |
|----------------|-------------------------|---------------------|-------------------|----------------|----------------|----------------|-----------------|----------------|-------------------|-----------------|-----------------------|-------------------|-------------|-------------|-------------|
| | <i>sp. tabaci</i> | <i>sp. viridula</i> | <i>sp. tabaci</i> | <i>urticae</i> | <i>sp. sp.</i> | <i>sp. sp.</i> | <i>Chrysopa</i> | <i>Scymnus</i> | <i>Coccinella</i> | <i>Paederus</i> | <i>Scolothrips</i> | <i>Predacious</i> | <i>mite</i> | | |
| April | 3 | 13.67 | 2.33 | 4.33 | 3.33 | 4.00 | 3.33 | 3.67 | 0.00 | 0.00 | 0.67 | 1.00 | 0.33 | 0.33 | 0.00 |
| | 10 | 18.00 | 4.33 | 5.33 | 10.67 | 28.33 | 3.33 | 5.00 | 0.33 | 0.00 | 1.33 | 0.33 | 1.00 | 0.33 | 0.33 |
| | 17 | 32.67 | 11.67 | 7.67 | 15.33 | 5.00 | 4.33 | 8.00 | 0.00 | 1.33 | 3.67 | 2.33 | 1.33 | 2.67 | 0.00 |
| | 24 | 37.00 | 8.67 | 25.33 | 7.33 | 5.00 | 3.67 | 9.33 | 1.33 | 1.00 | 4.67 | 0.67 | 0.33 | 0.67 | 1.67 |
| Mean | 25.33 | 6.75 | 10.66 | 9.16 | 10.58 | 3.66 | 6.50 | 6.50 | 0.41 | 0.58 | 2.58 | 1.08 | 0.75 | 1.00 | 0.50 |
| May | 1 | 29.33 | 3.00 | 13.67 | 4.67 | 49.00 | 20.33 | 16.67 | 1.00 | 2.33 | 3.00 | 3.67 | 1.00 | 1.00 | 2.00 |
| | 8 | 33.00 | 6.33 | 7.00 | 6.33 | 12.00 | 3.00 | 19.67 | 1.66 | 2.67 | 5.33 | 3.67 | 2.33 | 2.33 | 2.00 |
| | 15 | 37.33 | 4.33 | 13.67 | 6.00 | 8.00 | 4.33 | 26.33 | 1.33 | 3.33 | 5.00 | 5.00 | 4.00 | 5.33 | 4.33 |
| | 22 | 52.00 | 5.00 | 29.00 | 5.67 | 2.67 | 2.67 | 43.67 | 3.00 | 1.67 | 7.33 | 6.00 | 4.67 | 5.33 | 4.67 |
| Mean | 36.93 | 4.07 | 17.53 | 5.33 | 14.67 | 6.73 | 30.93 | 30.93 | 2.06 | 3.13 | 5.20 | 5.00 | 3.67 | 4.13 | 3.93 |
| June | 5 | 22.00 | 5.00 | 5.33 | 5.33 | 33.67 | 26.33 | 56.33 | 4.00 | 4.00 | 5.33 | 5.00 | 4.67 | 5.67 | 5.67 |
| | 12 | 29.67 | 3.33 | 2.67 | 5.67 | 13.00 | 9.33 | 33.67 | 1.66 | 3.33 | 3.00 | 2.00 | 2.67 | 2.33 | 3.33 |
| | 19 | 16.67 | 2.00 | 1.00 | 2.33 | 3.33 | 5.67 | 18.33 | 0.67 | 1.00 | 1.00 | 1.67 | 1.00 | 2.00 | 0.33 |
| | 26 | 12.00 | 0.67 | 0.67 | 1.67 | 2.33 | 3.67 | 9.33 | 0.00 | 1.00 | 0.67 | 0.33 | 0.33 | 0.67 | 0.67 |
| Mean | 20.08 | 2.75 | 2.42 | 3.75 | 13.08 | 11.25 | 29.41 | 29.41 | 1.58 | 2.33 | 2.50 | 2.25 | 2.17 | 2.67 | 2.50 |
| G. Mean | 27.45 | 4.52 | 10.20 | 6.08 | 12.78 | 7.21 | 22.28 | 22.28 | 1.35 | 2.01 | 3.43 | 2.78 | 2.20 | 2.60 | 2.31 |
| | A | E | C | DE | C | D | B | B | D | CD | A | AB | BC | BC | BC |
| L.S.D. | 0.05 | | | | | | | | | | | | | | |
| | 2.63 | | | | | | | | | | 0.72 | | | | |

Regarding the *Nezara viridula*, the results cleared that April recorded the highest mean numbers (6.66 and 9.16) of the individuals in the 2020 and 2021 seasons, respectively, while June recorded the least mean numbers (2.25 and 3.75) of the individuals during both seasons, respectively (Gawad *et al.*, 2021).

As for the *Liriomyza* sp. individuals, may rank first in the average mean numbers recorded on kidney bean plants, followed by June and April, during 2020 and 2021 (11.73, 10.17 and 8.50) and (14.67, 13.08 and 10.58) respectively. Data obtained in the present study are in general agreement with those obtained; by Ekram *et al.* (2019) who stated that *L. trifolii* represented higher average numbers of individuals in summer cultivated (March) in 2017 and 2018 by 21.95 and 18.31 individuals/25 leaves, respectively on kidney bean plants. Bassiony (2019) showed that the mean infestation caused by *Liriomyza trifolii* on *Phaseolus vulgaris* was 241 larvae/ 25 leaflets and recorded the highest infestation through the second week of February. Abd El-Gawad (2008) found that the average number of *Liriomyza trifolii* individuals on kidney bean crops reached the peak in April during the 2005 & 2006 seasons, and also noticed that the average number of *L. trifolii* populations on *Phaseolus vulgaris* plants recorded its peak in April during the 2005 & 2006 seasons. The average numbers of the whitefly, *Bemisia tabaci* began to appear in low numbers through April (1.67 & 3.66) during the 2020 and 2021 seasons, respectively, then the average mean numbers increased gradually until reached the month of June (8.83 & 11.25) during 2020 and 2021 seasons, respectively.

Similar results were obtained by; Abdel-Samad & Al-Habshy (2013) who stated that the cotton and tomato whitefly, *Bemisia tabaci* was the most species on broad bean plants showing two peaks that occurred in the 2nd week of March and 4th week of April during the two seasons, 2011 & 2012, respectively, and Awadalla *et al.* (2011) stated that the summer plantation of kidney bean during the two seasons 2009 & 2010 sheltered the highest average numbers of the *Bemisia tabaci*.

The highest average mean numbers of two-spotted spider mite, *Tetranychus urticae* recorded in May (28.40 and 30.93) during both growing seasons, 2020 & 2021 respectively, while June ranked second in both seasons (27.17 & 29.41) respectively. Data obtained in the present study are in general agreement with those obtained; by Abdelaal *et al.* (2015) who indicated that the two-spotted spider mite, *Tetranychus urticae* appears more serious on the common bean during the summer season because of shorter developmental time and higher fecundity. In addition, Awadalla *et al.* (2011) showed that the red spider mite, *Tetranychus urticae* recorded the highest average mean numbers in late summer plantation on kidney bean plants during the 2009 season.

From the previously obtained results, *Aphis* sp. and *Tetranychus urticae* were the main pests in the highest average number of individuals; followed by *Lirimoyza* sp., *Empoasca* sp, *Bemisia tabaci*, *Nezara viridula* and *Thrips tabaci*. In addition, *Aphis* sp., *Empoasca* sp., *Liriomyza* sp. and *Tetranychus urticae* recorded the

highest average mean numbers during May, while *Thrips tabaci* and *Nezara viridula* during April and *Bemisia tabaci* during June.

b) Natural enemies

The average numbers of natural enemies found on kidney bean plants were indicated in Tables 2 and 3 over the two successive planting seasons, 2020 and 2021.

The average number of individuals of *Orius* sp. that appeared in, the first week of June recorded the highest average numbers (3.33 and 4.00), *Scymnus* sp. through the end week of May (4.33 and 3.33), *Chrysoperla* sp. during the fourth week of May (6.33 and 7.33), *Coccinella* sp. during the end of May (6.33 and 6.67), *Paederus alfieri* during the end of May (6.33 and 6.33), *Scolothrips* sp. on the end of May (7.66 and 6.67) and predacious mites appeared the end of May (7.00 and 6.67) recorded the highest mean numbers, during 2020 and 2021 growing seasons, respectively. Similar results were obtained by; Ekram *et al.* (2019) who showed that the average number of predators oscillate in March and April and increased gradually to reach its peak in May at summer seasons, 2017 and 2018 on kidney bean plants, then decreased towards the end of the season. El-Garhey *et al.* (2015) stated that the greatest values of predacious mite's frequency occurrence were recorded on soybean and cotton plants.

From the previously obtained results, *Chrysoperla* sp. and *Coccinella* sp. were the main natural enemies in the highest average number of individuals, followed by *Scolothrips* sp., predacious mites, *Paederus alfieri*, *Scymnus* sp. and *Orius* sp. in both growing seasons 2020 and 2021. In addition, May recorded the highest average mean numbers of natural enemies during two successive seasons.

III- The relation between major pests and their natural enemies found on kidney bean plants

Results in Tables 4 and 5 indicated that the simple correlation co-efficient and regression values for the impact of the natural enemies; *Orius* sp., *Scymnus* sp., *Chrysoperla* sp., *Coccinella* sp., *Paederus alfieri*, *Scolothrips* sp. and predacious mites on the population of key pests; *Aphis* sp., *Thrips tabaci*, *Empoasca* sp., *Nezara viridula*, *Liriomyza* sp., *Bemisia tabaci* and *Tetranychus urticae* found on kidney bean crops through the two planting years 2020 and 2021.

Results showed the highest positive correlation values to *T. urticae* and *Aphis* sp. and on the other hand all-natural enemies through the two years, while was significant positive correlation values for *Empoasca* sp. from one hand and all-natural enemies from another hand, followed by *B. tabaci*, *Liriomyza* sp. and *N. viridula* with all-natural enemies in both seasons 2020 and 2021.

Table 4. Simple correlation co-efficient and regression values between the key pests and natural enemies in kidney bean plants through the 2020 season at Assiut governorate

| Predators Pests | <i>Orius</i> sp. | | <i>Scymnus</i> sp. | | <i>Chrysopa</i> sp. | | <i>Coccinella</i> sp. | | <i>Paederus affterii</i> | | <i>Scolothrips</i> sp. | | Predacious mite | |
|----------------------------|------------------|-------|--------------------|-------|---------------------|-------|-----------------------|-------|--------------------------|-------|------------------------|-------|--------------------|-------|
| | r | b | r | b | r | b | r | b | r | b | r | b | r | b |
| <i>Aphis</i> sp. | 0.836** | 0.048 | 0.883** | 0.074 | 0.960** | 0.118 | 0.900** | 0.104 | 0.830** | 0.081 | 0.800** | 0.091 | 0.769** | 0.080 |
| <i>Thrips tabaci</i> | 0.471* | 0.217 | 0.500* | 0.337 | 0.545* | 0.590 | 0.476* | 0.441 | 0.387* | 0.244 | 0.312* | 0.282 | 0.267* | 0.221 |
| <i>Empoasca</i> sp. | 0.710** | 0.092 | 0.727 | 0.138 | 0.819** | 0.228 | 0.765* | 0.198 | 0.801** | 0.174 | 0.777* | 0.197 | 0.647* | 0.151 |
| <i>Nezara viridula</i> | 0.519* | 0.165 | 0.552* | 0.258 | 0.632* | 0.434 | 0.546* | 0.351 | 0.464* | 0.249 | 0.399* | 0.250 | 0.414* | 0.250 |
| <i>Liriomyza</i> sp. | 0.578* | 0.052 | 0.544* | 0.072 | 0.613* | 0.120 | 0.577* | 0.106 | 0.420* | 0.064 | 0.454* | 0.081 | 0.468* | 0.077 |
| <i>Bemisia tabaci</i> | 0.662* | 0.121 | 0.642* | 0.172 | 0.595* | 0.234 | 0.571* | 0.210 | 0.400* | 0.123 | 0.448* | 0.161 | 0.593* | 0.195 |
| <i>Tetranychus urticae</i> | 0.952** | 0.057 | 0.982** | 0.084 | 0.913** | 0.119 | 0.935** | 0.113 | 0.891** | 0.091 | 0.892** | 0.106 | 0.968** | 0.105 |

* Significant, ** Highly significant.

Table 5. Simple correlation co-efficient and regression values between the major pests and natural enemies in kidney bean plants through the 2021 season at Assiut governorate

| Predators Pests | <i>Orius</i> sp. | | <i>Scymnus</i> sp. | | <i>Chrysopa</i> sp. | | <i>Coccinella</i> sp. | | <i>Paederus affterii</i> | | <i>Scolothrips</i> sp. | | Predacious mite | |
|----------------------------|------------------|-------|--------------------|-------|---------------------|-------|-----------------------|-------|--------------------------|-------|------------------------|-------|--------------------|-------|
| | r | b | r | b | r | b | r | b | r | b | r | b | r | b |
| <i>Aphis</i> sp. | 0.811** | 0.051 | 0.821** | 0.072 | 0.968** | 0.132 | 0.892** | 0.107 | 0.840** | 0.083 | 0.851** | 0.098 | 0.820** | 0.089 |
| <i>Thrips tabaci</i> | 0.605* | 0.214 | 0.622* | 0.307 | 0.836** | 0.645 | 0.670* | 0.454 | 0.608* | 0.341 | 0.655* | 0.426 | 0.564* | 0.344 |
| <i>Empoasca</i> sp. | 0.778* | 0.103 | 0.715* | 0.132 | 0.894** | 0.258 | 0.826** | 0.209 | 0.776* | 0.163 | 0.774* | 0.189 | 0.793* | 0.182 |
| <i>Nezara viridula</i> | 0.579* | 0.158 | 0.637* | 0.242 | 0.795* | 0.471 | 0.674* | 0.352 | 0.636* | 0.274 | 0.661* | 0.330 | 0.567* | 0.267 |
| <i>Liriomyza</i> sp. | 0.578* | 0.057 | 0.589* | 0.081 | 0.577* | 0.124 | 0.587* | 0.110 | 0.637* | 0.078 | 0.477* | 0.086 | 0.546* | 0.093 |
| <i>Bemisia tabaci</i> | 0.734* | 0.137 | 0.728* | 0.188 | 0.655* | 0.265 | 0.687* | 0.244 | 0.630* | 0.186 | 0.639* | 0.218 | 0.688* | 0.221 |
| <i>Tetranychus urticae</i> | 0.976** | 0.065 | 0.934** | 0.086 | 0.902** | 0.130 | 0.942** | 0.119 | 0.967** | 0.102 | 0.956** | 0.117 | 0.970** | 0.111 |

* Significant, ** Highly significant.

T. tabaci recorded positive correlation values from one hand and *Orius* spp. (0.471), *Scymnus* sp. (0.500), *Chrysopa* sp. (0.595), *Coccinella* sp. (0.476), *Paederus alfieri* (0.387), *Scolothrips* sp. (0.312) and *predacious mites* (0.267) from other hand during 2020 season, while recorded significant positive correlation values with *Orius* sp. (0.605), *Scymnus* sp. (0.622), *Coccinella* sp. (0.670), *Paederus alfieri* (0.608), *Scolothrips* sp. (0.655) and *predacious mites* (0.564), except *Chrysopa* sp. (0.836) was highly significant positive during second season 2021. Similar data were obtained through; Abou El-Saad (2018 and 2015) indicated highly important positive correlation values to *Empoasca decipiens*, *Bemisia tabaci* and *Thrips tabaci* on the other hand all predators were in sweet basil through the planting years 2017 and 2018.

Finally, the differences in the main pests and natural enemies from one season to another may be due to the differences in the prevailing weather factors and/or the existing natural enemies. Results will aid in planning programs for integrated control of *Phaseolus vulgaris* main pests.

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حصر وتذبذب تعداد الآفات الرئيسية التي تصيب الفاصوليا وعلاقتها بالأعداء الحيوية بمحافظة أسيوط

جمال همام عبد العليم همام¹، أيمن كامل ابو السعد¹، علاء الدين عبد القادر احمد سالم¹، محمود فقير محمد على²

¹معهد بحوث وقاية النباتات، مركز البحوث الزراعية، الدقي، الجيزة، مصر.

²قسم وقاية النباتات، كلية الزراعة، جامعة الوادي الجديد، مصر.

الملخص

أجريت هذه الدراسة خلال موسمي 2020، 2021 في منطقة عرب العوامر – أبنوب – اسيوط وذلك بهدف:

- حصر أهم الآفات الحشرية والأعداء الحيوية المرتبطة بها.
- دراسة تقلبات تعداد الآفات الرئيسية وأعدائها الحيوية.
- العلاقة بين الآفات الرئيسية وأعدائها الحيوية.

أوضحت النتائج المتحصل عليها الآتي:

أمكن تسجيل 41 نوعاً متواجداً على الفاصوليا يتبع 20 عائلة تتبع 10 رتبة. تم تسجيل 27 نوع من الآفات الضارة تتبع 14 عائلة و9 رتبة كما تم تسجيل 14 نوع من الأعداء الحيوية تتبع 9 عائلة و7 رتبة.

سجل المنّ وأكاروس العنكبوت الأحمر أعلي تعداد على نباتات الفاصوليا، يليهم ذبابة صانعة الأنفاق، نشاط الأوراق، الذبابة البيضاء، البقّة الخضراء والتربس. أيضاً أسد المنّ وأبو العيد سجلوا أعلي تعداد على نباتات الفاصوليا، يليهم التريبس المقترس، الأكاروسات المقترة، الرواغة، بقّة الأسكمنس وبقّة الأوريس.

أشارت النتائج إلى أن الارتباط بين أكاروس العنكبوت الأحمر والمنّ من جهة والأعداء الحيوية من جهة أخرى كانت موجبا وعالية المعنوية. بينما كانت موجبا معنويا بين نشاط الأوراق والذبابة البيضاء وذبابة صانعة الأنفاق والبقّة الخضراء من جهة والأعداء الحيوية من جهة أخرى.

أخيراً ومن خلال النتائج السابقة يتضح أن نباتات الفاصوليا تصاب بأفات عديدة، هذا من جانب، أما من الجانب الآخر هو وجود أعداء حيوية التي تدخل في إطار منظومة تطبيق استراتيجية لمكافحة تلك الآفات مع باقي الطرق الأخرى الأمانة للحفاظ على البيئة المحيطة من التلوث بالمبيدات.