Egyptian Journal of Plant
Protection Research Institute
www.ejppri.eg.net

Seasonal abundance of the prevalent arthropods inhabiting cowpea plantations with reference to the relative susceptibility of certain cowpea cultivars to the main sap sucking pests

Mohamed, Abd Elrahman Amro[1]; Ali, Mohamed Ali [2]; Ahmed, M. A. Ibrahim[2]; Mohamed, H.A. Hassan[3] and Samar, Adel Sayed [2]

[1]*Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.*
[2]*Zoology and Entomology Department, Faculty of Science, Assiut University, Assiut, Egypt.*
[3]*Plant Pathology Department, Faculty of Agriculture, Assiut University.*

ARTICLE INFO
Article History
Received:25 /1 /2024
Accepted:28 /3/2024

Keywords

Cowpea foliage, arthropod pests, seasonal abundance and relative susceptibility.

Abstract

Species composition, dominance, and seasonal abundance of the prevalent arthropod pests and associated natural enemies inhabiting cowpea plantations during the 2020 and 2021 cowpea growing seasons were evaluated in Assiut Upper Egypt. Except for the two-spotted spider mite *Tetranychus urticae* Koch (Acari: Tetranychidae), the obtained results revealed the presence of 23 arthropod species belonging to 14 families and 7 insect orders in association with cowpea plantations. The collected species were divided into 5 groups. Group1 contained 12 phytophagous species, group 2 contained 3 predominantly phytophagous (predacious in part) species, group 3 contained 6 predatory species, group 4 contained 1 predominantly predacious (Phytophagous in part) species and group 5 contained 1 parasitoid species. Concerning the dominance percentages of the phytophagous group, *Empoasca* spp. (Hemiptera: Cicadellidae) ranked the first in both seasons with an average of 84.63 and 89.84 %, respectively. In the predatory group, the ladybird beetle *Coccinella undecimpunctata* (L.) (Coleoptera: Coccinellidae) ranked first in the first season with an average of 41.10 %. However, *Orius* spp. (Hemiptera: Anthocoridae) ranked first in the second season with an average of 44.84 %. It is important to note that the predatory group constituted 5.12 and 9.03 percent of the phytophagous group during both seasons of study, respectively. The examination of cowpea leaves revealed the presence of three sap sucking species viz. *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), *Thrips tabaci* Linderman (Thysanoptera: Thripidae) and *T. urticae*. The tested cowpea cultivars showed diverse susceptibility degrees against the leaves sap sucking arthropod pests. In general (Kafr-Elsheikh1 and Kaha1) appeared as low resistant (LR) cultivars against the whitefly *B. tabaci*, the leafhopper *T. tabaci* and *T. urticae.* Resistant cowpea cultivars were hoped for but not found. Therefore, cowpea cultivars that showed some sort of resistance can be included among advanced breeding programs to select new varieties resistant to sap sucking pests infesting cowpea plantations.

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is one of the major legume crops, globally recognized for its nutritional value (Kumar *et al.*, 2024). It is commonly grown in Africa, including Egypt, for its dry seeds and/or green pods before maturity as a vegetable (Metwally *et al.*, 2021). In Africa, different insects attack cowpea plants at various stages of the crop's life cycle viz. Aphids [*Aphis* spp. (Hemiptera: Aphididae)], the green leafhopper [*Empoasca* spp. (Hemiptera: Cicadellidae)], the whitefly [*Bemisia tabaci* (Hemiptera: Aleyrodidae)], the flower bud thrips [*Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae)] (Togola *et al.*, 2017). The two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) had special attention to cowpea foliage by Mohamed *et al.* (2000). In northern Upper Egypt, Amro (2004) recorded 15 phytophagous insect species and 5 natural predators by using sweeping net method on cowpea plantations. The most dominant pest species were the piercing sucking pests *Empoasca* spp., *Nezara viridula* (L.) (Hemiptera: *Pentatomidae), Creontiades pallidus* (Rambur) (Hemiptera: Miridae) and the lycaenid *Lampides boeticus* (Lepidoptera: Lycaenidae). However, the most dominant predators were *Coccinella undecimpunctata* (L.) (Coleoptera: Coccinellidae), *Orius* spp. (Hemiptera: Anthocoridae) and *Scymnus interruptus* (Goeze) (Coleoptera: Coccinellidae). The study also revealed a fascinating compatibility between pest numbers and predator presence.

In the present study, the authors surveyed for two years on cowpea in Assiut Governorate to evaluate dominance and seasonal abundance, types and numbers of arthropod pests, and their associated natural enemies inhabiting cowpea plantations to ensure the most appropriate control method. Additionally, the relative susceptibility of 5 cowpea cultivars was carried out to control cowpea pests in the field.

Materials and methods

Experiments were carried out at the experimental farm of the Faculty of Agriculture, Assiut University, during the 2021 and 2022 cowpea growing seasons at approximately (1050 m^2). Five local and imported cowpea cultivars (Cream7; Kafr-Elsheikh1; Tiba; Kaha1; Sakha1) were obtained from Horticulture Institute, Agricultural Research Center. Cowpea cultivars were cultivated on 7th April, in both seasons. The sustainable farm was divided into two areas. The first area was cultivated by the most common cultivar (Cream7) to determine the faunal composition, dominance, and abundance percentages of the prevalent foliage cowpea arthropod pests. The second area was cultivated by the tested cowpea cultivars to estimate the seasonal abundance of the cowpea foliage sap sucking pests and determine their relations with the available ecological factors (Relative susceptibility). In both areas, each plot (10.50 m^2) was divided into 4 rows. Seeds were planted in 20 cm intervals. The observations of the targeted arthropod pest population were recorded 5 weeks after plantation until harvesting. Insecticides were completely prevented.

1. Species composition of arthropod pests and natural enemies' species inhabiting cowpea plantations:

Direct observations and the sweeping net method have been used as described by Borror and Delong (1971) to study the species composition of arthropod pests and their associated natural enemies inhabiting cowpea plantations. Weekly samples were randomly taken 5 weeks after plantation and continued till harvesting whereas ten double strokes/plot (10.5 m^2) were used. Each collected sample was emptied into a labeled collecting muslin bag and transferred to the laboratory. Collected insect species were anesthetized by chloroform and examined under a stereomicroscope. The number of species of each sample was recorded. Identification of the collected insect species was made by specialists from Insect Classification Department, Plant Protection Research Institute, Agricultural Research Center.

2. Dominance and abundance of arthropod pests and natural enemies' species inhabiting cowpea plantations:

Dominance and abundance percentages of the prevalent insect pests inhabiting cowpea plantations were determined by using the sweeping net method to illustrate the information base of the prevalent insect pests and the naturally occurring biological control agents inhabiting cowpea plantations. To determine the dominance and abundance percentages of the collected species, Facylate (1971) equation was used as follows:

D = Dominance percentage

$D = t / T \times 100$, where

t= Total number of each species during the collecting period.

T= Total number of all species collected during the collecting period.

A = Abundance percentage

$A = n/N \times 100$, Where

n = Total number of samples in which each species appeared.

N = Total number of samples taken all over the season.

3. Seasonal abundance and relative susceptibility of cowpea leave's arthropod pests:

3.1. Seasonal abundance of cowpea leave's arthropod pests:

To determine populations of arthropod pests inhabiting cowpea plants, leaf sampling was used. Samples of 5 cowpea trifoliate leaves were picked up weekly at random/each cowpea cultivar from each experimental unit (4 replicates), 5 weeks after plantation for 12 weeks. Samples were kept in polyethylene bags until thoroughly examined in the laboratory by using a stereomicroscope. The number of individuals of the whitefly (Nymphs), Thrips (Nymphs and adults), and the two-spotted spider Mite (Mobile stages) within each sample were counted and recorded on each inspection date. Collected specimens were preserved for later improved identification.

3.2. Relative susceptibility of cowpea leave's arthropod pests:

Mean numbers of the targeted species were used to determine the relative susceptibility degrees of the tested cowpea cultivars as described by Chiang and Talekar (1980) equation. Relative susceptibility degree was dependent on the general mean number of the pest ($\bar{X}$) and the standard deviation (SD). Cultivars that had mean numbers more than $\bar{X}$+2SD were considered highly susceptible (HS); between $\bar{X}$ and $\bar{X}$+2SD, susceptible (S); between $\bar{X}$ and $\bar{X}$-SD, low resistant (LR); between $\bar{X}$-SD and $\bar{X}$-2SD, moderately resistant (MR) and less than $\bar{X}$-2SD, were considered highly resistant (HR) cultivars.

Results and discussion

1. Species composition of arthropod pests and natural enemies' species inhabiting cowpea plantations:

Except for the two-spotted spider mite *T. urticae* data presented in Table (1) revealed the presence of 23 arthropod species belonging to 14 families and 7 insect orders in association with cowpea plantations. The collected species were divided into 5 groups. The first group contained 12 phytophagous species. The second group contained 6 predatory species. The third group contained 3 predominantly phytophagous (Predacious in part) species. The fourth group contained 1 predominantly Predacious (phytophagous in part) species. However, the fifth group contained 1 parasitoid species. The abovementioned identification is dependent on that reported by Amro *et al.* (2016 and 2017) and classified according to Borror and Delong (1971) and Bourgoin and Campbell (2002).

Intensive and extensive observations indicated that collected species during this work can be classified as sucking pests, leaf feeders, leaf miners, pod borers, seed pests, predators, and parasitoids. In the same approach (Amro, 1999) data revealed the presence of 38 insect species belonging to 37 genera, 26 families, and 9 orders. Moreover, one species of spider mites belonging to order Acari was recorded. Unwise use of chemical compounds and variations in environmental circumstances could be responsible for the shrinking of arthropod populations during the last 30 years.

Table (1): A partial taxonomic list of arthropods collected from cowpea plantations by using a sweeping net and leaves direct count methods during the 2020 and 2021 growing seasons at Assiut Governorate.

Taxon: Order & family	Scientific name	Status	Sampling Method
Thysanoptera: Thripidae (Thrips)	*Scolothrips sexmaculatus* (Pergande, 1890)	Predacious	LDC
	Thrips tabaci Linderman,1889	Phytophagous	LDC&SN
Hemiptera-Heteroptera Anthocoridae (Minute pirate bugs)	*Orius* spp. 1832	Predominantly Predacious (Phytophagous in Part)	SN
Lygaeidae (Bugs/seed bugs)	*Geocoris megacephalus* (Rossi, 1790)	Predacious	SN
	Nysius graminicola (Kolenati, 1845)	Phytophagous	SN
	Oxycarenus hyalinipennis (Costa, 1843)	Phytophagous	SN
	Spilostethus longulus (Dallas, 1852)	Phytophagous	SN
Miridae (Plant bugs)	*Campylomma impicta* (Wagner 1956)	Predominantly Phytophagous (Predacious in Part)	SN
	Creontiades pallidus (Rambur,1839)	Predominantly Phytophagous (Predacious in Part)	SN
	Deraeocoris serenus (Douglas and Scott, 1868)	Predominantly Phytophagous (Predacious in Part)	SN
Pentatomidae (Stink bugs)	*Acrosternum millierei* (Mulsant and Rey, 1866)	Phytophagous	SN
	Nezara virdula Linnaeus,1775	Phytophagous	SN
Homoptera Cicadellidae (Leafhoppers)	*Empoasca* spp.	Phytophagous	SN
Aleyrodidae (Whiteflies)	*Bemisia tabaci* (Gennadius, 1889)	Phytophagous	LDC
Neuroptera Chrysopidae (Ggreen lace wing)	*Chrysoperla carnea* Steinmann, 1964	Predacious	SN
Coleoptera Chrysomelidae (Leaf beetles)	*Callosobruchus maculatus* (Fabricius, 1775)	Phytophagous	SN
Coccinellidae (Lady bugs)	*Coccinella undecimpunctata* Linnaeus, 1758	Predacious	SN
	Scymnus interruptus Goeze, 1777	Predacious	SN
	Stethorus punctillum Weise, 1891	Predacious	SN
Lepidoptera Nolidae (Tuft moths)	*Earias insulana* (Boisduval, 1833)	Phytophagous	SN
Lycaenidae (Butterflies)	*Lampides boeticus* (Linnaeus, 1767)	Phytophagous	SN
Pyralidae (Snout moth)	*Etiella zinckenella* (Treitschke, 1832)	Phytophagous	SN
Hymenoptera Aphelinidae (Parasitic wasps)	*Encarsia formosa* Gahan, 1924	Parasitoid	LDC
Arachnida: Acari: Tetranychidae (Two-spotted spider mite)	*Tetranychus urticae* Koch, 1836	Phytophagous	LDC

SN= Sweeping Net LDC= Leaves Direct Count

2. Dominance and abundance of arthropod pests and natural enemies' species inhabiting cowpea plantations:

Total numbers, dominance, and abundance percentages of arthropod pests and natural enemies' species collected from cowpea plantations by sweeping net at Assiut Governorate during the 2021 and 2022, growing seasons were presented in Table (2). Concerning the dominance of the phytophagous species, *Empoasca* spp. ranked the first in both seasons with an average of 84.63 and 89.84 dominance %, respectively. In the predatory group, the ladybird beetle *C. undecimpunctata* ranked first in the first season with an average of 41.10 dominance %. However, the minute pirate bug *Orius* spp. ranked the first in the second season with an average of 44.84 dominance %. It is important to note that the predatory group constituted 5.12 and 9.03 percent of the phytophagous group during both seasons of study, respectively.

In respect to the abundance percentages, data in Table (2) revealed that *C. pallidus*; *N. viridula* and *Empoasca* spp. were the most abundant phytophagous species that presented 100% abundance during both seasons of study. On the other hand, the predatory species *C. undecimpunctata* and *Orius* spp. presented the highest abundance percentages with an average of 87.5 and 68.75 in the 2021 season, respectively, and 100% abundance in the 2022 season for both.

This finding agrees with those of many investigators who studied cowpea entomology. The results indicated that the dominance degrees of the prevalent natural enemies were less than that of the recorded pests. So, insect pests can cause considerable damage to cowpea plantations. Therefore, it is important to increase the population density of the predacious arthropods which is considered an important agent of biological control in the agro-ecosystem for regulating insect pest populations by conservation and/or inundation. This would avoid the hazards caused by chemical control methods. This finding agrees with those of many investigators who studied cowpea entomology e.g., Abdel-Alim, 1994; Nosser, 1996 and Amro, 1999.

Table (2): Total numbers, dominance, and abundance percentages of arthropod pests and predators collected from cowpea plantations by sweeping net during 2021 and 2022, seasons, Assiut Governorate.

Taxon	2021				2022			
	Total number	Dominance %	Presence	Abundance%	Total number	Dominance %	Presence	Abundance %
Phytophagous species								
Thrips tabaci	6	0.42	4	25	97	2.38	13	81.25
Nysius graminicola	6	0.42	5	31.25	9	0.22	7	43.75
Oxycarenus hyalinipennis	33	2.32	10	62.5	2	0.05	2	12.5
Spilostethus longulus	15	1.05	12	75	4	0.10	4	25
Campylomma impicta	39	2.74	11	68.75	17	0.42	12	75
Creontiades pallidus	46	3.23	16	100	87	2.13	16	100
Acrosternum millierei	28	1.96	11	68.75	13	0.32	6	37.5
Nezara viridula	40	2.81	16	100	166	4.07	16	100
***Empoasca* spp.**	1206	84.63	16	100	3661	89.84	16	100
Earias insulana	3	0.21	3	18.75	9	0.22	9	56.25
Lampides boeticus	3	0.21	3	18.75	10	0.25	9	56.25
Total	1425	95.13	--	--	4075	91.72	--	--
Predatory species								
***Orius* spp.**	14	19.18	11	68.75	165	44.84	16	100
Chrysoperla carnea	18	24.66	10	62.5	47	12.77	10	62.5
Coccinella undecimpunctata	30	41.10	14	87.5	69	18.75	16	100
Scymnus interruptus	3	4.11	2	12.5	45	12.23	14	87.5
Stethorus punctillum	8	10.96	6	37.5	42	11.41	12	75
Total	73	4.87	--	--	368	8.28	--	--
Grand total	1498	--	--	--	4443	-	--	--

@ Based on 16 samples

3. Seasonal abundance and relative susceptibility of cowpea leave's arthropod pests:

3.1. *Bemisia tabaci*:

Data presented in Table (3) expressed the average numbers of *B. tabaci* infesting cowpea leaves and susceptibility degrees that appeared by cowpea cultivars in Assiut during the 2021 and 2022 growing seasons. The obtained data revealed that the cowpea cultivar (Sakha1) harbored the highest numbers of *B. tabaci* nymphs and recorded 2.21 individuals / 5 trifoliate leaves during the entire period of study. The remaining cultivars occupied fewer numbers ranging between 0.58 and 0.88 individuals / 5 trifoliate leaves. Variations between the tested cultivars and/or months showed highly significant F values. Depending on the pest mean numbers and the standard deviation values and using Chiang and Talekar (1980) equation, (Sakha 1) cultivar appeared as a susceptible (S) cultivar to *B. tabaci*. However, the remaining cultivars presented some sort of resistance and appeared as low resistant cultivars (LR) against this insect pest.

3.2. *Thrips tabaci*:

Average numbers of *T. tabaci* (Nymphs + adults) infesting cowpea leaves and susceptibility degrees appeared by cowpea cultivars in Assiut during the 2021 and 2022 growing seasons were initiated in Table (4). The obtained data revealed that (Cream7 and Tiba) cultivars harbored the highest mean numbers of *T. tabaci* during the entire period of study with an average of 6.46 and 5.63 individuals / 5 trifoliate leaves, respectively. Regardless of cowpea cultivars, the average number of pests during the entire period of the study recorded 4.79 individuals / 5 trifoliate leaves. Variations between the tested cultivars and/or months showed highly significant F values. Two cultivars (Cream7 and Tiba) were appeared as susceptible (S) cultivars. However, the remaining cultivars showed some sort of resistance and appeared as low resistant (LR) and moderately resistant (MR) cultivars and harboring less than 5.00 individuals / 5 trifoliate leaves.

3.3. *Tetranychus urticae*:

Average numbers of the two-spotted spider mite (TSSM) *T. urticae* infesting cowpea leaves and susceptibility degrees that appeared by cowpea cultivars in Assiut during the 2021 and 2022 growing seasons were clarified in Table (5). Although the cowpea cultivar (Tiba) harbored 2.33 individual/5 trifoliate leaves during the 2021 season it harbored the highest mean numbers of the pest during the 2022 season with an average of 17.08 individual/5 trifoliate leaves. During the entire period of the study, the pest recorded 9.71 individuals / 5 trifoliate leaves on (Tiba) cultivar. Similar results were recorded concerning (Sakha1) cultivar. Both cultivars appeared as susceptible cultivars (S) to *T. urticae*. Regardless of the cowpea cultivar, it can be noted that the average number of pests during the entire period of the study recorded 6.55 individuals/5 trifoliate leaves. The remaining cowpea cultivars harbored the lowest numbers of the (TSSM). These cultivars were categorized as low-resistance (LR) cultivars. Variations between the tested cultivars and/or months showed highly significant F values.

Relatively resistant cultivars could appear as non-preferred to sap-sucking pests. Morphological non-preference results from plant structural characteristics, which disrupt the normal behavior of insects by physical means (color, light penetration, hairiness, leaf angle). Low resistant (LR) cultivars often have a higher economic threshold level than the susceptible cultivars, and are highly stable, as they do not provide any selection pressure on pest populations to evolve virulence and thus are useful in preventing the development of insect biotypes (Heinrichs, 1986).

The use of resistant host plants has been recognized by leguminous entomologists as a highly desirable control tactic with excellent potential for regulating populations of certain insect pests in an Integrated Pest Management system (IPM). Therefore, the present research covers the most important tactics concerned with the susceptibility of cowpea cultivars to serious pests such as piercing and sucking pests.

Table (3): Average numbers of *Bemisia tabaci* infesting cowpea leaves and susceptibility degrees appeared by cowpea cultivars in Assiut during 2021 and 2022 growing seasons.

Inspection Year	Inspection Month	Mean No. / 5 trifoliate leaves / cowpea cultivar					
		Cream7	Kafr-Elsheikh1	Tiba	Kaha1	Sakha1	Mean ± SE
2021	May (2)	0.25ef ± 0.25	0.00f ± 0.00	0.00f ± 0.00	0.00f ± 0.00	0.00f ± 0.00	**0.05C ± 0.05**
	June (5)	1.25 cd± 0.25	0.00f ± 0.00	0.50ef ± 0.29	1.25cd ± 0.25	5.75a ± 0.48	**1.75A ± 0.49**
	July (5)	0.25ef ± 0.25	2.00b ± 0.00	0.75de ± 0.25	2.25b ± 0.25	1.75bc ± 0.25	**1.40B ± 0.20**
	Mean	**0.58C ± 0.19**	**0.67C ± 0.28**	**0.42C ± 0.15**	**1.17B ± 0.30**	**2.50A ± 0.74**	**1.07 ± 0.06**
2022	May (2)	0.00e ± 0.00	0.00e ± 0.00	0.00e ± 0.00	0.00e ± 0.00	0.00e ± 0.00	**0.00C ± 0.00**
	June (5)	1.25bc ± 0.25	1.50b ± 0.29	0.75cd ± 0.25	1.25bc ± 0.25	1.00bcd ±0.00	**1.15B ± 0.11**
	July (5)	0.50de ± 0.29	0.75cd ± 0.25	1.50b ± 0.29	0.50de ± 0.29	4.75a ± 0.25	**1.60A ± 0.39**
	Mean	**0.58b ± 0.19**	**0.75b ± 0.22**	**0.75b ± 0.22**	**0.58b ± 0.19**	**1.92a ± 0.62**	**0.92 ± 0.05**
2021&2022	**Grand Mean ±SD**	**0.58C ± 0.16**	**0.71BC ± 0.18**	**0.58C ± 0.17**	**0.88B ± 0.21**	**2.21A ± 0.48**	**1.00 ± 0.31**
Susceptibility degree		**LR**	**LR**	**LR**	**LR**	**S**	**-**

( ) No of monthly samples
2021: F value: Between months = 78.71; between cultivars = 42.20**; Months × Cultivars = 37.81** -**
2022: F value: Between months = 78.34; between cultivars = 22.05**; Months × Cultivars = 27.52****
Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests. S = Susceptible LR = Low Resistant

Table (4): Average numbers of *Thrips tabaci* infesting cowpea leaves and susceptibility degrees appeared by cowpea cultivars in Assiut during 2021 and 2022 growing seasons.

Inspection Year	Inspection Month	Mean No. / 5 trifoliate leaves / cowpea cultivar					
		Cream7	Kafr-Elsheikh1	Tiba	Kaha1	Sakha1	Mean ± SE
2021	May (2)	0.25de ± 0.25	2.50a ± 0.29	0.00e ± 0.00	1.25bc ± 0.25	1.25bc ± 0.25	**1.05A ± 0.22**
	June (5)	1.00bcd±0.41	1.00bcd ± 0.00	0.50cde±0.29	1.75b ± 0.25	0.25de ± 0.25	**0.90A ± 0.16**
	July (5)	1.75b ± 0.25	1.25bc ± 0.25	0.25de ± 0.25	1.50b ± 0.29	0.50cde±0.29	**1.05A ± 0.17**
	Mean	**1.00B ± 0.25**	**1.58A ± 0.23**	**0.25C ± 0.13**	**1.50A ± 0.15**	**0.67B ± 0.19**	**1.00 ±0.06**
2022	May (2)	15.00b ± 0.41	8.25f ± 0.25	10.75d ± 0.48	9.50e ± 0.50	10.00de±0.41	**10.70A±0.55**
	June (5)	18.75a ± 0.75	9.75de ± 0.25	12.00c ± 0.41	8.00f ± 0.41	5.50g ± 0.29	**10.80A±1.05**
	July (5)	2.00i ± 0.00	3.25h ± 0.25	10.25de±0.25	5.00g ± 0.41	0.75j ± 0.25	**4.25B ± 0.77**
	Mean	11.92a ± 2.18	**7.08c ± 0.85**	**11.00b ± 0.30**	**7.50c ± 0.61**	**5.42d ± 1.15**	**8.58 ±0.10**
2021& 2022	Grand Mean ±SD	**6.46A ± 1.03**	**4.33C ± 0.45**	**5.63B ± 0.19**	**4.50C ± 0.31**	**3.05D ± 0.63**	**4.79±0.58**
Susceptibility degree		**S**	**LR**	**S**	**LR**	**MR**	**-**

( ) No of monthly samples
2021: F value: Between months = 0.63^{ns}; between cultivars = 15.93; Months × Cultivars = 6.58****
2022: F value: Between months = 504.21; between cultivars = 163.24**; Months × Cultivars = 82.12****
Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests.
S = Susceptible LR = Low Resistant MR= Moderately Resistant

Table (5): Average numbers of *Tetranychus urticae* infesting cowpea leaves and susceptibility degrees appeared by cowpea cultivars in Assiut during 2021 and 2022 growing seasons.

Inspection Year	Inspection Month	Mean No. / 5 trifoliate leaves / cowpea cultivar					
		Cream7	Kafr-Elsheikh1	Tiba	Kaha1	Sakha1	Mean ± SE
2021	May (2)	0.50gh ± 0.29	4.00d ± 0.00	6.25b ± 0.25	1.25fg ± 0.95	4.50cd ± 0.29	**3.30A ± 0.52**
	June (5)	1.00fgh±0.00	1.00fgh±0.00	0.75fgh±0.25	5.00c ± 0.41	2.50e ± 0.29	**2.05B ± 0.38**
	July (5)	0.75fgh±0.25	0.00h ± 0.00	0.00h ± 0.00	1.75e f ± 0.25	9.75a ± 0.25	**2.45B ± 0.85**
	Mean	**0.75D ± 0.13**	**1.67C ± 0.51**	**2.33B ± 0.85**	**2.67B ± 0.59**	**5.58A ± 0.93**	**2.60±0.09**
2022	May (2)	17.50b ± 0.87	9.75d ± 0.25	25.75a ± 0.63	11.00cd±0.58	10.50cd ± 0.5	**14.90B ±1.42**
	June (5)	16.25b ± 0.63	11.50c ± 0.87	24.75a ± 0.25	9.75d ± 0.25	16.25b ± 0.75	**15.70A±1.22**
	July (5)	0.50e ± 0.29	1.75e ± 0.25	0.75e ± 0.25	0.50e ± 0.29	1.00e ± 0.00	**0.90C ± 0.14**
	Mean	**11.42b ± 2.36**	**7.67d ± 1.31**	**17.08a ± 3.49**	**7.08d ± 1.43**	**9.25c ± 1.92**	**10.50±0.14**
2021&2022	**Grand Mean±SD**	**6.09C ± 1.17**	**4.67D ± 0.82**	**9.71A ± 2.04**	**4.88D ± 0.84**	**7.42B ± 0.52**	**6.55 ± 0.93**
Susceptibility degree		**LR**	**LR**	**S**	**LR**	**S**	**-**

( ) No of monthly samples

2021: F value: Between months = 18.98; between cultivars = 92.71**; Months × Cultivars = 74.93****

2022: F value: Between months = 1268.79; between cultivars = 179.78**; Months × Cultivars = 57.63****

Averages having the same letter are not significant at 5% level according to Duncan's multiple range tests. S = Susceptible LR = Low Resistant

References

Abdel-Alim, A. (1994): Ecological studies on certain insects infesting cowpea plants in minia region. Minia Journal of Agricultural Research and Development (Egypt), 16 (2): 261-273.

Amro, M.A (1999): Ecobiological studies on certain arthropod pests infesting selected cowpea cultivars and control strategy in arid-ecosystem. Ph.D.Thesis, Faculty of Agriculture. Assiut University.

Amro, M.A. (2004): The influence of plant characteristics on the field infestation and resistance status of certain cowpea cultivars to the lima bean pod borer *Etiella zinckenella* Treitschke and the southern cowpea weevil Callosobruchus macultatus (Fabricius). The 2nd International Conference For Development and Environment in the Arab World, March 23-25: 375-384.

Amro, M. A.; El-Raheem, A. and Salem, A. E. D. A. (2017): Suitability of two sampling methods for determining the population trends of certain sap-sucking species inhabiting Tomato and Cucumber plantations. Egyptian Academic Journal of Biological Sciences. A, Entomology, 10(7): 303–309. DOI:10.21608/eajb.2017.12116

Amro, M. A.; Hassan, M. H. A. and Abdel-Galil, Y. M. A. (2016): Evaluation the population dynamics of onion thrips (*Thrips tabaci* Lind.) by different sampling methods in Upper Egypt. The 8th International Conference For Development and Environment in the Arab World Assiut,1: 22-24.

Borror, D. J. and Delong, D. M. (1971): New York, USA, Holt, Rinehart & Winston.

Bourgoin, T. and Campbell, B.C. (2002): Inferring a phylogeny for hemiptera: Falling into the 'autapomorphic trap, 176: 67-82.

Chiang, H. S. and Talekar, N. S. (1980): Identification of sources of resistance to the beanfly and two other agromyzid flies in soybean and mungbean. Journal of Economic Entomology, 73(2): 197-199. Doi.org/10.1093/jee/73.2.197.

Facylate, K.K. (1971): Field studies of soil invertebrate (2nd ed). Vishia Shkoola Press, Mosco, USSR: pp. 424.

Heinrichs, E.A. (1986): Perspectives and directions for the continued development of insect-resistant rice varieties. Agriculture, Ecosystems & Environment, 18(1): 9-36. Doi.org/10.1016/0167-8809(86)90172-6.

Kumar, K. B.C.; Tripathi, K.; Singh, R.; Gore, P. G.; Kumar, R.; Bhardwaj, R. and Gupta, K. (2024): Screening diverse cowpea (*Vigna unguiculata* (L.) Walp.) germplasm for *Callosobruchus chinensis* (L.) resistance and SSR based genetic diversity assessment. Genetic Resources and Crop Evolution, 1-17. Doi.org/10.1007/s10722-024-01863-1.

Metwally, E.; Sharshar, M.; Masoud, A.; Kilian, B.; Sharma, S.; Masry, A.; Shaw, P. D.; Raubach, S.; Fiad, A. and Rakha, M. (2021): Development of high yielding cowpea [*Vigna unguiculata* (L.) walp.] lines with improved quality seeds through mutation and pedigree selection methods. Horticulturae, 7(9): 271. Doi.org/10.3390/horticulturae7090271.

Mohamed, S. H.; Abdel-Galil, F. A.; Morsi, M. A. and Amro, M. A.

(2000): Susceptibility of cowpea cultivars to natural infestation with whitefly, *Bemisia tabaci* Gennadius and the two-spotted spider mite, *Tetranychus urticae* Koch. In Proceedings of the 2nd Scientific Conference of Agricultural Sciences, Assiut University, Egypt, 601-611.

Nosser, M.A. (1996): Mechanism of resistance in bean and cowpea varieties to certain sucking insects infestation. M.Sc.Thesis Faculty of Agriculture, Cairo University.

Togola, A.; Boukar, O.; Belko, N.; Chamarthi, S. K.; Fatokun, C.; Tamo, M. and Oigiangbe, N. (2017): Host plant resistance to insect pests of cowpea (*Vigna unguiculata* L. Walp.): Achievements and future prospects. Euphytica, 213: 1-16. Doi.org/10.1007/s10681-017-2030-1.