Susceptibility of Eight Sweet Pepper Cultivars to Infestation with *Tetranychus urticae, Aphis gossypii* and *Thrips tabaci*

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ABSTRACT

Field experiments were conducted to estimate the susceptibility of eight sweet pepper cultivars, *i.e.* Bella yellow, Bella red, Jumbo yellow and Roxy red at Giza governorate and Carmen yellow, Toranto yellow, Inspition red and Blocky red at Behera governorate to infestation with *Tetranychus urticae* Koch, *Thrips tabaci* Lind and *Aphis gosspii* Glover. Their population fluctuations during the two successive seasons, (2008/9) and (2009/10) at Giza and Behera governorates, revealed that Roxy red cultivar was the most highly susceptible to *T. urticae* infestation recording averages of 131.5 and 162.4 mite moving stages/leaf, while Jumbo yellow cultivar was the most highly susceptible to aphis and thrips recording averages of 161.15 and 114.39 *Aphis gossypii* and 75.78 and 92.00 *Thrips tabaci* L. during the two successive seasons respectively at Giza governorate.

Key Words: Susceptibility, Host plant resistance, Sweet pepper cultivars, Population dynamics, *Tetranychus urticae, Thrips tabaci, Aphis gossypii.*

INTRODUCTION

Sweet pepper *Capsicum annuum* (Fam: Solanaceae) is considered one of the most important vegetable crops in Egypt which can be produced all the year round under adjusted weather conditions in Greenhouses. It is usually infested with the spider mite; *Tetranychus urticae* Koch, *Thrips tabaci* Lind and *Aphis gossypii* Glover, Farrag *et al.*, 1984, *T. cinnabarinus* Boisd. Mansour and Karchi 1994, *T. kanzawai* Kishida ,Morishita & Yano 1996 and the tarsonemed mite *Polyphagotarsonemus latus* Banks, Kousik *et al.*, 2007.

Evaluation the susceptibility of some sweet pepper cultivars to infestation with *T. urticae* in order to select the most resistant ones is considered important to avoid using more pesticides. Chemical contents and morphological characteristics which normally vary from plant variety to another, may affect the population levels of herbivores. There were several studies on the host plant resistance to the infestation with *T. urticae*; Ahmed 1994, Tomczyk *et al.*, 1996, Hanafy 2004, Lopez *et al.*, 2005, Jyotika 2006, Ibrahim *et al.*, 2008 and Abdallah *et al.*, 2009.

Therefore, the present work was conducted to determine the susceptibility to infestation of eight sweet pepper cultivars with the two spotted spider mite *T. urticae*, *T. tabaci* and *A. gossypii* and relationship with plant leaf morphological characteristics and certain chemical contents. The population dynamics of the mite throughout the two successive seasons; 2008/9 and 2009/10 were also studied.

MATERIALS AND METHODS

Experimental procedures:

Eight different sweet pepper cultivars, *i.e.* Bella yellow, Bella red, Jumbo yellow and Roxy red at Giza governorate and Carmen yellow, Toranto yellow, Inspition red and Blocky red at Behera governorate were cultivated in greenhouses during the two successive seasons; 2008/9 and 2009/10. Experiment contained four replicates and a check; each cultivar treatment contained 192 plants; 48 plants per each replicate. Each treatment was replicated four times and consisted of two lines 12m. long x 75cm wide. Plastic sheets were used as barriers between treatments dividing the plastic house longitudinally to 5 parts.

In the first season (2008-2009) at Giza governorate, sweet pepper cultivars were sown in nursery in the first week of May and after about six to eight weeks, at the fourth week of June planted in the greenhouses. In the second season (2009-2010), sweet pepper cultivars seeds were sown in the second week of May in the nursery then seedlings were planted in the greenhouses in the first week of August, samples were taken weekly.

In the first season (2008-2009) at Behera

governorate, sweet pepper cultivars seedling were sown in the nursery in the beginning week of June and after about six to eight weeks, at the beginning of August planted in the greenhouses. In the second season (2009-2010), sweet pepper seeds were planted in the second week of May in the nursery then seedlings were planted in the greenhouses in the fourth week of June. Each sample, included 40 leaves, taken randomly from every treatment of each cultivar. Leaf samples were examined for *T. urticae*, *T. tabaci* and *A. gossypii*.

Morphological and Biochemical Studies:

Imaging the bottom surface of eight cultivars of sweet pepper leaves using the scanning Electron Microscopic technique (SEM) (Joel GM 4200) was used at the Applied Center for Entomonematodes (ACE), Faculty of Agriculture, Cairo University. Samples for SEM technique were dehydrated in ethyl alcohol and dried using the critical point procedure, then individually affixed using double coated sticky tape, and sputter coated with gold palladium according to Fashing *et al.*, 2000. Some specific chemical contents of sweet pepper leaves were determined as follow: Total phenols contents were determined by Floin-Ciocalteu method as described by Meda *et al.*, 2005. Total carbohydrates were estimated as total soluble sugars and total non-soluble sugars, according to Duboies *et al.*, 1956. Total Protein contents were determined using Kjeldatherm; Gerhardt, Laboratory Instrument and Vapodest 50; Gerhardt, Laboratory Instrument (AOAC, 1995). Total Nitrogen contents were determined using Kjeldatherm; Gerhardt, Laboratory Instrument and Vapodest 50; Gerhardt, Laboratory Instrument (AOAC, 1995). Phosphorus was determined colorimetric according to Goodwin, 1970. Potassium was determined using Advanced Microwave Digestion system. (ETHOS 1) and ICP spectrometer according to (AOAC, 2000). Chemical analysis was carried out during the growing season of eight sweet pepper cultivars in the second season 2009-2010 during two periods' first sign and peak of infestation. Sweet pepper leaves were collected and transferred to the laboratry and dried at room temperature (26±2°C) and relative humidity (70-80% R.H.) then transferred to the Faculty of Agriculture Research Park, Cairo Univ. for chemical analysis.

RESULTS AND DISCUSSION

Susceptibility of different sweet pepper cultivars to *T. urticae* infestation:

The tested sweet pepper cultivars differed in their susceptibility to *T. urticae* infestation during the two successive seasons (2008/9 & 2009/10) at Giza and Behera governorates. They could be arranged in a descending order as follows:

At Giza governorate Roxy red was the highly susceptible (33.99% &39.5%), followed by Jumbo yellow moderately infested (28.8% & 27.6%); while Bella red and Bella yellow cultivars were the lowest infested recording (21.9% &16.5% and 15.4% &16.4%), respectively (Table 1).

At Behera governorate, Inspection red was the highly susceptible (39.0% & 40.1%), followed by Tronto yellow moderately infested (32.8%&33.4%) ; while Blocky red and Carmen yellow cultivars were the lowest, recording (15.4% &14.4% and 12.8% &12.1%) during the two abovementioned seasons, respectively (Table 2).

Therefore, it could be concluded that all tested sweet pepper cultivars were variably infested with *T. urticae*. These results were in agreement with those obtained by Tomczyk *et al.*, 1996, Edelstain *et al.*, 2000, Castagnoli *et al.*, 2003, Maklad 2004, Ibrahim *et al.*, 2008 and Abdallah *et al.*, 2009.

The relationship between leaves characters and some phytochemical compounds of sweet pepper cultivars with *T. urticae* infestation level.

Susceptibility of sweet pepper cultivars to infestation with *T. urticae* may be affected by plant leaf morphological structure. Therefore, the differences between the eight sweet pepper cultivars, and their leaf morphological structure were studied. Trichomes and stomata where presence or absence of differed with sweet pepper cultivars at Giza (Fig.1) and Behera (Fig.2).

One of the most important factors which play a role in the susceptibility of sweet pepper cultivars to *T. urticae* infestation is

Table (1): Susceptibility of four sweet pepper cultivars to *Tetranychus urticae* infestation during two seasons at Giza governorate

Sweet pepper cultivars	Mean number of *T. urticae* movable stages/leaf			
	Season 2008/9		Season 2009/10	
	Mean No.	Infestation%	Mean No.	Infestation%
Bella red	84.55	21.9	67.99	16.5
Bella yellow	59.54	15.4	67.3	16.4
Jumbo yellow	111.3*	28.8	113.46	27.6
Roxy red	131.5*	33.99	162.4	39.5
L.S.D at 0.05	12.66	_	7.43	_

* Significant difference

Table (2): Susceptibility of four sweet pepper cultivars to *Tetranychus urticae* infestation during two seasons at Behera governorate

Sweet pepper cultivars	Mean number of *T. urticae* movable stages/leaf			
	Season 2008/9		Season 2009/10	
	Mean No.	Infestation%	Mean No.	Infestation%
Carmen yellow	35.5	12.8	44.68	12.1
Tronto yellow	91.3	32.8	123.4	33.4
Blocky red	42.9	15.4	53.4	14.4
Inspition red	108.7*	39.0	148.4	40.1*
L.S.D at 0.05	5.68	_	16.3	_

* Significant difference

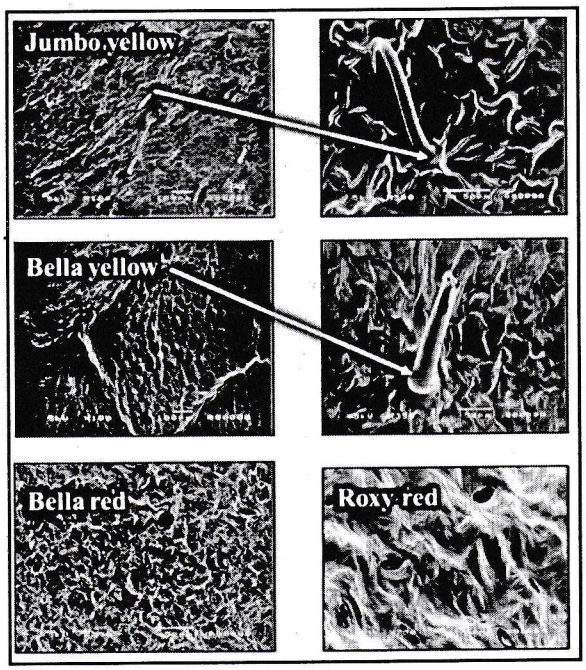

Fig. (1): Traichoma and stomata of four cultivars.

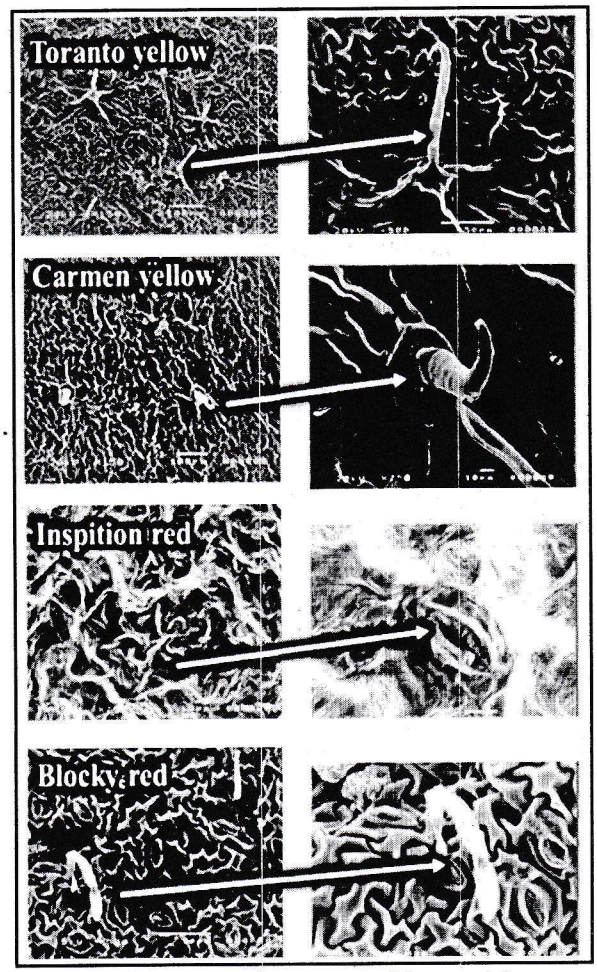

Fig. 2. Traichoma and stomata of four cultivars

Table (3): Relationship between phytochemical components of four sweet peeper cultivars leaves and population of *T. urticae* at Giza governorate

Varieties	Avg. No. Mites/leaf	Carbohy.	Protein	Phenols	N	P	K
Bella yellow	70.05	49.97	19.28	2.02	4.02	0.88	1.66
Bella red	116.89	61.57	23.67	1.82	4.85	1.14	2.27
Jumbo yellow	65.75	53.61	21.20	1.94	4.38	1.06	1.86
Roxy red	152.95	65.56	28.59	1.67	5.62	1.18	3.30

Table (4): Relationship between phytochemical components of four sweet peeper cultivars leaves and population of *T. urticae* at Behera governorate

Varieties	Avg. No. Mites/leaf	Carbohy.	Protein	Phenols	N	P	K
Carmen yellow	56.88	55.92	15.91	2.04	3.42	1.01	1.75
Blocky red	134.87	64.49	19.83	1.82	4.12	1.14	2.85
Tronto yellow	56.92	63.22	17.54	1.90	3.45	1.07	2.95
Inspition red	160.90	71.05	28.53	1.76	3.03	1.24	5.80

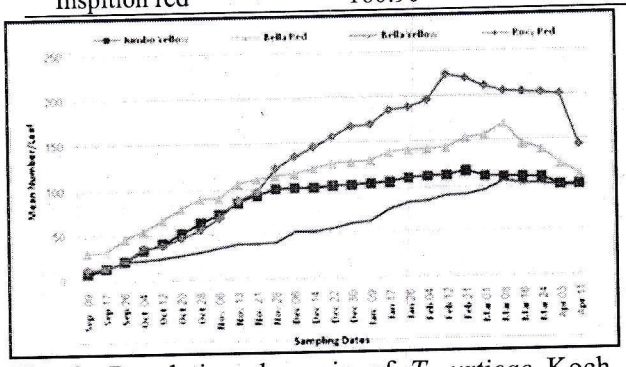

Fig. 3: Population dynamic of *T. urticae* Koch movable stages on four cultivars of sweet pepper at Giza governorate during 2008-2009.

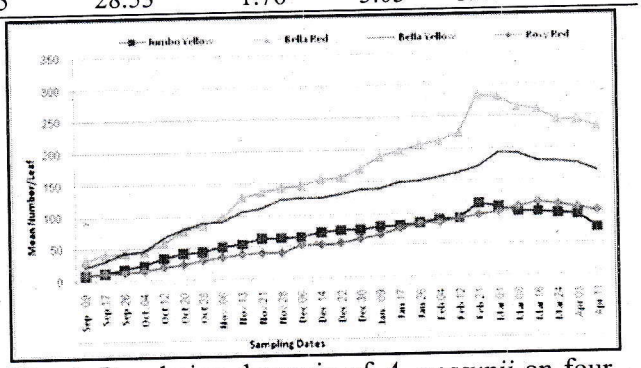

Fig. 4. Population dynamic of *A. gossypii* on four cultivars of sweet pepper at Giza governorate during 2008-2009.

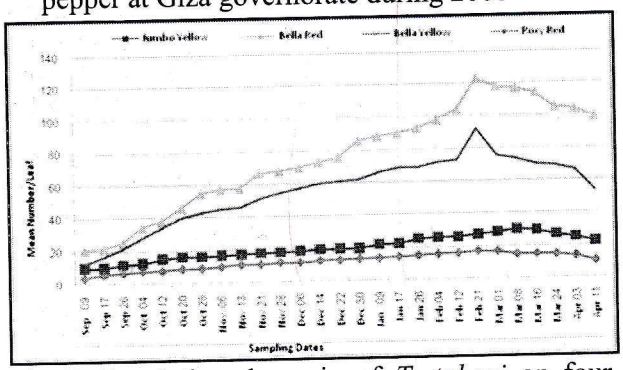

Fig 5. Population dynamic of *T. tabaci* on four cultivars of sweet pepper at Giza governorate during 2008-2009.

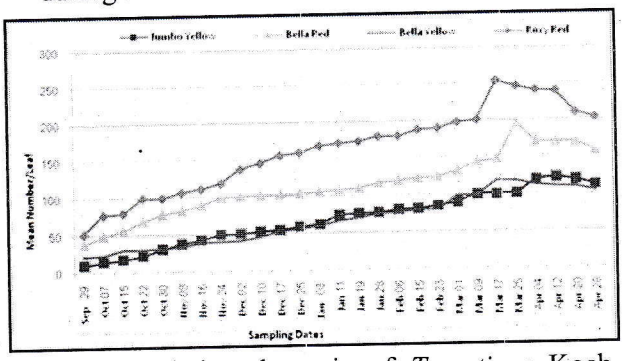

Fig. 6. Population dynamic of *T. urticae* Koch adults on four cultivars of sweet pepper at Giza governorate during 2009-2010.

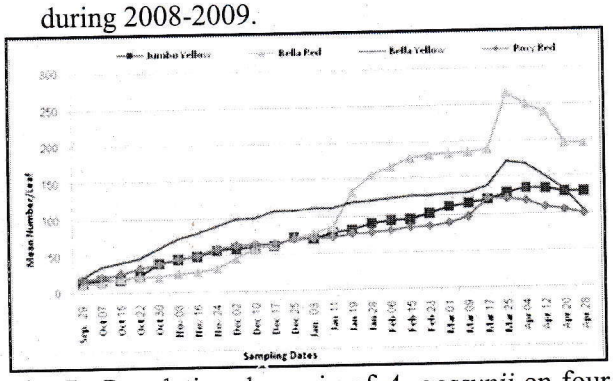

Fig. 7. Population dynamic of *A. gossypii* on four cultivars of sweet pepper under greenhouse condition at Giza governorate during 2009-2010.

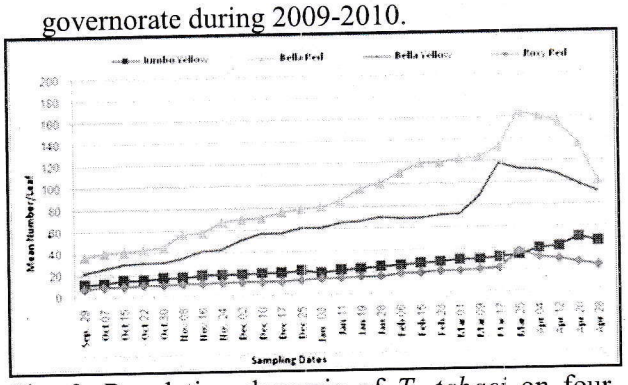

Fig. 8. Population dynamic of *T. tabaci* on four cultivars of sweet pepper under greenhouse condition at Behera governorate during 2009-2010.

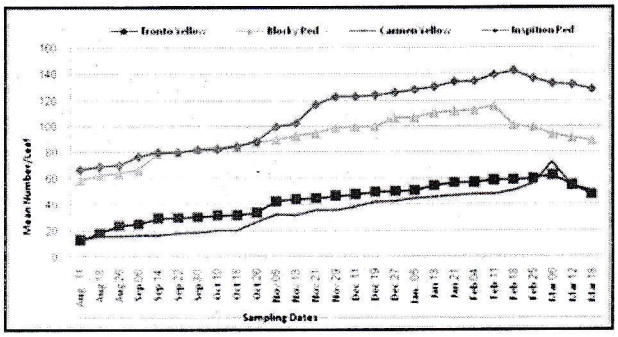

Fig. 9. Population dynamic of *T. urticae* adults on four cultivars of sweet pepper at Behera governorate during 2008-2009.

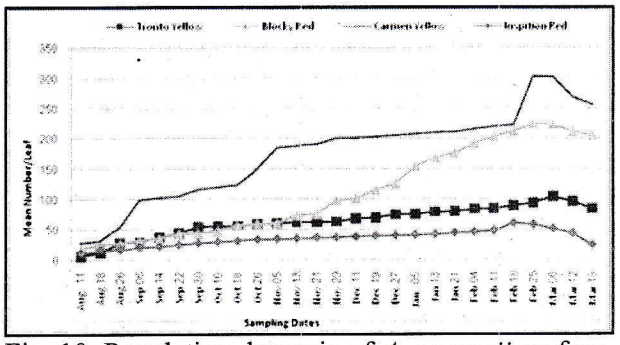

Fig. 10. Population dynamic of *A. gossypii* on four cultivars of sweet pepper at Behera governorate during 2008-2009.

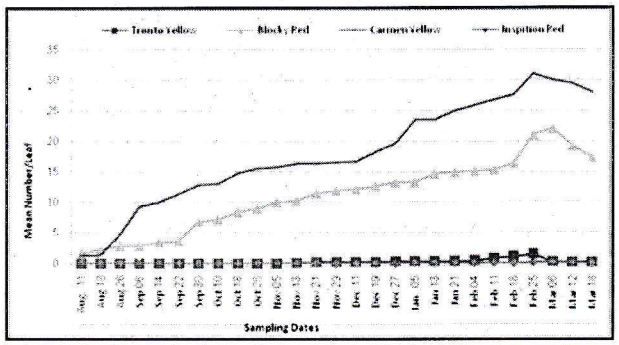

Fig. 11. Population dynamic of *T. tabaci* on four cultivars of sweet pepper at Behera governorate during 2008-2009.

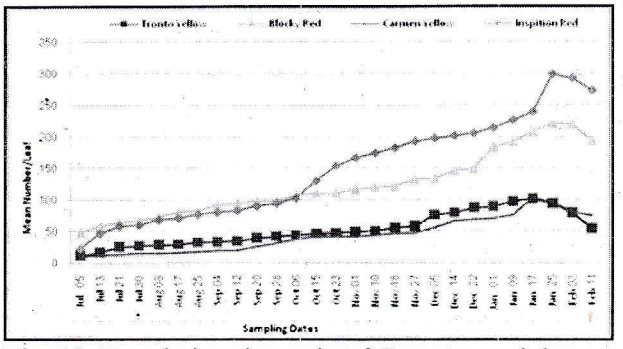

Fig. 12. Population dynamic of *T. urticae* adults on four cultivars of sweet pepper under greenhouse condition at Behera governorate during 2009-2010.

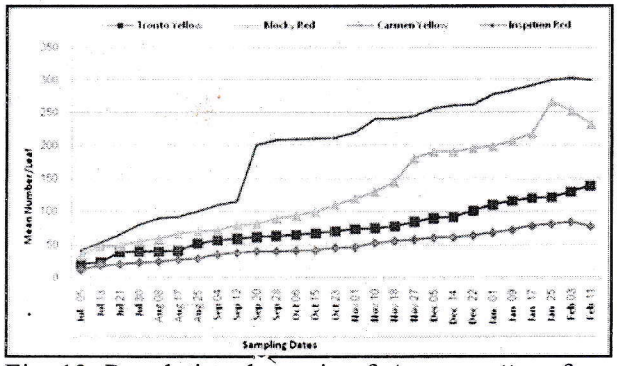

Fig. 13. Population dynamic of *A. gossypii* on four cultivars of sweet pepper at Behera governorate during 2009-2010.

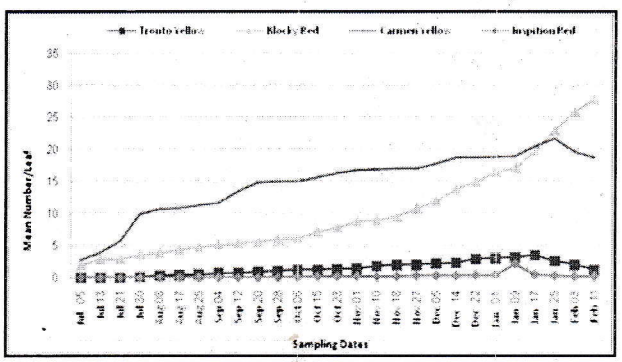

Fig. 14. Population dynamic of *T. tabaci* on four cultivars of sweet pepper under greenhouse condition at Behera governorate during 2009-2010.

leaf phytochemical components. Obtained data indicated positive relationships between mite infestation levels and total carbohydrates, total protein, nitrogen, phosphorous and potassium in sweet pepper cultivars; while negative relationship was found with total phenolic compounds (Table 3). These results are in agreement with those recorded by; Tomczyk & Kropczynska 1985, Rasmy 1985, Tomczyk *et al.*, 1987, Aggour *et al.*, 2001, El-Saiedy 2003, Lopez *et al.* ,2005, Jyotika 2006, Kotb 2007, Ibrahim *et al.*, 2008 and Abdallah *et al.*,2009.

Population dynamics of *T. urticae* on eight sweet pepper cultivars:

Population dynamics of the two spotted spider mite *T. urticae, T. tabaci* and *A. gosspii* at Giza governorate were recorded during the season 2008/9 from the first week of August till the second week of April and during the season 2009/10 from the second week of August till the fourth week of April.

At Behera governorate population were recorded during the season 2008/9 from the fourth week of June till the third week of March and during the season 2009/10 from the fourth week of May till the second week of February.

During season 2008/9 at Giza, the infestation of sweet pepper cultivars; with *T. urticae, Thrips tabaci* and *Aphis gosspii* started from the 2th week of September then gradually increased to reach its peaks in the 2th week of march for Bella yellow and Jumbo yellow cultivars, and the 3rd week for Bella red and 2nd week for Roxy red cultivar. Then, it gradually decreased till the end of the season. The peak recorded the highest level on Roxy cultivar, followed by Jumbo, Bella red and Bella yellow for *T. urticae*. The peak also recorded the highest level on Jumbo yellow, followed by Bella yellow, Bella red and Roxy red for *T. tabaci* and *A. gossypii* (Figs. 3, 4, 5).

During season 2009/10 at Giza, the infestation started from the 4th week of September then gradually increased to reach its peaks in the 3rd week of march for Bella yellow, 4th week of march for Jumbo yellow, the 2nd week of April for Bella red and 3rd week of march for Roxy red cultivars. Then, it gradually decreased till the end of the season. The peak recorded the highest level on Roxy cultivar, followed by Jumbo, Bella red and Bella yellow for *T. urticae*. The peak recorded the highest level on Jumbo yellow, followed by Bella yellow, Bella red and Roxy red for *T. tabaci* and *A. gossypii* (Figs. 6, 7, 8).

During season 2008/9 at Behera, the infestation started from the 2nd week of August then gradually increased to reach its peaks in the beginning week of march for Carmen yellow, 2nd week of February for Tronto yellow, first week of march for Blocky red and 3rd week of February for Inspition red cultivars. Then, population gradually decreased till the end of the season. The peak recorded the highest level on Inspition cultivar, followed by Tronto, Blocky red and Carmen yellow for *T. urticae*. Also the peak recorded the highest level on Carmen yellow, followed by Tronto yellow, Blocky red and Inspection red for *T. tabaci* and *A. gossypii* (Figs. 9, 10, 11).

During season 2009/10 at Behera, the infestation started from the 4th week of September then gradually increased to reach its peaks in the 3rd week of January for Carmen yellow, 4th week of January for Tronto yellow, the 3rd week of January for Blocky red and 4th week of January for Inspition red cultivars. It then, gradually decreased till the end of the season. The peak recorded the highest level on Inspition cultivar, followed by Tronto, Blocky red and Carmen yellow for *T. urticae*. Also the peak recorded the highest level on Carmen yellow, followed by Tronto yellow, Blocky red and Inspection red for *T. tabaci* and *A. gossypii* (Figs. 12, 13, 14).

REFERENCES

Abdallah, A. A.; El-Saiedy, E. M. A.; Sholla, Salwa, M. E. and El-Fatih, Monira, M. 2009. Field and Labortory studies to evaluate three Squash cultivars for their relative susceptibility to spider mite *Tetranychus urticae* Koch and three sucking insect species. Minufiya, J. Agric. Res., 34 (5):1913-1926.

Ahmed, M. A. 1994. Differences in susceptibility of six cucumber cultivars to infestation by *Aphis gossypii* Glov. *Tetranychus urticae* and *Bemisia tabaci* correlated to protein and amino acid contents of leaves. Ann. Agric. Sci. Moshtohor, 32 (4): 2189-2194.

Aggour, A. R.; G. H. Rady; M. M. Kandil and Azouz, H. A. 2001. Evaluation of some *Phaseolus* germplasm for resistance to two-spotted red spider mite. Biological, Histological and Chemical studies. The second Pl. Breed. Conf., Octobr 2, 2001, Assiut Univ.,:391-410.

A.O.A.C. 1995. Method of analysis, Association of Official Agriculture Chemists. 16"' ed., Washington D.C., USA.

Block R.J.; Durrum, E.L. and Zweig, G. 1958. Annual of paper chromatography and paper electrophoresis. 2"d., Academic press, New York, 75-80 pp.

Burn, E. R. 1971. Method for estimation of tannin in grain Sorghum Argon. J., 63,511 pp.

Castagnoi, M.; M. Liguori; S. Simon; S. Marinari and Soressi, G. P. 2003. Tomato stransgenic lines and *Tetranycus urticae:* changes in plant suitability and susceptibility. Exp. Appl. Acarol., 31 (3-4): 177-189.

Chiang, M.S. and Nip, W.K. 1973. Free amino acid content in leaf and root tissues of clubroot-

resistant and clubroot-suscepible cabbages.J. Euphytica, 22:393398.

Dubois, M.; Smith, F.; Gilles, K.A.; Hamilton, J. K and Rebers, P.A. 1956. Calorimetric method for determination of sugars and related substances. Anal. Chem., 28(3):350-356.

Edelstain, M.; Y. Tadmor; F. Abo-Moch; Z. Karchi and Mansour, F. 2000. The potential of Lagenaria rootstock to confer resistance to the carmine spider mite, *Tetranychus cinnabarinus* (Atari: Tetanychidae). Bull. of Entomo. Res., 90:113-117.

El-Saiedy, E.M.A. 2003. Integrated control of red spider mite *Tetranychus urticae* Koch on strawberry plants. Ph. D. Thesis, Fac. of Agric., Cairo Univ., 170 pp.

Etsushiro, D.; Daisuke, S. and Eruyoshi, M. 1981. Modified colormetric ninhydrine methods for peptidase assay. Anal. Biochern., 118:173-184.

Farrag, A. M. I.; Wahba, M. L. and Abdel-Hafez, M. A. 1984. Effect of planting date on the population fluctuations of *Tetranychus urticae* on some cucurbitaceous plants at Quolyobia Province. Agri. Res., 60 (1): 107-117.

Fashing, N. J.; Oconnor, B. M. and Kitching, R. L. 2000. *Lamingtona Carus,* a new genus of Algophagidae (Acari: Astigmata) from water filled treehotes in Queensland. Australia. Invertebrate Taxonomy, 14:591-606.

Goodwin, J.F. 1970. Clin. Chem., 16(9): 776-780.

Hanafy, A. R. I. 2004. Studies on the most important cucumber pests in the open field and suitable control programs. Ph.D. Thesis. Fac. of Agric., Moshtohor, Zagazig Univ. 279pp.

Holden, M. 1965. Chlorophylls: In chemistry and biochemistry of plant pigment. Ed., Goodwin, T. W., PP.462-88. Academic press, London.

Hung, P.V. and Morita, N. 2008. Distribution of phenolic compounds in the graded flours milled from whole buckwheat grains and their antioxidant Capacities. J. Food Chemistry, 109 (2):325-331.

Ibrahim, M. M. S.; El-Esnawy, B. A. and El-Adawy, A. M. 2008. Imbrications of certain cucurbit crops characteristics with the two-spotted spider mite infestation. J. Acarines, 2: 61-65.

Jyotika K. 2006. Comparative susceptibility of various cucurbits to infestation with two-spotted spider mite, *Tetranychus urticae* under laboratory conditions. Annals of Biology, 22 (1): 27-29.

Kotb, Enas, M. 2007. Ecological and biological studies on the Tarsonemid mites *Polyphagotarsonemus latus.* M.Sc.Thesis, Fac. of Agric. Cairo University, 132pp.

Kousik, C. S.; Shepard, B. M.; Hassell, R.; Levi, A. and Simmons, A. M. 2007. Potential sources of resistance to broad mites *(Polyphagotarsonemus latus)* in watermelon germplasm. Hort. Science, 42 (7):1539-1544.

Lopez, R.; Levi, A.; Shepard, B. M.; Simmons, A. M. and Jackson, D. M. 2005. Sources of resistance to two-spotted spider mite (Acari: Tetranychidae) in *Citrullus* spp., Hort. Science, 40 (6): 1661-1663.

Maklad, A. M. 2004. Ecological studies on some insects and animal pests infesting certain vegetable crop under protected cultivation and their control. M.Sc. Thesis. Fac. of Sci. Al-Azhar Univ., 321pp.

Mansour, F. A. and Karchi, Z. 1994. Resistance to carmine spider mite in watermelon. Phytoparasitica, 22, 1: 43-45.

Meda, A.; Lamien, C. E.; Romito, M.; Millogo, J. and Nacoulma, O. G. 2005. Determination of total phenolic, flavonoid and proline contents in Burkina Fasan honey, as well as their radical scavenging activity. Food Chemistry, 91:571-577.

Morishita, M. and Yano, S. 1996. Economic injury level of two spider mites, *Tetranychus urticae* Koch and T *kanzawai* Kishida in watermelon. Proceedings of the Kansai Plant Protection Society, 38: 17-22.

Rasmy, A.H. 1985. The biology of the two spotted spider mite *Tetranychus urticae* as affected by resistant solanaceous plants. Agric. Ecosystem Environ., 13: 325-328.

Sabri, N.N.; El-Masry, S. and Khafaey, S. M. 1973. Phytochemical investigation of *Hyoscyamus desertorum*. Plants Medics., 23:49.

Tomczyk, A. and Kropczynska, D. 1985. Effect the host plant. In world crop pests, spider mites, their host plant. In world crop pests, spider mites, their biology, natural enemies and control. By Helle. W. and Sabelies, M.W. Volume IA, Elsevier, Science Publishers. Amsterdam, the Netherlands: 317-327.

Tomczyk, A.; Kropczynska D. and Kielkiewicz, M. 1987. Manifestations of resistance to spider mites in cultivated plants. Materialy XXVII Sesjinaukowej Instytutu Ochrony Roslin. Czese I. Referaty, 65-79.

Tomczyk, A.; Pilko, A. and Lenteren, J.C. 1996. Prospects for integration of the defence abilities of the host plant and *Phytoseiulus persimilis* activity in spider mite control on cucumber. Bull. OILB /SROP, 19 (1): 175-178.