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Environmental Impact Assessment of the two-spotted spider mite , Tetranychus urticae Koch on Phaseolus vulgaris L plants as in Light of temperature Changes in Sohag Governorate

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Abstract: Climate change and global warming are of great concern to agriculture worldwide and are among the most discussed issues in today's society. Climate parameters such as increased temperatures, rising atmospheric CO_2 levels, and changing precipitation patterns have significant impacts on agricultural production and on agricultural insect pests. Changes in climate can affect insect pests in several ways. As a result, there is a serious risk of crop economic losses, as well as a challenge to human food security. As a major driver of pest population dynamics, climate change will require adaptive management strategies to deal with the changing status of pests. Several priorities can be identified for future research on the effects of climatic changes on agricultural insect pests. The popoulation abundance of the two-spotted spider mite, Tetranychus urticae infesting Phaseolus vulgaris L plants in upper Egypt was studied during spring plantations of 2015 and 2016 season. The obtained results showed that, the spider mite population fluctuated in its density during the whole season of both studied years with a peak number occurrence the end of season (May 30), when plant age was 90 day-olds when temperature and relative humidity were in moderate levels. Also, the current study showed that, Phaseolus vulgaris L plants severely affected by the pest in addition to the few numbers of predators were observed during this season. The temperature and relative humidity, in addition to the plant age probably play an important role in the infestation other than the biotic factors (predators). Accordingly, further studies are required to set up and confirm the main factors affecting the population of this pest. This study is useful for determining the timing of the control program for the two-spotted spider mite, Tetranychus urticae infesting Phaseolus vulgaris L plants during spring plantations.

Keywords: Tetranychus urticae ;Phaseolus vulgaris L plants ;spring plantations; temperature; relative humidity

1. Introduction

Phaseolus vulgaris L. which commonly known in Egypt as Phasolia is a member of Fabaceae (Papilionaceae) family. It is known as Common, Snap, Kidney, French or Haricot beans [1-3] The Kidney beanis a tender annual, cultivated as a food crop in many parts of the world including the temperate, sub-tropical and tropical zones.

It plays an important role in human nutrition as a cheap source for protein, carbohydrates, vitamins and minerals and is considered one of the most important vegetable crops cultivated in Egypt for exportation and for local market as well.

The immature pods of these beans are also an important food source in many locations around the world, where they are known as green beans, snap beans, French beans or string beans. They are important foods in most tropical and subtropical countries of the world and they are second only to cereals as a food source for humans and animals [4].

One of the most important pests in commercial crops worldwide is the polyphagous, two-spotted spider mite, Tetranychus urticae Koch. This mite is able to alter the physiological processes of plants, reducing the area of photosynthetic activity and causing the abscission of leaves in severe infestations [5].

The cost of damages caused by this pest in crops such as beans, citrus, cotton, avocado, apples, pears, plums, and many other horticultural and ornamental crops are estimated at over USD$ 4500 per hectare. Such costs correspond to 30% of the total cost of pesticides in crops of ornamental flowers. This constitutes a spending of almost 62% of the global market value on T. urticae Koch control based on data of 2008 [6]. The main tools used to control this pest are chemically synthesized acaricides.

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Abou El-Saad [7] studied the numerical density of phytophagous mites (i. e. Tetranychus urticae Koch, (Acari: Tetranychidae) inhabiting common bean, Phaseolus vulgaris L. The data indicated that T. urticae Koch and T. cucurbitacearum (Sayed) infested Phaseolus vulgaris L Sarwar [8] studied the population density of the two-spotted spider mite, Tetranychus urticae Koch (Tetranychidae), on Phaseolus vulgaris L. which was the pest of agricultural crops that could potentially be controlled by the predatory mite.

Basha et al. [9] obtained the two- spotted spider mite, Tetranychus urticae Koch. (Tetranychidae) on common been Phaseolus vulgaris were conducted during 2016 and 2017 seasons at Kom-Hamada district, Beheira governorate, Egypt. The spider mite occurred in relatively few numbers of 1.60 & 0.84 individuals per leaf at the late February of both seasons, respectively and the populations increased and reached the highest density of 18.20 and 20.60 individuals per leaf. Basha et al. [9] found the initial incidence of the spider mite occurred in relatively few numbers of 1.60 & 0.84 individuals per leaf. Temperature appeared to be the most environmental factor affecting population build-up of this pest on the investigated crop at Kom-Hamada district, Beheira governorate, Egypt.

Allam [10] investigated three acaricides Indo 50% EC; Challenger 36% SC and Ortus 5% SC for controlling the phytophagous mites, Tetranychus urticae Koch at Gharbia Governorate on kidney bean plants. Ammar et al. [11] evaluated the efficiency of Abamectin against Tetranychus urticae (Koch) infesting green bean (Phaseolus vulgaris) on the autumn. Abou-Zaid et al. [12] studied that the bio pesticide Abamectin1.8 EC.+ mineral oil Cable against the eggs, immature and adults of Tetranychus urticae Koch (Acari: Tetranychidae) infesting two cultivars of both P. vulgaris (Hama and Bolista) under net house conditions at Beheira Governorate. Therefore, the current study was carried out to show the effect of weather factors, plant age and plant levels on the population density of the mite pest on cucumber plants during spring plantation.

2. Materials and Methods

The present study was conducted at the experimental farm of the Faculty of Agriculture (Al-Kawamil city), Sohag University during two successive spring seasons of 2015 and 2016. An area of about quarter feddan (1050 m²) was divided into 100 plots (each was 3×3.5m). The spring plantations were sown on March 1 of both years. Normal agricultural practices free from pesticides treatment were followed. Sampling started two weeks after planting data, and continued fortnightly until harvest. Nine cucumber leaves from five randomized chosen plots of different sides with three replicates at three plant levels (top, middle and bottom) were taken fortnightly leaves were put in tightly closed paper bags labeled with necessary informations, then translocated into the laboratory for examination by using stereoscopic binocular microscope of 40-100 times magnification force. The number of Tetranychus urticae motile stages were counted and recorded. Temperature (°C), (max. and min.) and relative humidity (%) max and min were obtained from the meteorological station of the experimental farm of the Faculty of Agriculture, Sohag University. Simple correlation co-efficient (r) was calculated in order to study the effect of weather factors, plant age and plant levels on the population density of the two-spotted spider mite, Tetranychus urticae motile stages on cucumber plants during the spring planations of both years (2015 and 2016).

3. Results and discussions

In general, the current study showed that the number of days from the date of cucumber planting to harvest took about 90 days in spring plantations during the two studied years (2015 and 2016) in Al-Kawamil city, Sohag Governorate. The population fluctuations of T. urticae motile stages are presented in Table (1). The first appearance of the mite was recorded on March 16th, when plant age was 16 day-olds. The mite density begins with relatively high abundance 28.26 individuals / 9 plant leaves (2015) and 32.4 individuals / 9 leaves (2016), then increased gradually by the end of (March 30) was recorded 32.7 individuals (2015) and 38.9 individuals (2016), when max. and min. of both temperature and relative humidity were 25, 14°C; 38, 22 %R.H. (2015) and 25, 11°C and 55,15 % R.H. (2016), respectively. Then, the population of the pest fluctuated in high density until the end of the season. (May 30) in both years, with an average number of 81.96 individuals / 9 plant leaves of max .and min. of both temperature and relative humidity were 32 and 19 °C; 36 and 15% R.H. (2015 season), respectively. In 2016 season, the number was 86.6 individuals / 9 plant leaves at 35 and 35 and 19 °C; 45 and 10 % R.H.

Data in Table (2) showed the correlations (r) between the pest population recovered from the three plant levels of P. vulgaris in spring plantations of 2015 and 2016 seasons with (max. and min.) temperature and relative humidity. Highly significant positive correlations were recorded between the pest population on the three plant levels (top , middle and bottom) and (max.and min) temperature, where r =0.956 , 0.959 ,0.957 ,0.969 ,0.972 ,0.970 during spring plantations of 2015 season , respectively .Whereas the relationship with R.H.% ,were highly significant negative with max. R.H. (r = -0.962,-0.959, 0.961) on the three plant levels, and negative significant ones with min. R.H.(r = -0.720, -0.727, -0.722) on the three plant levels of spring plantations of , 2016 season ,respectively. The same trend of results was also found with few differences in 2016 spring season.

Sampling date		Mean No. of mites /9leaves	Temp. (°C)		R.H. (%)	
			Max.	Min.	Max.	Min
2015	March 15	96.7	25	12	50	18
	March 30	123.9	25	14	38	22
	April 15	150.65	24	11	45	13
	April 30	171.4	36	21	42	8
	May 15	201.7	35	18	34	7
	May30	280.9	32	19	36	15
2016	March 15	120.96	23	11	48	19
	March 30	132.9	25	11	55	15
	April 15	149.1	32	16	35	11
	April 30	174.5	35	17	24	6
	May 15	211.2	43	26	12	4
	May30	286.8	35	19	45	10

Table 1: Population fluctuations of T. urticae motile stages on P. vulgaris plant in spring plantations of 2015 and 2016 seasons:

- Temp. Max. = Temperature Maximum and Temp. Min. = Temperature Minimum
- R.H. Max. = Relative humidity Maximum and R.H. Min. = Relative humidity Minimum

Factors	No. of mite /9 leaves					
	2015			2016		
	Top leaves	Middle leaves	Bottom leaves	Top leaves	Middle leaves	Bottom leaves
Temp. Max.	0.956**	0.959**	0.957**	0.967**	0.940**	0.949**
Temp. Min.	0.969**	0.972**	0.970**	0.997**	0.986**	0.990**
R.H. Max.	-0.962**	-0.959**	-0.961**	-0.830**	-0.778*	-0.794**
R.H. Min.	-0.720*	-0.727*	-0.722*	-0.882**	-0.837**	-0.851**

Table 2: Simple correlations coefficient (r) between number of T. urticae (motile stages) on three P. vulgaris plant levels and the temperature, relative humidity during two growing spring seasons 2015 and 2016.

** Correlation is highly significant at the 0.05 level.
* Correlation is significant at the 0.01 level.

The spider mite T. urticae showed non-significant positive correlation with average temperature and a non-significant negative correlation with average relative humidity by Ammar and Abolmaaty [13] during two successive seasons on 2015 and 2016at cucumber crop. Our result was similar with Rinkikumari and Shukla [14] were reached to the spider mite showed non-significant negative correlation with average temperature and a non-significant positive correlation with average relative humidity. In poly house, throughout the crop season the distribution of T. urticae was higher on top strata followed by middle strata and bottom strata which studied the population dynamics of two spotted red spider mite, T. urticae.

From the study, it can be conculated that the two-spotted spider mite, T. urticae is a very crucial pest infesting P. vulgaris plants in Egypt. The present results showed that the pest started to infest early age plants (15 day-old). Temperature and relative humidity, as well as plant age, may play an important role in infection other than biotic factors (predators). Accordingly, further studies are required to prepare and confirm the main factors affecting the population of this pest. It is recommended to control weeds before planting both in and around the fields as they are the main source of infestation, and we can benefit from this study by determining the timing of the control program for the two-spotted spider mite infesting P. vulgaris plants during this period.

5. References

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