THE TOLERANCE OF THREE SOYBEAN VARIETIES TO THE INFESTATION WITH SOYBEAN STEM FLY, *MELANAGROMYZA SOJAE* (ZEHNT.) AT KAFR EL-SHEIKH REGION

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ABSTRACT: *Field experiments were carried out at Sakha Agriculture Research Station Farm and the laboratory of Field Crop Pests Research Department, Kafr El-Sheikh region, Egypt during two successive seasons, 2009 and 2010 to study the population fluctuations of soybean stem fly, Melanagromyza sojae (Zehntner) on three soybean cultivars, the varietal tolerance of soybean cultivars to infestation and the relationship between soybean plant height and the infestation with M. sojae under field conditions.*

M. sojae generally infested three soybean cultivars (Giza 35, Giza 83 and Clark) throughout tow seasons. This insect had three peaks of mines, larvae and pupae during two seasons. Population density of M. sojae mines, larvae and pupae in 2009 season was lower than 2010 season on three soybean cultivars.

Statistical analysis showed highly significant differences among soybean cultivars to infestation with M. sojae during this study. Giza 35 cultivar was the most tolerant cultivar to the infestation with M. sojae. Positive significant correlation was recorded between soybean plant height and infestation with M. sojae.

It could be concluded that, Giza 35 cultivar was the most suitable variety, because it is tolerant to M. sojae, so this cultivar could use in breeding program for producing more tolerant varieties.

Key words: Soybean varieties, soybean stem fly, tolerance, Kafr El-Sheikh.

INTRODUCTION

Soybean, *Glycine max* (L.) occupies a premier position among legume crops, being the most important source of both protein concentrates and vegetable oils. As a legume it is capable of utilizing atmospheric nitrogen through biological nitrogen fixation and is therefore much less dependant on synthetic nitrogenous fertilizer than most crops (FAO, 1994).

In Egypt, soybean consider one of the most important legume crops as well as allover the world. It is a good source of protein and oil. Soybean plants are subjected to attack of many pests, among these insect pests, the soybean stem fly, *Melanagromyza sojae* (Zehntner) [Diptera: Agromyzidae] which is a serious pest causing 100 % infestation of soybean plants, as a result seed yield is reduced. The larvae of *M. sojae* cause extensive tunneling in the pith region of soybean stems causing seedlings to die, while growth and yield in mature plants are significantly reduced (Venkatesan and Kundu, 1994; Mesbah & El-Galaly, 1999; Mesbah *et al*, 2001; Abou-Attia & Youssef, 2007 and Shataa, 2010).

Morphological and chemicals characters of resistance to stem fly *M. sojae* in soybean was the greatest potential tool for effective and economic management of that insect which used as an alternative to chemical control (El-Borai *et al*, 1992; Venkatesn and Kundi, 1994; Mesbah and El-Galay, 1999; Salunke *et al*, 2002; and Sridhar *et al*, 2002).

Therefore, the present works aims to study population fluctuations of the this insect pest on some soybean cultivars, the tolerance of three soybean varieties to the infestation with *M. sojae* and the relationship between plant height and infestation rate.

MATERIALS AND METHODS

Field experiments were carried out at Sakha Agriculture Research Station Farm and the laboratory of Field Crop Pests Research Department, Kafr El-Sheikh region, Egypt during two successive seasons, 2009 and 2010 to study:

- The population fluctuations of *M. sojae* on three soybean cultivars.
- Investigate the varietal tolerance of three soybean cultivars for this insect pest.
- The relationship between *M. sojae* infestation and soybean plant height, number of soybean trifoliate leaves.

The tested three soybean cultivars; Giza 35, Giza 82 and Clark were obtained from Food Legumes Research Section, Sakha Agriculture Research Station and sown in the middle of May during two seasons (2009 and 2010). The experimental area (about 1/2 feddan) was divided into 12 plots (3 varieties × 4 replications) distributed in a complete randomized block design. All agricultural practices were done without insecticidal treatments during two growing seasons.

To determine the agronomic parameters of soybean varieties, study population fluctuations and varietal tolerance to *M. sojae*, samples of 20 plants (5 plants × 4 replicates) were chosen randomly per cultivar, transferred to the laboratory, measured plant height. Sampling started about one month after sowing and continued to harvest.

To examined stem miner *M. sojae*, main stem and branches of soybean plants were dissected to count and recorded mines, larvae and pupae.

Analysis of variance of insect population among varieties was conducted according to Duncan's Multiple Rang Test (1955). Correlation between stem fly, *M. sojae* populations and each of plant were calculated by using SPSS program.

RESULTS AND DISCUSSION

1. Population fluctuations of *M. sojae*:

Presented data in Tables (1 & 2) show that there were obvious differences in number of mines, larvae and pupae of soybean stem fly *M. sojae* per 20 plants of the tested soybean cultivars: Giza 35, Giza 83 and Clark during two seasons 2009 and 2010. The infestation of the considered insect was increased gradually from mid June to about mid August, then subsided again in the second and third week of August, respectively.

Table (1): Population fluctuations of soybean stem fly, *Melanagromyza sojae*, and some soybean parameters on three cultivars at Kafr El-Sheikh region during 2009 season.

Sampling date		Av. Plant height (cm)			No. of *M. sojae* /20 plants								
					Mines			Larvae			Pupae		
		Giza 35	Giza 83	Clark	Giza 35	Giza 83	Clark	Giza 35	Giza 83	Clark	Giza 35	Giza 83	Clark
June	13	33.51	35.11	32.32	10	14	18	0	0	10	10	14	10
	22	37.22	37.77	34.23	18	18	22	14	10	18	18	22	26
July	1	32.63	51.36	46.22	22	22	34	7	6	9	22	26	30
	10	48.23	66.22	66.19	18	18	22	8	11	12	10	18	26
	18	64.41	65.58	75.25	58	66	48	17	27	24	30	34	42
	26	84.55	86.12	90.00	38	34	40	10	9	10	14	18	38
August	4	87.11	91.00	97.33	50	48	78	14	17	14	34	30	74
	12	94.31	97.50	99.50	38	40	64	7	6	10	22	14	46
Total		481.97	530.66	541.04	252	260	326	77	86	107	160	176	292

Table (2): Population fluctuations of soybean stem fly, *Melanagromyza sojae*, and some soybean parameters on three varieties at Kafr El-Sheikh region during 2010 season.

Sampling date		Av. Plant height (cm)			No. of *M. sojae* /20 plants								
					Mines			Larvae			Pupae		
		Giza 35	Giza 83	Clark	Giza 35	Giza 83	Clark	Giza 35	Giza 83	Clark	Giza 35	Giza 83	Clark
June	12	41.41	47.72	48.35	13	17	15	13	17	9	13	15	13
	22	61.00	65.27	67.11	29	29	31	7	9	7	21	19	25
July	2	71.15	84.25	83.00	21	21	27	9	13	19	17	13	21
	10	87.42	84.51	95.31	45	51	49	9	7	12	37	17	45
	18	94.73	85.42	94.22	37	47	45	7	5	11	37	49	49
	27	95.45	91.20	97.21	33	61	61	3	5	13	29	41	41
August	4	96.78	98.35	96.43	77	81	69	5	10	15	61	57	61
	12	97.22	99.52	99.32	101	85	121	21	19	26	77	81	101
	19	97.4	100.00	102.00	69	53	57	13	11	14	41	49	49
Total		742.56	756.24	782.95	425	445	475	87	96	126	333	341	405

1. *M. sojae* mines:

Data in Tables (1 & 2) showed three peaks of *M. sojae* mines on soybean plants during two seasons. In season 2009, the first peak was recorded (22, 22 and 34 mines/20 plants) for Giza 35, Giza 83 and Clark cultivars, respectively on July 1st, second peak was (58, 66 and 48 mines/20 plants) respectively on July18th. Third peak was (50, 48 and 78 mines/20 plants) respectively on August 4th.

While in 2010 season, the first peak of mines on three consider cultivars was 29, 29 and 31 mines/20 plants, respectively on June 22nd. The second peak was 45, 51 and 48 mines/20 plants, respectively on July 10th. The third peak for infestation of *M. sojae* mines reached its maximum level 101, 85 and 121 mines/20 plants, respectively on August 12th.

2. *M. sojae* larvae:

The number of *M. sojae* larvae/20 plants of the tested cultivars had three peaks of larvae between about mid June and mid August. In 2009 season, no larvae were recorded on June 13th on Giza 35 and Giza 83 cultivars. The first peak of larvae was recorded with 14, 10 and 18 larvae/20 plants for Giza 35, Giza 83 and Clark, respectively on June 22nd. The second peak was the highest one 17, 27 and 24 larvae/20 plants, respectively on July18th, followed by the third peak 14, 17 and 14 larvae/20 plants, respectively on August 4th.

In 2010 season, the infestation by *M. sojae* larvae started during June with high numbers and had three peaks, the first and second peak was small (13, 17 and 9 larvae/20 plants) and (9, 13 and 19 larvae/20 plants) on June 12th and July 2nd, respectively. While the third one was the highest peak during this season (21, 19 and 26 larvae/20 plants) on Giza 35, Giza 83 and Clark, respectively on August 12th.

3. *M. sojae* pupae:

For *M. sojae* pupae (Tables 1 & 2), results were recorded three peaks during two seasons. In 2009 season, the first peak was recorded 14, 10 and 18 pupae/20 plants) for Giza 35, Giza 83 and Clark, respectively on July 1st and then the pupal population increased until record a second peak 30, 34 and 42 pupae/20 plants, respectively on July 18th. Subsequent fluctuation of pupal population showed a high third peak (34, 30 and 74 pupae/20 plants), respectively on August 4th.

In 2010 season, *M. sojae* pupal population showed the same trend as the first season. The first peak was recorded (21, 19 and 25 pupae/20 plants) respectively on June 22nd, then population increased gradually forming the second peak with 37, 49 and 49 pupae/20 plants, respectively on July 18th. While the third peak was the highest one (77, 81 and 101 pupae/20 plants) respectively on August 12th.

Generally, population density of *M. sojae* mines, larvae and pupae in 2010 season was higher in comparison with that in 2009 season on the three soybean cultivars.

The current results are in agreement with those obtained by Mesbah and El-Galaly (1999). They showed that infestation rate of soybean stem fly, *M. sojae* on soybean plants increased with increasing in plant age. Also, they indicated that *M. sojae* had three overlapping broods of larvae and pupae between mid-June and late September.

Berg *et al* (1995) and Abou-Attia & Youssef (2007) indicated that *M. sojae* generally infested soybean throughout the season, infestation was initially low, reached its peak in the 5th-8th weeks after planting and declined towards the end of the season.

2. Comparing the varietal tolerance between some soybean cultivars to the infestation with soybean stem fly, *M. sojae*:

Results in Fig. (1) show the mean numbers of *M. sojae* mines, larvae and pupae counted allover the growing season on the tested varieties of soybean; Giza 35, Giza 83 and Clark during 2009 and 2010. Statistical analysis showed highly significant differences between soybean varieties to infestation with *M. sojae* during study seasons.

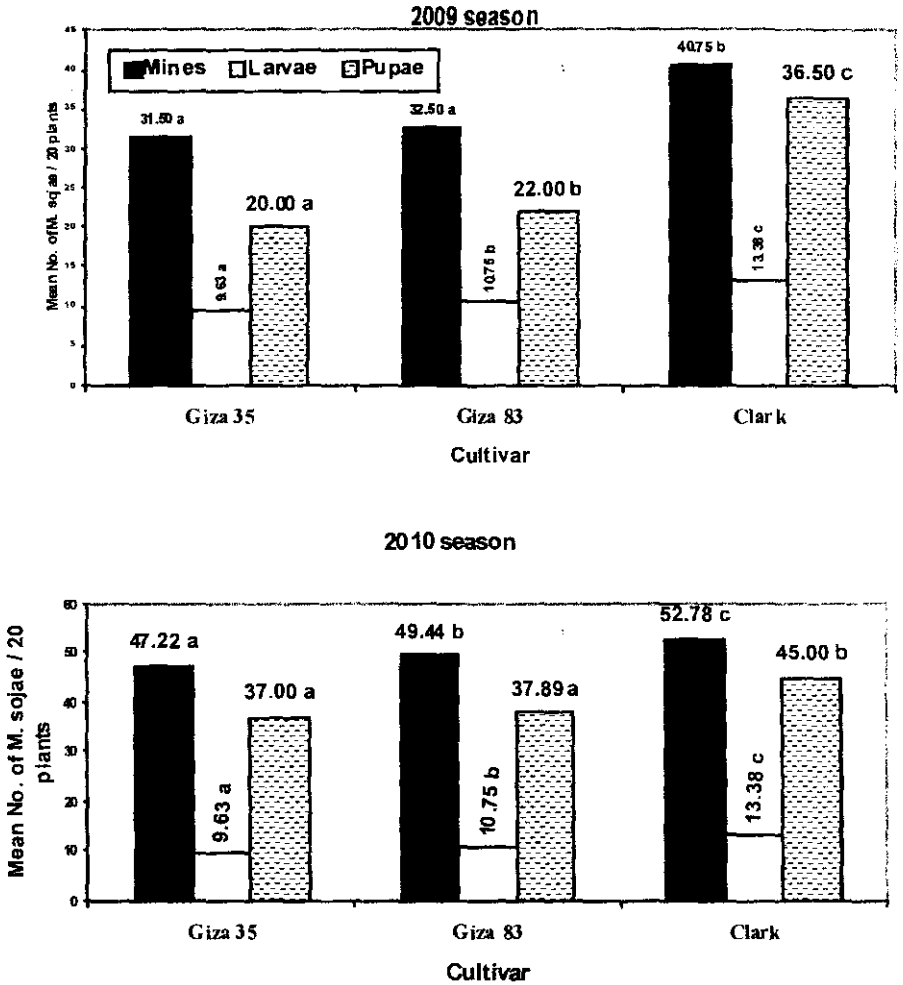

Fig. (1): The tolerance of three soybean varieties to infestation with soybean stem fly, *Melanagromyza sojae* at Kafr El-Sheikh region during 2009 and 2010 seasons.

For *M. sojae* mines, Giza 35 cultivar was the most tolerance cultivar to the infestation with *M. sojae* mines during two seasons, so harboring the lowest mean numbers of mines (31.50 and 47.22 mines/20 plants respectively). While Clark cultivar was the most susceptible cultivar, its harboring the highest mean numbers of mines (40.75 and 52.78 mines/20 plants respectively). Insignificant differences were recorded between Giza 35 and Giza 83 in the first season for *M. sojae* mines.

M. sojae **larvae, were showed highly significant differences among three soybean varieties during two seasons. Giza 35 was more tolerant to *M. sojae* larvae (9.63 and 9.67 larvae/20 plants, respectively). While Clark cultivar was susceptible to infestation, so harboring the highest mean numbers of larvae (13.38 and 14.00 larvae/20 plants respectively). Giza 83 was moderate to infestation.**

In the first season, highly significant differences were found among three soybean varieties for *M. sojae* pupae, while highly significant between Clark cultivar and both Giza 35 and Giza 83 varieties in the second season. Giza 35 harboring the lowest mean numbers of pupae in the two seasons (20 and 37 pupae/20 plants respect), while Clark cultivar was high susceptible cultivar harboring the highest mean numbers of pupae (36.50 and 45.00 pupae/20 plants respectively). Giza 83 cultivar came in between.

Data are in agreement with those obtained by Mesbah and El-Galaly (1999) they showed that, Giza 35, Crawford and $H_{15}L_{17}$ were the most resistant genotypes for *M. sojae* and could be used as sources of resistance to that insect and in crossing programs for improving the commercial soybean cultivars. Also, these results are in agreement with Abou-Attia and Youssef (2007) they reported Clark was susceptible cultivar have highest number of *M. sojae* pupae compared with Giza 35, while Giza 85 located in moderate tolerance to *M. sojae* infestation.

Gai *et al.* (1992) showed that soybean genotypes differed in number of *M. sojae* eggs per leaf, apparently because of chemical antixenosis. They found that number of larvae in the stem, in the petiole and in the whole plant also differed significantly between genotypes but apparently represented an independent mechanism antibiosis.

3. The relationship between soybean plant height on *M. sojae* infestation rate:

Results in Table (3) showed that correlation coefficient between mean soybean plant height of three varieties (Giza 35, Giza 83 and Clark) and infestation with *M. sojae* (mines, larvae and pupae) were usually positive during 2009 and 2010 seasons, but highly significant correlation was recorded between plant height and numbers of *M. sojae* mines on Clark cultivar (r = 0.799), while significant on Giza 35 (r = 0.761*) in the first season. In the second season, significant correlation was recorded between plant height and *M. sojae* mines on three soybean varieties (r= 0.695*, 0.789* and 0.701* respectively).**

Table (3): Correlation coefficient between soybean plant height & number of plant trifoliate and *M. sojae* infestation during 2009 and 2010 seasons.

cultivar	Correlation coefficient value (r)					
	Mean No. of *M. sojae* / 20 plants					
	2009			2010		
	Mines	Larvae	Pupae	Mines	Larvae	Pupae
Giza 35	0.761*	0.292	0.472	0.695*	- 0.061	0.746*
Giza 83	0.601	0.253	0.046	0.789*	- 0.202	0.698*
Clark	0.799**	- 0.031	0.792*	0.701*	0.522	0.745*

According to *M. sojae* larvae, negative correlation was found between plant height and numbers of larvae on Clark (r = -0.031) in the first season, while in the second season on Giza 35 and Giza 83 (r = -0.061 and -0.202, respectively).

Significant and positive correlation were recorded between plant height and *M. sojae* pupae on Clark cultivar in 2009 season (r = 0.792*), while on the considered three soybean varieties the (r) values were 0.746*, 0.698* and 0.745*, respectively in 2010 season.

The current results are in agreement with those obtained by Mesbah and El-Galaly (1999). They showed that Giza 35 was the shortest genotype with little difference from $H_{15}L_{17}$, while H_2L_{20} and Giza 21 were significantly higher than the other soybean genotypes. In the same time, they reported that Giza 35, Crawford and $H_{15}L_{17}$ were most resistance to infestation with *M. sojae*, while both of H_2L_{20} and Giza 21 were most susceptible to infestation with *M. sojae*. Berg *et al.*, (1998) showed early attack by *M. sojae* to soybean plants adversely affects plant development and associated with decreases in stem diameter, plant height and seed number/plant. Exit holes above the hypocotyl are indicative of attack later in the season and were associated with an increase in plant parameters. Late attack occurred in response to plant size or vigour. The obtained data showed similar trend with data recorded by Abou-Attia and Youssef (2007) which they showed the correlation between soybean plant height and the infestation with *M. sojae* were positive and significant.

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التحمل الصنفي لثلاثة أصناف من فول الصويا للإصابة بذبابة ساق فول الصويا

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الملخص العربي

أجريت الدراسة الحقلية فى المزرعة البحثية بمحطة البحوث الزراعية بسخا – كفر الشيخ خلال موسمين متتاليين ٢٠٠٩ ، ٢٠١٠ لدراسة الوفرة الموسمية لحشرة ذبابة ساق فول الصويا على ثلاثة أصناف لفول الصويا (جيزة ٣٥ ، جيزة ٨٣ ، كلارك). وكذا التحمل النسبى لهذه الأصناف للإصابة بالحشرة، كما تم دراسة العلاقة بين كل من طول النبات وعدد الأوراق المركبة الثلاثية لكل نبات ودرجة الإصابة تحت ظروف الحقل.

وأظهرت النتائج ما يلى:–

تصيب هذه الحشرة الثلاثة أصناف محل الدراسة (جيزة ٣٥ ، جيزة ٨٣ ، كلارك) على مدار الموسمين، حيث بدأت الإصابة من منتصف شهر يوليو منخفضة ثم ازدادت تدريجياً مكونة ثلاثة ذروات للتعداد خلال الموسمين، ففى الموسم الأول كانت فى الأسبوع الرابع من شهرى يوليو وأغسطس، والأسبوع الأول من سبتمبر، أما فى الموسم الثانى فكانت مثل الأول ما عدا الذروة الثالثة كانت فى الثانى من سبتمبر. ثم تناقصت أعداد الحشرة خلال الأسبوع الثانى أو الثالث من سبتمبر فى الموسمين. وقد تم ملاحظة ثلاث ذروات لتعداد الحشرة من الأنفاق – اليرقات – العذارى، حيث كانت الذروة الأولى والثانية منخفضة، ثم جاءت الذروة الثالثة عالية التعداد فى كلا الموسمين. كما أوضحت النتائج أن تعداد الحشرة من أنفاق – يرقات – عذارى فى موسم ٢٠١٠م كان أعلى من موسم ٢٠٠٩م على أصناف فول الصويا الثلاثة.

أظهر التحليل الإحصائى وجود فروق عالية المعنوية بين أصناف فول الصويا الثلاثة للإصابة بحشرة ذبابة ساق فول الصويا ***M. sojae*** خلال موسمى الدراسة ٢٠٠٩، ٢٠١٠، حيث كان الصنف جيزة ٣٥ أكثر الأصناف تحملاً للإصابة بالحشرة وأستقبل اقل نسبة إصابة من الحشرة (٣١.٥٠ نفق ، ٩.٦٣ يرقة ، ٢٠.٠٠ عذراء/٢٠ نبات) فى الموسم الأول، (٤٧.٢٢ نفق ، ٩.٦٣ يرقة ، ٣٧.٠٠ عذراء/٢٠ نبات) فى الموسم الثانى، بينما كان الصنف كلارك أعلى الأصناف إصابة وأستقبل أعلى تعداد للحشرة (٤٠.٧٥ نفق ، ١٣.٣٨ يرقة ، ٣٦.٥٠ عذراء/٢٠ نبات) فى الموسم الأول، أما فى الموسم الثانى (٥٢.٧٨ نفق ، ١٣.٣٨ يرقة ، ٤٥.٠٠ عذراء/٢٠ نبات)، أما الصنف جيزة ٨٣ فكان متوسط الإصابة بين الصنفين السابقين.

لقد وجد ارتباط موجب معنوى بين طول نبات فول الصويا ونسبة الإصابة بذبابة الساق (أنفاق – عذارى)، حيث وجد ازدياد الإصابة بتقدم النبات فى العمر وزيادة طول النبات على مدار الموسمين، وكانت الإصابة مرتفعة فى صنف كلارك نظراً لطوله عن باقى الأصناف، فى حين أن الصنف جيزة ٣٥ كان أقل إصابة بالحشرة حيث أن تميز بقصر طوله عن بقية الأصناف.

ومما سبق نستنتج أن الصنف جيزة ٣٥ من الأصناف المتحملة للإصابة بذبابة الساق مقارنة بالصنفين السابقين محل الدراسة ولذا ينصح بزراعته فى المناطق المحتمل إصابتها بهذه الحشرة.