MONITORING POPULATION DYNAMICS OF GREEN STINK BUG, *NEZARA VIRIDULA* (L.)(HEMIPTERA: PENTATOMIDAE) AT THE AGROECOSYSTEM IN EL-BEHEIRA GOVERNORATE

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ABSTRACT

Survey studies of the southerngreen stink bug (SGSB), *Nezara viridula* L. (Hemiptera: Pentatomidae) population were conducted for two seasons 2003/2004 and 2004/2005, at El-Beheira Governorate, on different crops planted only for one season, *i.e.* bean, water melon, sweet potato, green gram, paprika, potato, okra, sesame and lama, as well as other crops planted in both two seasons *i.e.* squash, tomato, cotton, maize, sugar beet and peas.

The present results indicated that arrangement all of the tested crops according to the number of harbored insects was as follow, okra (511 insects), sugar beet (224 insects), and maize (132 insects). Results showed that the population began to appear or increased when the flowers began to appear.

Seasonal Abundance of *N. viridula* was recorded to establish the number ofadult generations a year. The first peak of *N. viridula* was observed at June 2003, by 60 insects on summer crops, *i. e.* squash, bean, tomato, water melon, sweet potato, cowpea, cotton and maize. A distinct peak was recorded on green gram (31 adults) followed by bean (17 adults). The second peak occurred in August (42 insects), with the highest numbers of adults on cowpea (16 adults) and sweet potato (10 adults). The third peak appeared in November and December (53 and 68 insects, respectively) with the highest numbers on maize (40 adults) and sweet potato (26 adults).

In season 2004-2005, 11 successive and overlapping field crops were investigated, *i.e.*, squash, paprika, tomato, summer plantation of sugar beet, okra, sesame, cotton, maize, peas, potato and winter plantation of sugar beet. Such peaks were occurred at May (284 adults), June (254 adults) and November (107adults), which may represent three generations of that pest. The number of nymphs was very low in August (35 nymphs).

Proc. 2nd Inter. Conf. Ent. Soc. Egypt, Vol. I, 2007 (135-146)

The sex ratio among adult population of *N. viridula* was about 1:1.18. Also; mating activity of *N. viridula* was recorded in the field during the winter season, assuring that SGSB individuals do not enter adult diapauses in Egypt.

INTRODUCTION

Many insect species are expanding their distribution ranges northward following the current climate warming (Parmesan and Yohe, 2003; Roote *et al.*, 2003). Stink bugs now are present demonstrating higher and more damaging levels in cotton, have become major pests in a relatively short time, and accordingly seem to be expanding their population. Bugs can cause significant yield losses and reduce cotton lint quality (Greene and Herzog, 2001: and Emfinger *et al.*, 2004). The southern green stink bug (SGSB), *N. viridula* L. (Hemiptera: Pentatomidae) is a multivoltine seed-sucking species that occurs throughout tropical, sub tropical, and southern temperate regions of the world (Todd, 1989: and Panizzi *et al.*, 2000). SGSB, *N. viridula,* is an important pest. Such importance comes from its geographical distribution at a wide area in most of continents (Draz, 1981). SGSB, *N. viridula,* population density tended to be high recently in Egypt causing considerable damage to several field and horticultural crops (Abd El-Baky, 1989).

It feeds on a lot of vegetables, fruits, and field crops. That pest had to be honored by many of different studies. The pest has three sub species (Singh and Rawat, 1982) and has two or three generations a year commensurate with temperature (Draz, 1981). Many natural enemies of that pest were recorded at many countries of the world, but in Egypt only one parasitoid was recorded which was the egg parasitoid *Trissolcus basalis* (Wellston) (Hymenoptera: Sceloneidae) (Kamal, 1937, El-Husseini *et al.* 2006).

The aims of the present studies are survey of population dynamics of *N. viridula* L. on summer and winter crops in two years, season 2003/2004 and season 2004/2005 at area of EL-Mahmodia, EL-Behcaira Governorate, as well as determining the number of generations of that pest a year3- Showing if the adult of the bug enter diapause or not.

MATERIAL AND METHODS

1. Seasonal Population Fluctuations of *Nezara viridula* Inhabiting Different Crops

Many of summer and winter field crops and vegetables were examined to estimate the population dynamics and spatial distribution of *N. viridula,* during the two successive seasons 2003/2004 and 2004/2005 at El-Beheira Governorate.

During 2003/2004 seasons, the crops presented in the area were squash, during the growing season from March 3rd to June 6th; beans (April 22nd to July 17th 2003); tomato (April 10th to July 6th); watermelon (May 30th to August 18th); sweet potato (June 12th to September 3rd); cowpea (May 23th to September 12th); cotton (May 15th to October 26th); maize (June 28th to September 19th); maize (September 10th to December 9th); sugar beet (October 13th to May 14th , 2004); peas (November 1st to March 3rd, 2004); and lama (December 27th to April 25th , 2004).

However, in season 2004/2005 crops presented were, squash, growing period Mar. 15th to Jun. 28th; paprika, growing period Mar. 29th to Jul. 10th; tomato, growing period Mar. 25th to Jul. 12th; sugar beet, growing period Feb. 13th to Jul. 16th; okra, growing period Apr. 17th to Oct. 17th; sesame, growing period Jun. 11th to Aug. 29th; cotton, growing period May 15th to Nov. 7th; maize, growing period Aug. 19th to Dec. 17th; peas, growing period Oct. 15th to Feb. 15th , 2005; potato, growing period Nov. 25th to Mar. 17th , 2005; and sugar beet, growing period Dec. 1st to Jun. 20th ,2005.

N. viridula stages were counted at weekly intervals at the late afternoon according to Draz (1981) on fifty plants / crop / week. Countation was random from the cardinal directions of a fixed area ranged between 0.25 to one feddan for each hosts plant. The number of nymphs, adults and eggs were recorded throughout the whole growing period of the host plants in the field.

2. Dormancy and Sex Ratio

To investigate if the green bug *N. viridula* enters a diapause or not, the male and female adults were counted for long time in autumn and winter field crops from November 25th to April 27th, *i.e.* maize, sugar beet, elephant grass and lama. The no regular and fluctuated observations about the activity (feeding and mating) of the adult bugs were recorded.

RESULTS AND DISCUSSION

1. Population survey of *N. viridula* adults during 2003/2004 and 2004/2005 seasons on different crops

The survey study was started at April 2003 and continued for two successive years in the selected area depending on the crops grown by the farmers according to their own needs from one side and the regulation of crop rotation in each field. On the other side, the targeted crops were those grown in sequence during the period of 24 months. Some crops were cultivated in the chosen area in the two seasons 2003 and 2004. *(i. e.* squash tomato, cotton, maize, sugar beet and

peas). Other crops were grown only once during this period (*i. e.* paprika, watermelon, sweet potato, cowpea, lama, okra, sesame and potato). Presentation of *N. viridula* population survey results during this period followed its occurrence on the present crops in the area around the two years of study as follows:

1.1. Seasonal investigation of *N. viridula* during 2003/ 2004

In season 2003-2004, the survey of *N. viridula* was started in April 2003 to end of March 2004. Eleven overlapping crops occupied the area of study along this season from April–March comprising the following crops: squash, bean, tomato, water melon, sweet potato, green gram, cotton two maize plantations (summer and autumn), sugar beet, peas and lama. The Monthly numbers of nymphs and adults on each crop are presented in Table (1) and Figure (1)

The first peak of *N. viridula* was observed at June 2003, (Fig. 1) by 60 individuals on summer crops, *i. e.* squash, bean, tomato, water melon, sweet potato, green gram, cotton and maize. The highest population was recorded on green gram (31 adults) followed by bean (17 adults) as shown in Table (1) adults). The second peak was detected in August (42 adults), with distinct population on green gram (16 adults) and sweet potato (10 adults). The 3rd peak appeared in November and December (53 and 68 adults, respectively) with the highest numbers on maize (40 and 33 adults, respectively) and sugar beet (33 adults).

Among the nymphs of *N. viridula*, the first peak appeared in August 2003 (98 nymphs). The second peak of nymphs appeared in November with low number (33 nymphs). The decreasing number of nymphs occurred due to two reasons. The first reason was the use of pesticides (7 treatments in June and July) which affected the number of adults in August and September at the area of survey, and secondly due to parasitism in eggs by the scelionid egg parasitoid *T. basalis* as will be explained later. Thus, population dynamics showed two peaks representing two generations in season 2003/2004.

It is observed from the present results that maize is the most favorable host plant for *N. viridula*, where a total of 93 adults were counted, followed by Green gram (78 adults) and Sugar beet (68 adults)

1.2. Seasonal investigation of *N. viridula* during 2004/2005

In season 2004-2005, 10 successive and overlapping field crops were investigated, *i.e.*, squash, paprika, tomato, sugar beet as summer plantation, okra, sesame, cotton, maize, peas, potato and sugar beet (winter plantation) were shown in Table (2).

TABLE (I)

Population figures of *N. viridula* in season 2003-2004 associated with present field crops at El-Mahmoudia region, El-Beheira Governorate.

Crop	Month													
	April	May	June	July	August	September	October	November	December	January	February	March	Total adults	Total nymphs
Squash	1	0	1										2	0
Bean		2	17*	4 (1)									23	1
Tomato		0 (1)	5	0									5	1
Water melon			8	1*	5								14	
Sweet potato			0	13*	10 (35)	0							23	35
Green gram			25*	31*	16 (23)	6 (1)							78	24
Cotton			4	5*	7 (30)	14 (4)	11						41	34
Maize(1)				2*	4	3							9	
Maize(2)							20 (18)	40 (30)	33 (2)				93	50
Sugar beet							0	10 (1)	26 (5)	2*	7	23	68	6
Peas								3 (2)	9	1	6		19	2
Lama											3	6	9	
Total adults	1	2	60	56	42	23	31	53	68	3	16	29	387	
Total nymphs		1		1	98	5	18	33	7					153

*Treatment with pesticide. ( ): Number of nymph

TABLE (II)

Population figures of *N. viridula* in season 2004-2005 associated with present field crops at El-Mahmoudia region, El-Beheira Governorate.

Crop	Month												Total adults	Total nymphs
	April	May	June	July	August	September	October	November	December	January	February	March		
Squash	0*	21	27 (3)										48	3
Paprika	0	14	14*	90									118	
Tomato	0*	36 (12)	23*	8									67	12
Sugar beet (SP)	4 (21)	140 (98)	78 (15)	2									224	134
Okra		73 (5)	88	156 (11)	163 (11)	24 (13)	7						511	40
Sesame			12	29 (3)	62 (19)								103	22
Cotton			12*	22* (2)	39 (5)	14*	8	0					95	7
Maize					0*	20*	39 (1)	63 (11)	10				132	12
Peas								44	13*	4	0		61	
potato									4	7*	3	0	14	
Sugar beet (WP)									4	7	4	7	30	
Total adults	4	284	254	307	264	58	54	107	31	18	7	7	1403	
Total nymphs	21	115	18	16	35	13	1	11						230

* Treatment with pesticide. ( ): Number of nymphs.

Data represented in Table (2) proved that okra is the most favorable host plant for *N. viridula*, where a total of 511 adults were counted, followed by the summer plantation of sugar beet (224 adults), and maize (132 adults).

Although the surveyed field crops in the area of study had received 11 insecticide applications, 2 in April on squash and tomato, 3 in June on paprika tomato and cotton, 1 in July on cotton, 1 in August on maize, 2 in September on cotton and maize, 1 in December on peas, and 1 in January on potato, the total numbers of *N. viridula* adult in the area remained high from May to August by total numbers of 284, 254, 307 and 264 adults, respectively. This observation could be explained by the suppression of the egg parasitoid *T. basalis* population by insecticide application during the egg-laying period of *N. viridula* in June. Thus, the few escaped egg masses from the pesticide treatments gave their progeny. However, parasitism rates among eggs of *N. viridula* were studied by many authors (Viggiahi and Mazzone, 1976; Hoffman *et al.*, 1991; Colazza and Bin, 1995; Awadallah, 1996; Coombs, 2000; Ehler, 2002; Peres and Correa, 2004; and Draz *et al.*, 2006).

Present results indicated that there were three distinctive peaks of *N. viridula* adults. Such peaks occurred at May (284 adults), June (254 adults) and November (107adults) which may represent three generations of that pest. Nymphs were observed during the period from April till November; thereafter, only adults were present from November till June of the next year. Adults remain active feeders during winter and have been seen also copulating in January and February (the most cold winter period). Thus, as previously mentioned for population dynamics of *N. viridula* in the previous season (2003-2004), the SGSB does not enter adult diapause in Egypt due to the relatively mild environmental conditions, specially the temperature, in winter.

Concerning the nymphal population, the first peek in May (115 nymphs) shortly prior to the adult peak of May. The next peak was very low in August (35 nymphs), because egg masses previously laid by adults of the previous generation during June and July were mostly parasitized by *T. basalis* causing a high suppression of nymphal population, as it will be explained later. However, activity of *Trissolcus basalis* Wollaston as a monophagous specialized scelionid egg parasitoid plays a major role in suppressing population of *N. viridula* during this period (Kamal, 1937; Turner, 1983; Jones, 1988; Orr, 1988; Colazza and Bin, 1995; and Odermatt, 2000).

Results in Tables (1) and (2) and Figure (1) indicated that *N. viridula* have 3 generation/year. The first generation started with eggs laid from the winter adults at April and produced progeny that peaked to adults in May or June. The egg masses

laid by those adults gave progeny that peaked at July or August. Adults of the 2nd generation their laid eggs in August that produced adults of the 3rd generation in November. Accordingly, *N. viridula* has 3 generations/year in Egypt.

The present results agree with those of Van Heerden (1933) and Kamal (1937) who stated that *N. viridula* may have three overlapping generations or two complete generations/ year with a partial third one. In Egypt, Draz (1981) reported that SGSB have 3 distinct peaks (generations) appeared in May, July and September. This deviation in timing of the peak for the 2nd and 3rd generations may be attributed to prevailing weathering conditions in summer and winter of each season. Also, Liljesthrom (1999) found three discrete generations of *N. viridula*/year along an activity period of approximately 28 weeks.

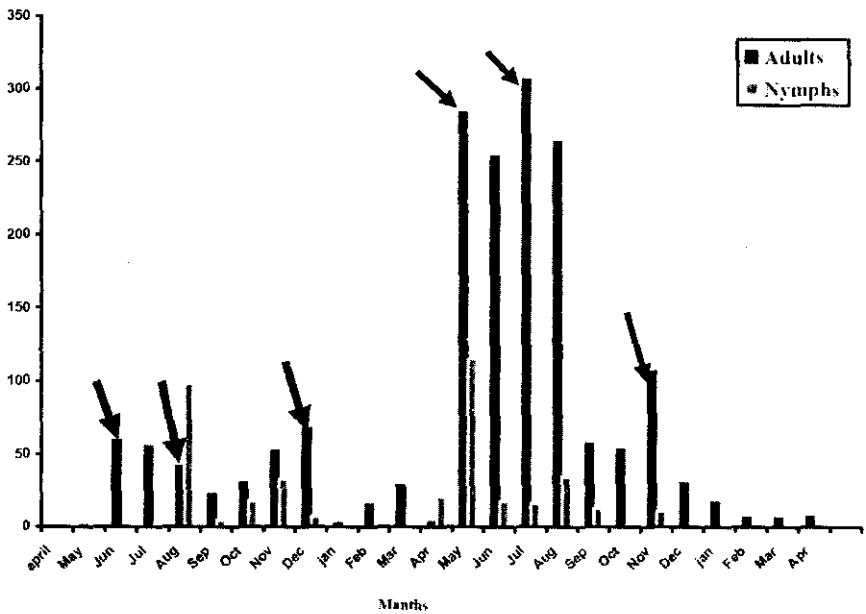

Fig. (1): Population figures of *N. viridula* in season 2003-2004 and 2004-2005 associated with present field crops at El-Mahmoudia, El Beheira Governorate.

2. Dormancy and Sex ratio

Table (3) represents numbers of males and females of *N. viridula* collected from four field crops, *i. e.* maize, sugar beet, elephant grass and lama. A total of 186 males and 220 females were collected. Thus, the sex ratio among adult population of *N. viridula* is nearly 1:1.18. Also, mating activity of *N. viridula* was recorded in the

field during the winter season from November, 2003 till February 2004 (Table 3). assuring that SGSB may not enter an adult diapause in Egypt. However, such observation needs more investigation. Musolin and Numala (2004) demonstrated that if egg masses of *N. viridula* are produced in mid-September and nymphs attain adulthood in November, the adults do not start reproduction in autumn and are likely to successfully overwinter and survive until the next reproductive season.

TABLE (II)

Numbers of males and females of *N. viridula* collected from different crops from November, 2003 to April, 2004.

Data	Crop	No. of males	No. of females	Remarks
Nov. 25th,03	Maize	14	13	
30th		19	22	mating
Dec. 10th		33	31	
12		9	11	
27		16	18	
Dec. 3rd,03	Sugar beet	8	8	
4		4	5	
6		6	7	Mating
15		2	3	
17		6	5	mating
Mar.13th,04		3	4	
16		0	2	
23		1	3	
Apr.3rd,03		3	8	
Dec. 23h,03	Elephant grass	2	3	
Jan. 13th,04		1	1	Mating
Feb. 9th	Lama	14	18	
27		16	18	mating
Apr. 25th		3	4	
27		26	36	
Total Sex ratio		186	220	1:1.18

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