

## Preferred direction site of the sugar-cane field to infestation by *Pulvinaria tenuivalvata* (Newstead) and its relation with parasitized *Coccophagus scutellaris* Hymenoptera Aphelinidae

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### ABSTRACT

This research aims to evaluate the effects of biotic factors on the population density of the sugar cane soft scale *P. tenuivalvata*. Population estimation was performed in different sites of the sugar cane field, i.e, east, north, south, west and field center. Results show that, scales proportionally increased from May to December in all field sites and the scales were intensively through September, October and November. Plants located in the west site intensively harbored the highest population of scales, followed by north site. The number of scales on plant in west and south sites was approximately similar. The field center harbored the lowest scale population. These results reveal that the west direction followed by north are preferred by this insect in its various stages. This could be attributed to the direction of the wind which always blows from north to west carrying crawlers to these directions where it may aggregate for feeding and growth. During the two successive seasons of the study, data also revealed the incidence of the Aphelinidae parasite *Coccophagus scutellaris* (Aphelinidae: Hymenoptera) parasitizing the different immature stages (except 1<sup>st</sup> instar) and mature stage (adult females). The influence of such parasite on the insect was significant in both seasons. In conclusion, there are many biotic factors that can affect the population density of the sugar cane soft scale *P. tenuivalvata*. This can assist to avoid the difficult application of the insecticide and minimize the population of the environment. natural enemies (parasites).

**Keywords:** Direction Site; Sugar-cane; *P. tenuivalvata*; *C. scutellaris*; Hymenoptera; Aphelinidae.

### INTRODUCTION

The wide distribution of *Pulvinaria tenuivalvata* (Newstead) was observed for the first time by Ali *et al* (1997). in sugar cane fields at Atfeh locality, Giza Governorate, El-minia, Sohage, Quena, Luxor and Aswan. This reflects the seventy dangerous and bad situations of this pest on sugar-cane in Upper Egypt.

Sugar cane is cultivated in large contiguous areas and remains in the field for the whole year. Therefore, a wide range of insect species cause the most significant losses. Some of the insects are major pests of regular occurrence and cause survivor damage, others are minor species. Among these insect pests are soft scale insects Maareg *et al* (1992).

In 1995, 1996 season, the first noticed in sugar cane fields in Giza separated widely and quickly to cover of about 18 thousand feddaen in all sugarcane plantation in (2015-2016) season Besheit (2002). The nymph and adult females were found clustering on both leaf surface. They are arranged as a line near the edge of the leaf blade Mau (1992)

*P. tenuivalvata* causes severe damage due to the sucking leaf juice, leading to a loss of

leaves, tender young stems, stored plants growth and even death of the plant (Valand *et al.* 1989). The chemical control in sugar cane fields is very difficult due to foliage intensity and crowded plants. At the same time, many parasitoids are already found, amongst these parasitoids, *Coccophagus scutellaris* (Dolman) are the major attackers and represent a big portion of *P. tenuivalvata* population (Hindawy *et al.*, 2002).

Shalaby (2002) found that, this parasitism ranged between 60.1 in August to 33.1 in December, 1997, but in sugar cane season of 1998, the parasitism activity was higher and ranged between 66.7 – 72.2.

This research aims to evaluate the effects of biotic factors on the population density of the sugar cane soft scale *P. tenuivalvata*. This can assist to avoid the difficult application of the insecticide and minimize the population of the environment. natural enemies (parasites).

### MATERIAL AND METHODS

#### Spread pattern of insect all over the sugar cane field

One Fadden was selected for this study at Awadlah, Edfo, belonging to Aswan Governorate. During the period extending

from May to January, regular intervals sample of sugar cane plant leaves were collected from the field border 1,2,3,4 and 5 m. towards the field center. Sample were taken from the different directions of the sugar-cane field representing east, west, north and south directions, in addition to the center site of the field. For each direction, 20 plants were selected randomly and 3 leaves from each plant (lower, mid, and upper levels) were cut – off, kept in muslin bags and transferred to the laboratory. Regular inspection of *P. tenuivalvata* scales infesting sugarcane plants in (Edfo-Aswan) Governorate during (2015 and 2016) seasons revealed the incidence of the Aphelinidae parasite *Coccophagus scutellaris*. Data on the parasite activity was based on 2 weekly counts of parasitized scales. The wide distribution of *P. tenuivalvata* (Newstead) was observed for the first time by Ali *et al.*<sup>1</sup> in sugar cane fields at Atfeh locality, Giza Governorate, El-minia, Sohage, Quena, Luxor and Aswan. These results reflect the dangerous and bad effect of this pest on sugar-cane in Upper Egypt.

## RESULTS AND DISCUSSION

Data in Table (1 and 2) summarizes the changes in the population density of *P. tenuivalvata* expressed as monthly numbers of insect

As it appears from Table (1) result for 2015 indicate the presence of this insect during the main period of activity which extended from the first week of May to end of December.

Results also showed that *P. tenuivalvata* appeared for the first time, in a few numbers during the first week of May (79 insects), in all directions and increased gradually, afterwards. The insect reached the highest peak during the first period of September (445 insects). The population density of *P. tenuivalvata* decreased until the last period of December (117 insects).

The same trend was detected during the second year (2016) as showed in Table (2). The population of the insect increased gradually starting from June (99 Insects) and reached the maximum number at end of October (331 insects). After that, it decreased to reach (64 insects) on December. Tables (1 and 2) and Figs (1 and 2) summarizes the changes in the population density of *P. tenuivalvata* and parasites distribution in the different directions of sugarcane field in Awadlah village (Edfo, Aswan) in 2015 and 2016 seasons.

As it appears from Tables (3 and 4) and Figs (1 and 2) a significant positive relationship holds between the numbers of insects and parasites in both years such relationship seemed to be stronger in 2015 than 2016.

Numbers of scale insect, *Coccophagus scutellaris* and the parasite *Coccophagus Scutellaris* were estimated from May to December in sugar cane field during 2015 and 2016 seasons.

Data in Table (1) showed, the numbers of *P. tenuivalvata* and *Coccophagus scutellaris* distribution in different direction of sugar cane field in Awadlah, Edfo Aswan Governorate during 2015 season.

Results on parasitism in 2015 season in sugar cane field indicated that, the its activity increased of July by increasing the numbers of *Pulvinaria tenuivalvata* especially at the West direction then decreased at the end of December the data in Table (1) also showed that's the parasite activity increased in September at the West and North directions compared with other directions during 2015 season.

The highest total number of parasites appeared in west direction (359) during the whole season of 2015. The lowest total number of parasites appeared in South direction (87) during the whole season of 2015.

Parasitoid activity fluvttuted during the activity period of *P. tenuivalvata* (June-December).

The data recorded high abundance in September in West direction (64 parasite with 168 insect pest).

Data in Table (2) clarified, the relationship between *P. tenuivalvata* and *Coccophagus Scutellaris* as a parasite in Awadlah, Edfo, Aswan Governorate during season 2016.

The highest population of *Pulvinaria tenuivalvata* and their parasite was recorded at the West direction then North direction.

The lowest population of *P. tenuivalvata* and their parasite was recorded at the East and south directions during season 2016.

The data indicated that the numbers of parasite were gradually increased in all directions by increasing their host *P. tenuivalvata* from at the first of June till the first of December. Hot months (July, August, September and October) had considerable high population of *P. tenuivalvata* scales, consequently, the number of parasites

increased a close relationship between the parasite activity and the population density of insect pests especially at the west and north directions 2015 and 2016 seasons.

The highest total number of insect pests was recorded at the North and West directions (371 and 676 insect), while the highest number of parasites was recorded at the West and North directions (369 and 219 insect) during 2016 season. (Table 2).

The highest number of insect pest recorded at the West and North direction (766 and 437 insect), while the highest number of parasites recorded at the west and north direction (359 and 197 insect) during 2015 season (Table 1).

In 2015 sugar cane season, the parasitoid activity was higher than 2016 season, the parasitoid activated one week earlier than 2015. Number of parasitized increased steadily in the following months particular during July, August and September. The numbers scales were estimated from May to December of cane season 2015 and 2016. It was estimated in different sites of cane- fields, i.e. East, North, south west, and Center.

Results presented in Table (1) and (2) showed that this pest increased from May to December in all field sites, while scales numbers were intensively through August, September and October (322,445, and 359n respectively). The same trend was exhibited in 2016, reached to 231,309, and 331 respectively in the same months.

Hot months with high relative humidity (July, August and September) had considerable high population of *P. tenuivalvata* scales, consequently, the number of parasitized scales increased the relationship between the parasite activity and the population density of insect pests.

The Aphelinidae parasites particularly these of *Coccophagus* spp. play a great role in management of soft scale insect population. *Coccophagus lymania* is an internal parasite of the immature stage of *Parthenalecanium quercifex*, Fex attacking willow Oak in Virginia (USA) and parasitism rate averaged 10-60 %. Concerning *P. tenuivalvata* scale insects, Blumberg *et al.* (1984). In Egypt two species *Coccophagus bioittatus* and *Coccophagus lycinnia* were recorded by Abd- Rabou *et al.* (1998) on *Coccus hesperidus* and known as internal parasites of different insect scale species. No other species rather than *C. scutellaris* could be detected as parasite of *P. tenuivalvata* in sugar cane plantation.

Mahmoud (1981) showed that Nymphal stage tended to be concentrated in northern-west of sugar- cane field. The plants locating in this site may heavily suffer from being infested by this pest.

In the meantime, *P. tenuivalvata* is distributed in different sites of cane field. It was found that plants located in west site were intensively infested and recorded the highest population of scales (95.8 mean scales/leaf) followed by north site (54.4 mean scales/leaf). Other fields sites showed lower infestation plants locating in field center received the lowest scales population (21.1 mean scales/leaf). East and south received approximately similar population number (Table 1). In 2016 season, insect heavily existed sugar cane plants locating in west and north sites (676 and 371 scales/leaf. Moderately infestation was found in east and center (154 and 131 scale /leaf). The lowest population was recorded in south (105 scale/leaf) (Table 1) and 2). Sugar-cane plants infested with *P. tenuivalvata* showed considerable variation in the insect distribution, not only on plant leaves, but also in different field sites.

## CONCLUSION

The herein investigation indicated that, there are many biotic factors that can affect the population density of the sugar cane soft scale *P. tenuivalvata*. This can assist to avoid the difficult application of the insecticide and minimize the population of the environment. natural enemies (parasites).

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**Table 1.** Monthly counts *P. tenuivalvata* distributed in different direction of a sugar-cane fields, in (Edfo- Aswan Governorate (2015) season.

Sampling date	Total number of scales/sugar-cane leaf -Direction of sugar- cane field.					Total	Mean
	East	West	South	North	Center		
May	15	33	8	19	4	79	15.8
June	16	46	12	31	7	112	22.4
July	22	93	24	53	22	214	42.8
August	39	137	47	73	26	322	64.4
September	67	168	66	104	40	445	89
October	55	138	48	81	37	359	71.8
November	41	101	36	54	24	256	51.2
December	22	50	14	22	9	117	23.4
<b>Total</b>	277	766	255	437	169	1904	380.8
<b>Mean</b>	34.625	95.75	31.875	54.625	21.125	238	47.6
	C	A	C	B	D		

Grouping of number insect of *P. tenuivalvata* in different sites of sugar cane field (West 95.6 A - North 54.6 B- East 34.6 C- East 34.6 C -South 31.9 C -Center 21.1 D)-

**Table 2.** Monthly counts *P. tenuivalvata* distributed in different direction of a sugar – cane fields, in (Edfo- Aswan Governorate (2016) season.

Sampling date	Total number of scales/ sugarcane leaf -Direction of sugarcane field.					Total	Mean
	East	West	South	North	Center		
May	9	26	4	14	2	55	11
June	15	44	7	26	7	99	19.8
July	18	69	16	34	12	149	29.8
August	17	114	16	64	20	231	46.2
September	32	148	22	81	26	309	61.8
October	36	148	25	88	34	331	66.2
November	19	95	11	49	25	199	39.8
December	8	32	4	15	5	64	12.8
<b>Total</b>	154	676	105	371	131	1437	287.4
<b>Mean</b>	19.25	84.5	13.12	46.37	16.37	179.62	35.92
	C	A	C	B	D		

Grouping of number of insect *P. tenuivalvata* in different sites of sugar cane field (-West 84.5 A -North 46.37 B-East 19.25 C-Center 16.37 C -South 13.12 D)-

**Table 3.** No. of *P.tenuivalvate* and parasites distribution in different directions of Sugar cane fields in Awadlah village at Edfu district ,Aswan Governorate during (2015) season.

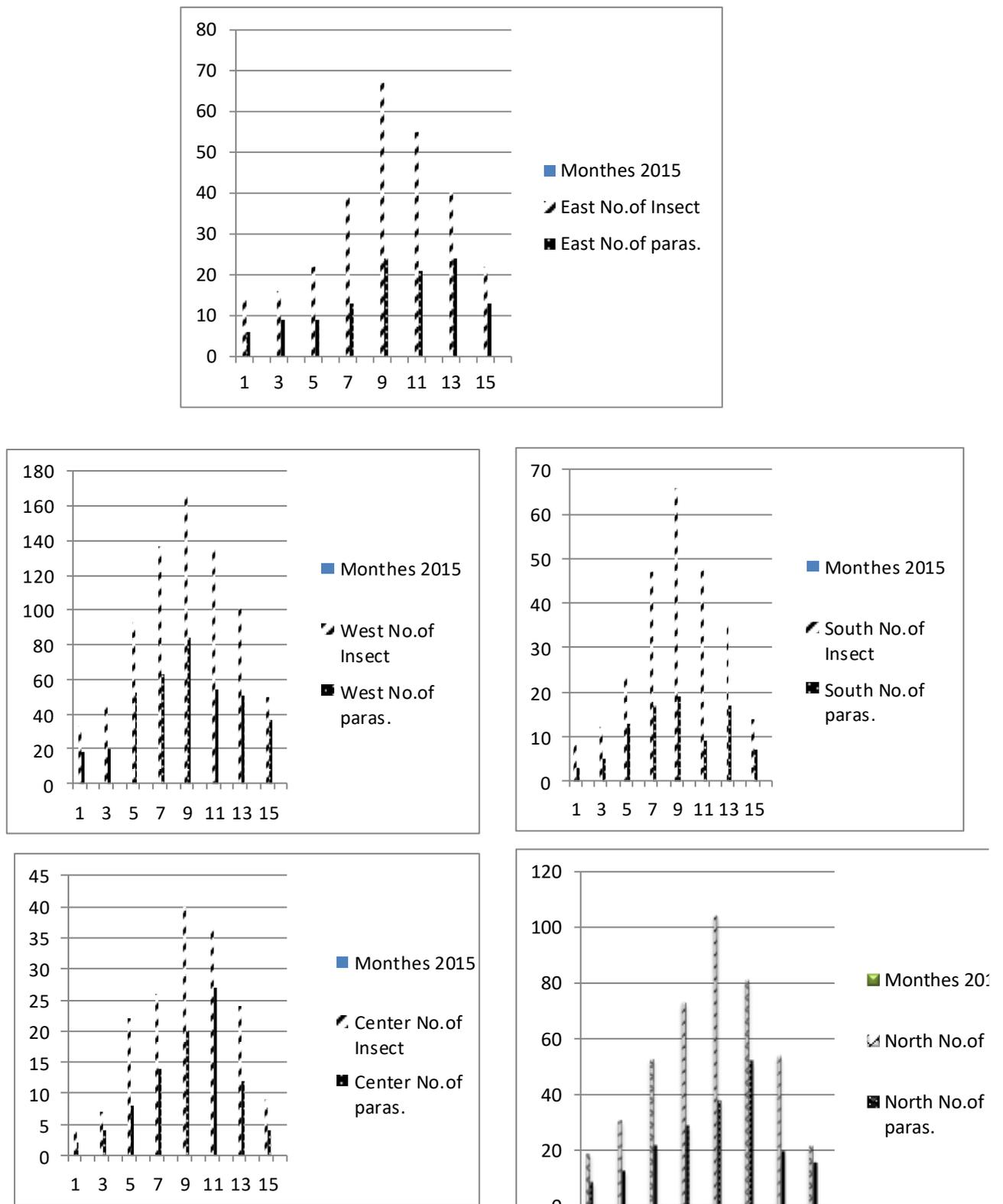
sampling date	East			West			South			North			Center		
	No. of Insect	Paras.	%												
May	8	3	37.5	15	10	66.6	3	1	33.3	9	3	33.3	2	0	0
	7	3	42.88	18	8	42.4	5	2	40	10	6	40	2	2	100
Jun.	8	5	62.5	21	11	52.38	4	2	50	13	4	30.76	3	1	33.3
	8	4	50	25	9	36	8	3	37.5	18	9	50	4	2	50
Jul.	10	2	13.3	45	15	33.3	10	4	26.6	25	12	48	7	3	42.85
	12	7	58.3	48	37	77.08	14	6	42.85	28	10	35.71	15	5	33.35
Aug	14	5	35.7	58	26	44.82	18	7	38.8	33	17	51.51	12	7	58.3
	25	8	32	79	37	46.85	29	10	34.4	40	12	30	14	7	50
Sept.	31	10	48.38	80	35	43.75	33	12	36.3	51	15	29.41	20	11	55
	36	14	38.88	88	29	32.95	33	7	21.21	53	21	39.62	20	9	45
Octob.	30	12	40	78	26	33.23	26	8	30.7	48	30	62.5	16	14	87.7
	25	9	36	60	28	46.66	22	1	50	33	22	66.6	21	13	61.9
Novem.	25	16	64	53	20	34.88	20	9	45	30	11	36.66	13	7	53.4
	16	8	50	48	31	68.88	16	8	50	24	9	37.5	11	5	45.3
Dec.	13	9	69.23	31	29	93.5	8	5	62.5	14	10	31.42	6	2	33.3
	9	4	44.4	19	8	42.15	6	2	33.3	8	6	75	3	2	66.6
<b>Total</b>	277	119	-	766	359	-	255	87	-	437	197	-	169	90	-
<b>Mean</b>	17.31	7.44	45.19	47.88	22.44	49.71	15.94	5.44	39.53	27.31	12.31	43.62	10.56	5.63	51.00

Paras. = parasite

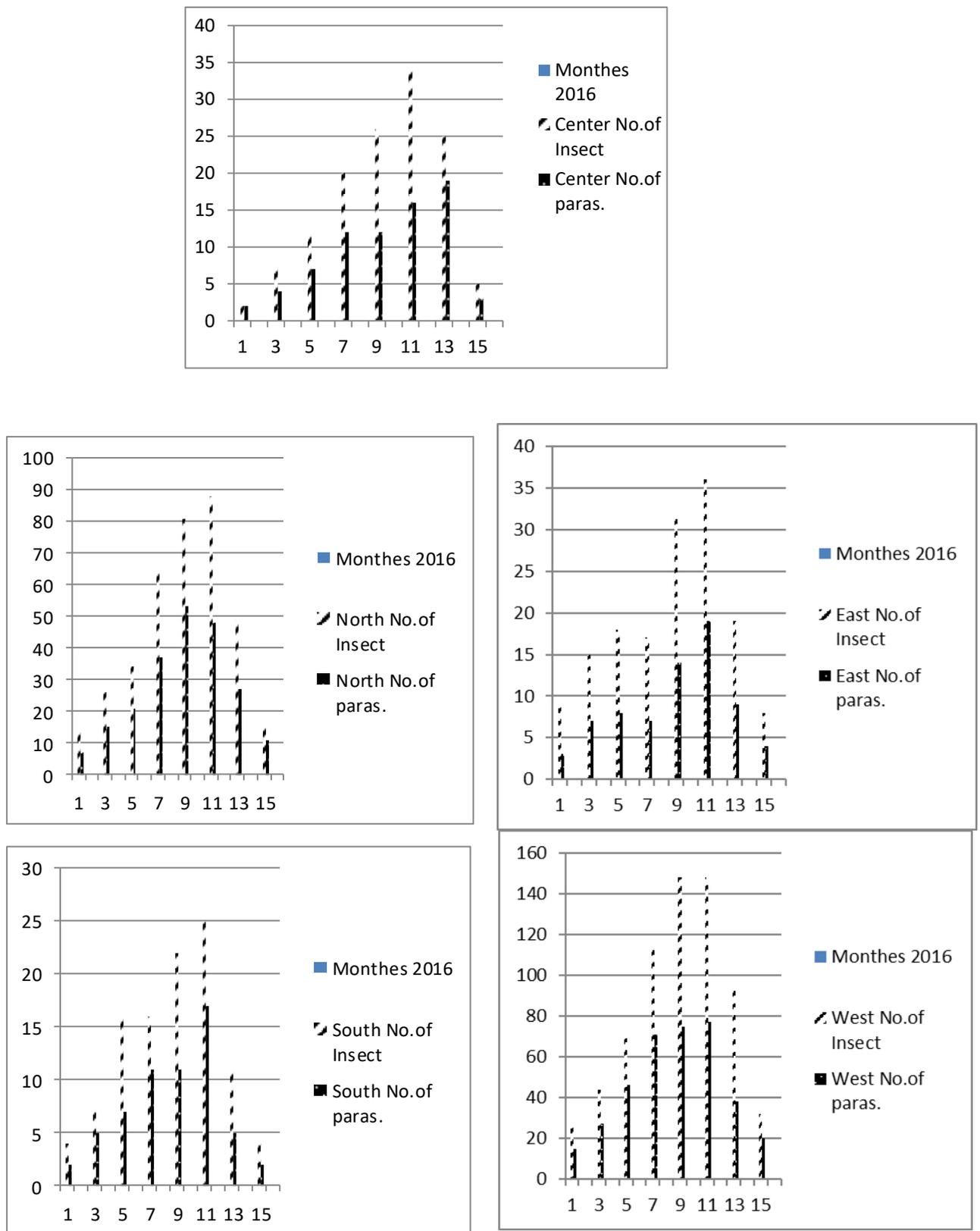
**Table 4.** No. of *P.tenuivalvate* and parasites distribution in differcnt directions of Sugar cane fields in Awadlah village at Edfu district ,Aswan Governorate during (2016) season.

sampling date	East			West			South			North			Center		
	No. of Insect	Paras.	%												
May	3	1	33.3	12	6	50	1	0	0	5	3	60	0	0	0
	6	2	33.3	14	9	64.2	3	2	66.6	9	4	44.4	2	1	50
Jun.	7	3	42	20	12	60	1	1	100	12	7	58.3	3	2	66.6
	8	4	50	24	15	62.5	6	4	66.6	14	8	57.1	4	2	50
Jul.	8	3	37.5	29	20	68.9	8	3	37.5	16	9	56.2	6	4	66.6
	10	5	50	40	26	65	8	4	50	18	12	66.6	6	3	50
Aug	8	3	37.5	48	30	62.5	10	7	70	29	17	58.6	8	5	62.5
	9	4	44.4	66	41	62.1	6	4	66.6	35	20	57.1	12	7	58.3
Sept.	15	6	40	72	45	62.5	10	6	60	39	23	58.9	12	4	33.3
	17	8	47	76	30	39.4	12	5	41.6	42	30	71.4	14	8	57.1
Octob.	20	10	50	80	42	52.5	15	9	60	45	27	60	18	7	38.8
	16	9	56	68	35	51.4	10	8	80	43	21	48.8	16	9	56.2
Novem.	11	5	45.4	59	20	33.8	6	3	50	30	15	50	15	10	66.6
	8	4	50	36	18	50	5	2	40	19	12	63.15	10	9	90
Dec.	6	3	50	20	12	60	4	2	50	10	8	80	4	2	50
	2	1	50	12	8	66.6	0	0	0	5	3	60	1	1	100
<b>Total</b>	154	71	-	676	369	-	105	60	-	371	219	-	131	74	-
<b>Mean</b>	9.63	4.44	44.78	42.25	23.06	56.96	6.56	3.75	52.43	23.19	13.69	59.41	8.19	4.63	56.00

Parasite.= paeasites



**Figure1.** Relationship between the parasitoid *Coccophagus scutellaris* and population of *P. tenuivalvata* on sugar cane fields during 2015 season Awadlah, Edfo Aswan Governorate at different directions.



**Figure 2.** Relationship between the parasitoid *Coccophagus scutellaris* and population of *P. tenuivalvata* on sugar cane fields during 2016 season Awadlah, Edfo Aswan Governorate at different directions.

## الموقع والاتجاه المفضل بحقول قصب السكر للإصابة بالحشرة القشرية الرخوة وعلاقته بطفيل الكوكوفاجس - غشائيات الأجنحة

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### الملخص العربي

يهدف هذا البحث إلى تقييم تأثير بعض العوامل الحيوية على الكثافة السكانية لمقياس قصب السكر الناعم *P. tenuivalvata*. تم إجراء تقدير السكان في مواقع مختلفة من حقل قصب السكر، أي الشرق والشمال والجنوب والغرب ومركز الحقل. واشتملت الدراسة على تقدير تعداد الحشرة في الاتجاهات الأربعة المختلفة من الحقل (الشمالية والجنوبية والشرقية ثم الغربية بالإضافة إلى المركز وقد أوضحت الدراسة أن التعداد قد ازداد بصفة عامة في الفترة من مايو إلى ديسمبر بكل أجزاء الحقل وخاصة الفترة من سبتمبر إلى نوفمبر كما أن نباتات الجزأ الغربي من الحقل كان عليها أكبر تعداد للحشرة يليها نباتات الجزأ الشمالي منه وتشابه التعداد علي نباتات كل من الجزئين الشرقي والجنوبي للحقل أما نباتات المركز فقد احتوت علي أقل تعداد للحشرة احتوت الدراسة أيضا علي وجود طفيل *Coccophagus scutellaris* على الأطوار الغير كاملة (عدا العمر الأول بالإضافة إلى الطور الكامل). وقد كان هناك ارتباط عالي المعنوية في كل من أعداد الطفيل والحشرة خلال موسمي الدراسة على تعداد كل من الحوريات والحشرات الكاملة. . ونستنتج من هذا أن هناك العديد من العوامل الحيوية التي يمكن أن تؤثر على الكثافة السكانية ل للإصابة بالحشرة القشرية الرخوة *P. tenuivalvata*. يمكن أن يساعد ذلك في تجنب استخدام المبيد الحشري وتقليل أعداد الحشرة في البيئة باستخدام الأعداء الطبيعية (الطفيليات).

**الكلمات المفتاحية:** المواقع والاتجاهات، قصب السكر، الحشرة القشرية الرخوة، طفيل الكوكوفاجس، غشائيات الأجنحة، أفليبيدي.