

IMPACT OF INTERCROPPING OF CITRONELLA GRASS (*Cymbopogon schoenanthus* cyperles) AND LEMON GRASS (*Cymbopogon citratus* stapf) OF THE INFESTATION LEVEL OF INSECT PESTS AND ACARI IN COWPEA CROP AT KAFR EL-SHEIKH REGION .

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ABSTRACT

In 2010 and 2011 cowpea seasons, experiments were carried out to investigate the effect of intercropping between cowpea and each of Citronella grass and lemon grass on the populations of insect pests attacking cowpea . Intercropping in general, reduced the pests complex in cowpea fields. These reductions were 94.34 – 97.78, 75.98 – 80.19 and 50.64 – 58.37% in case of intercropping of Citronella grass with one, two and three rows of cowpea, respectively. The corresponding values in case of lemon grass were 97.92 – 99.11, 75.08 – 82.47 and 47.95 – 61.77%. Values of insect diversity index in 2010 season were 1.0725, 1.6583 and 1.6549 when citronella grass was intercropped with one, two and three rows of cowpea. The corresponding values of diversity index, in case of lemon grass were 0.8743, 1.0425 and 1.6053. Diversity index took almost the same trend in the second season (2011).

INTRODUCTION

Nowadays, vegetable production is one of the important aspects to face the increasing requirements for local consumption and allow surplus for exportation. Legume vegetables are widely cultivated crops in many countries of the world and in Egypt, because they contain high protein that is characterized as more nutritional compared with that of other vegetables (Nasser, 1996). The cowpea crop, *Vigna unguiculata* (L) is one of the most important vegetable leguminous crops in many parts of the world and in Egypt as a protein rich food . In Egypt, cowpea is cultivated in 19,711 feddans in 2009 (Anonymous, 2010), however, only 224 feddans are cultivated at Kafr El-Sheikh Governorate. The three main cultivation districts are Kafr El-sheikh , Qillin and Sidi Salem.

Unfortunately, cowpea plants are attacked by several insect pests throughout their different stages of growth . Some of these insects are very injurious and cause serious damage to the yield in both quantity and quality (Jackai,1995 and Ward *et al.*, 2002). The most injurious insect pests attacking cowpea plants the leguminous aphid , *Aphis craccivora* (Koch), bean fly , *Melanogromyza phaseoli*_(Tyron) cotton leaf worm , *Spodoptera littoralis* (Bosid .) , cowpea pod – borer , *Etiella zinckenella* (Treitschke) and red spider, *Tetranychus cucurbitacearum* (Sayed), (Helaly *et al.*, 1990a and 1990 b, Nandakumar and Sheela 1996, Bochatly and Malak 2001, Ward *et al.*, 2002, Soliman 2004, El-Badry 2006 and Abo El -Naga , 2011).

Intercropping is a common agricultural practice carried out by cowpea farmers in Egypt. This practice is generally recommended from the economic point of view, especially in cowpea fields where plants are normally grown in wide spaces among rows (50 cm. apart). In this case, the in between field spaces are practically suitable for intercropping. However, insect populations may be altered by such practice, and therefore, must be taken into consideration as a factor affecting the population densities of cowpea insect pests.

The present investigation was, therefore, designed to evaluate the infestation levels of insect pests and mite in cowpea crop as affected by intercropping between cowpea and each of citronella grass and lemon grass. Because the last two plants have repellent effects against herbivores, it was found appropriate to investigate the effect of this intercropping practice on insect and mite population densities on cowpea crop.

MATERIALS AND METHODS

The experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station (SARS), Kafr El-Sheikh governorate as well as in cowpea, *Vigna unguiculata* (L)Walp farmer fields located at Kafr El-Sheikh region, during two successive seasons; 2010 and 2011.

The experimental field was divided into 28 plots, distributed in a complete randomized block design, as seven treatments and 4 replicates . Each plot measured 42 m², including 12 rows, each of 7 m length, and 50 cm width. The cowpea cultivar kaha-1 was planted on the second half of May in each season, with two plants per hill and 10 – 15 cm apart. The plants received all recommended agronomic practices, but without any insecticides throughout the season.

To evaluate the effect of intercropping each citronella grass (*Cymbopogon schoenanthus cyperles*) and lemon grass (*Cymbopogon citratus stapf*) (as weeds repelling some insects), the treatments were as follows :-

- a) one row cowpea with one row citronella grass.
- b) two rows cowpea with one row citronella grass.
- c) Three rows cowpea with one row citronella grass.
- d) One row cowpea with one row lemon grass.
- e) Two rows cowpea with one row lemon grass.
- f) Three rows cowpea with one row lemon grass.
- g) Check (solid cowpea) , i.e. the plot was sown with only cowpea.

Sampling, to evaluate the effect of intercropping on pest population densities, started on 20th of June , and continued weekly till cowpea harvest . Population densities of *Empoasca* spp. (nymphs and adults) *Etiella zinckenella* (Treitsehke) adult and *Cosmolyce baeticus* (L.) (adults) were evaluated by the sweep net as 10 double strokes / plot. Densities of *Aphis craccivora* Koch and *Macrosiphum* sp. nymphs and adults, and *Spodoptera littoralis* (Boisd) larvae were evaluated in 10 caged cowpea plants/plot. Each plant was introduced into plastic bag , and cut at the soil surface . The bags,

harboring cowpea plants, were transferred to the laboratory for examination. Numbers of larvae of *Melanagromyza phaseoli* (Tryon) and *liriomyza trifolii* (Burgess) and *Tetranychus cucurbitacearum* (Sayed) adults and nymphs were counted on 10 leaves / plot.

Sahnnon-Weaner diversity index (S.W.I) was adopted to measure the diversity of arthropods as it is the index most commonly used (Price, 1984). The Shannon – Weaner index was calculated according to the following equation:-

$$HS = \sum_{I=1}^S p_i \log p_i$$

Where:

HS= the amount of diversity in a group of species in this case the category of classification used in the species (hence the subscripts) but other categories could be used as well it may be applicable to families , orders, Etc.

S = Number of species in the sample.

Pi = the proportion of the 1st species in the total sample , it measures the relative abundance and ranges between 0.00 to 1.00

Log_e = Natural logarithm . The negative signs is added to make the come out positive value = 2.718

This function was derived independently by Shannon – Weaner and is sometimes mislabeled as the Shannon – Weaner function in the ecological literature (Kerbs , 1978).

RESULTS AND DISCUSSION

Effect of intercropping between cowpea and citronella grass on population densities of cowpea pests :-

Data presented in Table (1) show the effect of intercropping between citronella grass and cowpea in 2010 season on pests attacking cowpea.

Population densities of all considered pests were reduced when cowpea was intercropped with citronella grass. The overall reduction was highest (97.78%) when the intercropping ratio was one row cowpea / one row citronella. The reductions in pest population densities were 80.19 and 58.37 % when intercropping ratios were two rows cowpea / one row citronella and three rows cowpea / one citronella, respectively.

For the pest species, one row cowpea / one row citronella ratio resulted in a complete absence of *Macrosiphum* sp, *Melanagromyza phaseoli*, *Liriomyza trifolii* and *Etiella zinckenella*. In addition , *Aphis craccivora*, *Spodoptera littoralis* and *Tetranychus cucurbitacearum* were almost absent , as their population densities were reduced by 97.22, 96.07 and 99.44 % respectively . At a ratio of two rows cowpea / one row citronella, the reduction in pest population densities ranged between 63.89 % (in case of *Cosmolyce baeticus*) and 88.34 % (in case of both leafminers).

Table (1): Population densities of insect and mite pests as influenced by intercropping citronella grass on cowpea crop at Kafr El – Sheik region during 2010 season.

Pest species	Solid cowpea (control)	1 cowpea:1grass		2 cowpea:1grass		3 cowpea:1grass		Average reduction %
		mean	Reduction %	mean	Reduction %	mean	Reduction %	
<i>Empoasca</i> spp.	503.00	25.50	94.93	122.25	75.65	282.50	43.84	71.49
<i>Aphis craccivora</i> (koch)	404.25	11.25	97.22	57.25	85.84	130.00	67.84	83.63
<i>Macrosiphum</i> sp.	137.25	00.0	100.00	21.25	84.52	59.50	56.65	80.39
<i>Melanagromyza phaseoli</i> (tyron)	137.25	00.0	100.00	16.00	88.34	53.25	61.20	83.18
<i>Liriomyza</i> spp.								
<i>Etiella zinckenella</i> (treitschke)	37.50	00.0	100.00	7.25	80.66	15.50	58.66	79.77
<i>Cosmolyce baeticus</i> (L.)	78.25	4.25	94.56	28.25	63.89	37.75	51.76	70.07
<i>Spodoptera littoralis</i> (Boisd)	57.25	2.25	96.07	14.00	75.54	18.00	68.56	80.07
<i>Tetranychus cucurbitacearum</i> (L.)	44.50	0.25	99.44	5.25	87.07	18.50	58.43	81.65
Overall reduction%			97.78		80.19		58.37	

The effect of citronella as a repellent was reduced when three rows of cowpea were intercropped with only one row of citronella; the reduction values ranged between 43.84 % (for *Empoasca* sp.) and 68.56 % (for *S. littoralis*). Over the treatments, the repellent effect of citronella grass resulted in pest population density reduction ranging between 70.07 (*C. baeticus*) to 83.63 % (*A. craccivora*).

Results of the same treatments in 2011 took almost the same trend (Table 2) . The overall reduction in pest population densities were 94.34 , 75.98 and 50.64 % for intercropping ratios of one row cowpea / one row citronella, two rows cowpea / one row citronella and three rows cowpea / one row citronella, respectively.

For pest species , the reduction ranged between 85.23 % in case of *S. littoralis* and 100.00 % for each of *Macrosiphum* sp., leafminers and *E. zinckenella* , when the intercropping ratio was one / one row . However, the levels of reductions in pest population densities ranged between 62.41 and 86.16 % in case of two rows cowpea / one row citronella. Also , the repellent effect of citronella grass was more reduced in case of three rows cowpea / one row citronella, as the reduction in pest population densities ranged between 39.39 % and 67.54 % .

Effect of intercropping between cowpea and lemon grass on population densities of cowpea pests:-

Data in table (3) show the effect of intercropping between cowpea and lemon grass on the population densities of the considered arthropod pests in 2010 season. The average reductions in 2010 season were 99.11 , 82.47 and 61.77 % in case of applying one row of lemon grass with one , two and three cowpea rows , respectively. On the pest species level, the intercropping rate of one row lemon grass / one row cowpea, repelled all

insects , except *Empoasca* sp. and *Aphis craccivora* , that were reduced by 95.41 and 97.45 % , respectively . At two rows cowpea / one row lemon grass, reduction in pest population densities ranged 71.75 – 90.42 % , while three rows cowpea / one row lemon grass, reduced the population densities by 48.08 – 69.97 % . Over treatments, the reduction in pest population densities were relatively close, ranging between 72.83 and 86.67 %

Table (2): Population densities of insect and mite pests as influenced by intercropping citronella grass on cowpea crop at Kafr EI – Sheik region during 2011season.

Pest species	Solid cowpea (control)	1 cowpea:1grass		2 cowpea:1grass		3 cowpea:1grass		Average reduction %
		mean	Reduction %	mean	Reduction %	mean	Reduction %	
<i>Empoasca</i> spp.	498.75	41.50	91.67	119.75	75.98	302.25	39.39	69.01
<i>Aphis craccivora</i> (koch)	464.50	28.50	93.86	69.25	86.16	150.75	67.54	82.52
<i>Macrosiphum</i> sp.	157.00	0.0	100.00	32.75	79.14	78.00	50.32	76.49
<i>Melanagromyza phaseoli</i> (tyron)	163.25	0.0	100.00	26.25	83.92	70.75	56.66	80.19
<i>Liriomyza</i> spp.								
<i>Etiella zinkenella</i> (treitschke)	49.75	0.0	100.00	9.25	81.41	25.25	49.25	76.89
<i>Cosmolyce baeticus</i> (L.)	105.75	14.75	86.05	39.75	62.41	58.25	44.92	64.46
<i>Spodoptera littoralis</i> (Boisd)	81.25	12.00	85.23	26.50	67.38	37.50	53.85	68.82
<i>Tetranychus cucurbitacearum</i> (L.)	70.00	1.50	97.86	20.00	71.43	39.75	43.21	70.83
Overall reduction%			94.34		75.98		50.64	

Table (3): Population densities of insect and mite pests as influenced by intercropping lemon grass on cowpea crop at Kafr EI – Sheik region during 2010season.

Pest species	Solid cowpea (control)	1 cowpea:1grass		2 cowpea:1grass		3 cowpea:1grass		Average reduction %
		mean	Reduction %	mean	Reduction %	mean	Reduction %	
<i>Empoasca</i> spp.	458.00	21.00	95.41	114.50	75.00	237.75	48.08	72.83
<i>Aphis craccivora</i> (koch)	362.25	9.25	97.45	49.75	86.26	108.75	69.97	84.50
<i>Macrosiphum</i> sp.	129.75	0.0	100.00	15.50	88.05	46.75	63..96	84.00
<i>Melanagromyza phaseoli</i> (tyron)	120.00	0.0	100.00	11.50	90.42	36.50	69.58	86.67
<i>Liriomyza</i> spp.								
<i>Etiella zinkenella</i> (treitschke)	31.50	0.0	100.00	4.75	84.92	10.75	65.87	83.60
<i>Cosmolyce baeticus</i> (L.)	65.50	0.0	100.00	18.50	71.75	28.25	56.87	76.21
<i>Spodoptera littoralis</i> (Boisd)	44.00	0.0	100.00	9.75	77.84	15.50	64.77	80.87
<i>Tetranychus cucurbitacearum</i> (L.)	34.50	0.0	100.00	5.00	85.51	15.50	55.07	80.19
Overall reduction%			99.11		82.47		61.77	

Results of 2011 season are presented in Table (4). Intercropping of lemon grass with one, two and three rows of lemon grass reduced the pest population densities by 97.92 , 78.05 and 47.95%, respectively. Over treatments, the reduction in pest population was highest in *A. craccivora* but lowest in *C. baeticus*.

It could be concluded that intercropping obviously reduced pest infestation in cowpea. Such reductions were more evident in plots intercropped by 1 row citronella grass or lemon grass with one row cowpea , than in plots intercropped by one row grass with two or three cowpea rows. This might be due to relative humidity differences in the microclimate of cowpea plots intercropped by these plants. In this respect , Isa *et al.* (1974) found that increasing row width in sugar - cane plantations generally reduced infestation by *Chilo Agamemnon* Bles., and suggested that relative humidity in fields with crowded plants is higher than that in fields with wider rows where better aeration occurs.

Table (4): Population densities of insect and mite pests as influenced by intercropping lemon grass on cowpea crop at Kafr EI – Sheik region during 2011season

Pest species	Solid cowpea (control)	1 cowpea:1grass		2 cowpea:1grass		3 cowpea:1grass		Average reduction %
		mean	Reduction %	mean	Reduction %	mean	Reduction %	
<i>Empoasca</i> spp.	490.50	27.75	94.34	130.25	73.44	260.00	46.99	71.79
<i>Aphis craccivora</i> (koch)	389.50	13.50	96.53	65.50	83.18	126.00	67.65	82.45
<i>Macrosiphum</i> sp.	0.0	0.0	100.00	0.0	0.0	0.0	0.0	0.0
<i>Melanagromyza phaseoli</i> (tyron)	190.25	0.0	100.00	25.00	82.17	51.50	63.27	81.81
<i>Liriomyza</i> spp.								
<i>Etiella zinkenella</i> (treitschke)	40.25	0.0	100.00	8.25	79.50	19.00	52.79	77.43
<i>Cosmolyce baeticus</i> (L.)	79.00	6.00	92.40	29.50	60.66	42.00	46.83	67.30
<i>Spodoptera littoralis</i> (Boisd)	59.75	0.0	100.00	19.75	66.94	26.25	56.06	74.33
<i>Tetranychus cucurbitacearum</i> (L.)	90.50	0.0	100.00	9.50	76.54	20.25	50.00	75.51
Overall reduction%			97.92		78.05		47.95	

In such concern, Nasseh (1981) found that garlic crude extract had a strong antifeedant effect on larvae of *Epilachna varivestic* and metamorphosis was greatly affected.

The present findings point out to another reason, which is the repelling effect of volatile substances characteristic for these crops.

Shannon-Wiener diversity index (S.W.I.)

Citronella grass :

Data In table (5) present the computed values of the Shannon-Wiener diversity indices in relation to cowpea in which samples were taken . The S . W diversity index for pests in the sampled cowpea was higher in 2 rows and 3 rows cowpea, being 1.6583 and 1.6549, respectively. While in 1 row cowpea it was lower, being 1.0725. In 2010, The numbers of species were 9 for each of 2 and 3 rows, but for one row,the number of species was 5. In 2011, The S

. W diversity index for pests in the sampled cowpea, was higher in 2 rows and 3 rows cowpea , being 1.8767 and 1.8160 respectively. While in 1 row cowpea it was lower , being 1.3207. The number of was 9 for each of 2 and 3 rows, but 5 species for one row. It could be concluded that cowpea has dominant and subdominant pests species which can affect on diversity index values. The relationship between species and ecological process can change quantitatively and qualitatively with environment context (Cardinale & Nelseon, 1999).

Table (5) : Shannon-weaner diversity index in (S . W . I .) for species on cowpea intercropped with citronella and lemon grass.

Type of grasses	Citronella						Lemon grass					
	2010 Season			2011 Season			2010 Season			2011 Season		
	Mean No. of pests	Number of pests species	S .W.	Mean No. of pests	Number of pests species	S .W.	Mean No. of pests	Number of pests species	S .W.	Mean No. of pests	Number of pests species	S .W.
1 row cowpea	43.50	5	1.0725	98.25	5	1.3207	30.25	2	0.8743	47.25	3	0.9323
2 rows cowpea	272.00	9	1.6583	338.50	9	1.8767	229.25	9	1.5425	287.75	8	1.596
3 rows cowpea	615.00	9	1.6549	762.50	9	1.8160	499.75	9	1.6053	545.00	8	1.5607
Control	1399.25	9	1.7689	1590.25	9	1.8652	1246.00	9	1.7181	1239.75	8	1.5984

lemon grass

Data in table (5) revealed that S . W diversity index for pests species was higher in 3 rows cowpea and 2 rows cowpea being 1.6053 and 1.5425, respectively while in 1 row cowpea it was the lower, being 0.8743. In 2010, The number of species was 9 for each of 2 and 3 rows, but 5 for the one row. On the other hand, during season 2011, the S . W . diversity index for pests in the sampled cowpea was higher in 2 rows and 3 rows cowpea , being 1.596 and 1.5607 respectively while in 1 row cowpea it was lower , being 0.9323. The number of species was 8 for 2 and 3 rows, but 3 species for one row. Similar results were obtained by El-Dakhkhni *et al.* (1995) who reported that clover had the highest number of beneficial insect species (22), while cotton and soybean had the lowest one (12). The S . W . for natural enemy species in the sampled crops was highest in clover, being 2.52 while in maize it was lowest being 1.81. As for cotton and soybean, it was 2.08 and 2.41 , respectively. Also, El – Mezayymen (2001) indicated that the S . W . diversity index for pests, beneficial and visitor species in the sampled crops was highest in alfalfa in Sebha, being 1.664 , 0.6129 and 0.8222, but lowest in the Egyptian clover at Kafr El -Sheikh city, being 0.6154, 0.5152 and 1.1480. The numbers of species were 14,11 and 5 for alfalfa while they were 13,8 and 6 for the Egyptian clover, respectively. In the current study , it was

anticipated that the relative pest abundance of species on cowpea crop may have an effect on diversity index values of S . W.

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تأثير تحميل السيترونيلا وحشيشة الليمون على درجة الإصابة بالآفات الحشرية والأكاروسية في اللوبيا بكفر الشيخ

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أجريت تجربة بمحطة البحوث الزراعية بسخا بهدف دراسة تأثير التحميل بحشيشة السيترونيلا وحشيشة الليمون على نباتات اللوبيا على درجة الإصابة بالآفات الحشرية والأكاروسية. اتضح من الدراسة أن التحميل بصفة عامة بهذه الحشائش يعمل على خفض مستوى الإصابة بالآفات الحشرية والأكاروسية في حقول اللوبيا بما يتراوح بين 94.34 – 97.78 % عند تحميل خط واحد من الحشيشة مع خط واحد من اللوبيا ، وبين 75.98 – 80.19 % عند تحميل خط واحد من حشيشة السيترونيلا مع خطين من اللوبيا . وبين 50.64 – 58.37 % عند تحميل خط واحد من الحشيشة مع ثلاثة خطوط من اللوبيا . وعند تحميل حشيشة الليمون مع اللوبيا، كان النقص في تعداد الحشرات والآفات 97.92 – 99.11 ، 78.05 – 82.47 ، 47.95 – 61.77 % عند تحميل خط واحد من حشيشة الليمون مع خط واحد وخطين وثلاثة خطوط من اللوبيا على التوالي .

كانت قيم دلالات التنوع (1.0725 ، 1.6583 ، 1.6549) (1.3207 ، 1.8767 ، 1.8160) عند تحميل حشيشة السيترونيلا على خط واحد واثنين وثلاثة خطوط من اللوبيا خلال موسمي 2010 و 2011 م . بينما كانت قيم دلالات التنوع (0.8743 ، 1.0425 ، 1.6053) (0.9323 ، 1.596 ، 1.5607) عند تحميل حشيشة الليمون على خط واحد واثنين وثلاثة خطوط من اللوبيا خلال موسمي 2010 ، 2011 م. وجد أيضا أن التواجد النسبي لأنواع مفصليات الأرجل المختلفة في محصول اللوبيا لها تأثير على قيم دلالات التنوع .

قام بتحكيم البحث

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