RESULTS

III-RESULTS

Factors that may affect the role of S. urinator as mosquito predator: -

1.Water depth: -

1.1.Effect of water depth on the development of the immature stage : -

To determine the effect of water depth on the development of S. urinator nymphs, three groups of newly hatched nymphs were transferred into glass aquaria. Three levels of water depth were used (5,20 and 25cm). Each depth was replicated five times .The experiment was maintained under laboratory conditions (temperature 28±2°C and photoperiod 16L: 8D).

Duration of each nymphal instar and total duration and mortality percentage of the nymphal stages were all recorded in the following tables (1and 2) and graphically illustrated in the figures (1 and 2).

Table (1): Effect of water depth on the duration of different nymphal instars (*) of S. urinator under laboratory conditions (temp. 28±2°C and photoperiod16L: 8D).

Water depth	Duration of nympal instars (in days) mean ± S. E.					average total durations (in days)
	1st	2nd	3rd	4th	5th	
Low (5 cm)	3.2 ± 0.25	4.5 ± 0.35	4.90 ± 0.1	6.1 ± 0.24	7.60 ±0.29	23.8 ± 1.09
Medium (20 cm)	3.00 ±0.29	4.47 ±0.60	4.40 ±0.10	5.67 ±0.60	6.67 ±0.44	22.02 ± 0.74
High (35 cm)	2.99 ±0.20	4.01 ±0.32	4.30 ±0.33	5.74 ±0.38	7.67 ±0.44	22.86 ± 0.82

(*) Newly hatched nymphs were used.

The statistical analysis of data in table (1) indicate that the difference on the duration of each nymphal instar or the total duration of nymphal stage reared in different three water depths was not significantly different.

Table (2) : Effect of water depth on the percentage mortality of nymphal instars (*) of S. urinator under laboratory conditions (28±2°C photoperiod 16L: 8D).

Water DEPTH	Mortality %					
	1st	2nd	3rd	4th	5th	Total
Low (5 cm)	4	7	12	6	0	29
Medium (20 cm)	1.6	10.67	12.3	5.67	0	30.24
High (35 cm)	9	5	8.2	8.75	1.25	32.2

(*) Newly hatched nymphs were used.

It is clear from data in table (2) that the water depth had no marked effect on the percentage mortality, as the mortality was observed during all nymphal instars reared in different three water depths. The lowest mortality was observed during 5th nymphal instars reared in different three water depths. As a whole, mortality percentage was increased slightly with the increase of the water depth. It was 29, 30.42 and 32.2 % for nymphs reared in low, medium and high water depths respectively.

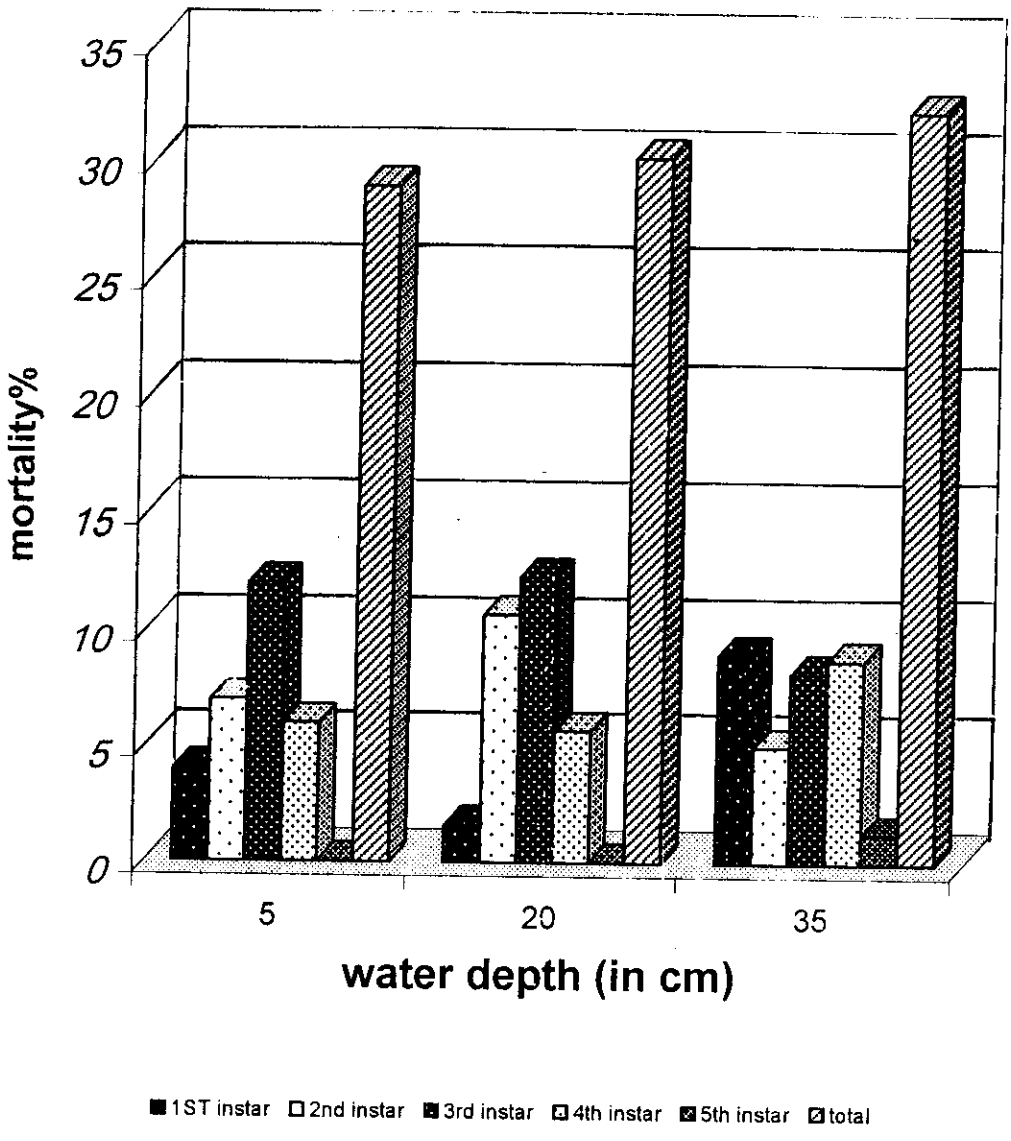


Fig.(2): Effect of water depth on the mortality%of nymphal instars of S. urinator

1.2. Effect of water depth on some biological aspects of the adult stage:-

To determine the effect of water depth on the sexual maturation (preoviposition, oviposition and postoviposition periods) fecundity (number of eggs per raft and number of rafts and eggs laid per female) and longevity of S. urinator adults, three groups of newly hatched adults were reared in three levels of water depth (low, medium and high) under laboratory conditions (temperature 28±2°C and photoperiod 16L: 8D).

The results of this experiment are given in the tables (3,4and5) and graphically illustrated in the figures (3, 4 and 5).

Table (3): Effect of water depth on the sexual maturation of S. urinator adults (*) under laboratory conditions (temp.28 ± 2°C and photoperiod 16L: 8D).

Water depth	Sexual maturation (in days) Mean ± S.E.		
	Preovipostion period	Ovipostion period	Postoviposion period
Low (5 cm)	10.13 ±1.14 ab	56.64 ± 3.82 a	11.46 ± 2.86 ab
Medium (20 cm)	9.60 ± 0.85 ac	53.07 ± 7.14 ac	9.64 ± 1.05 ac
High (35 cm)	10.87 ± 0.73 bc	44.71 ± 6.05 c	8.46 ± 0.83 bc

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analyses of data in table (3) indicate that: -

A non-significant difference in preoviposition, oviposition and postoviposition periods in all treatments of the experiment, whereas a significant difference was observed in oviposition period between insects reared in low and high water depths ($p < 0.05$).

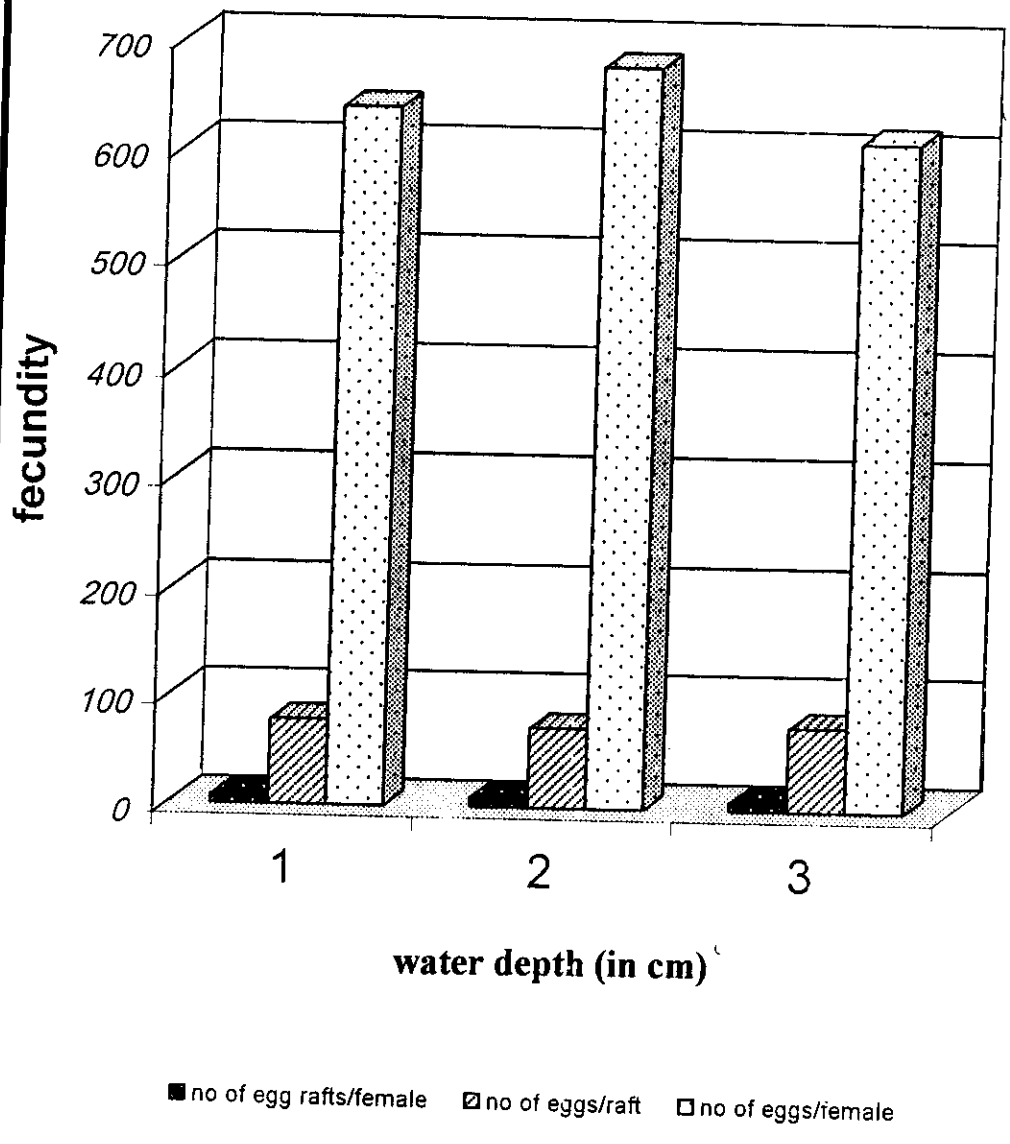


Fig.(4): Effect of water depth on the fecundity of S. urinator adults

Table (5): Effect of water depth on adult longevity of S. urinator (*) under laboratory conditions (temp.28±2°Cand photoperiod 16L: 8D).

Water depth	Longevity (in days) Mean ± S.E.	
	female	male
Low (5 cm)	78.73 ± 6.24	89.33 ± 5.48
Medium (20 cm)	69.00 ± 7.55	98.00 ± 6.44
High (35 cm)	72.33 ± 7.11	89.9 ± 10.56

(*) Newly hatched adults were used.

The statistical analyses of data in table (5) indicate that: -

A non-significant difference was observed in female and male longevity when reared in low, medium or high water depths. Females reared in low, medium and high water depths lived for 78.73, 69.00 and 72.33days and males lived for 89.33,98.00 and 89.9 days respectively.

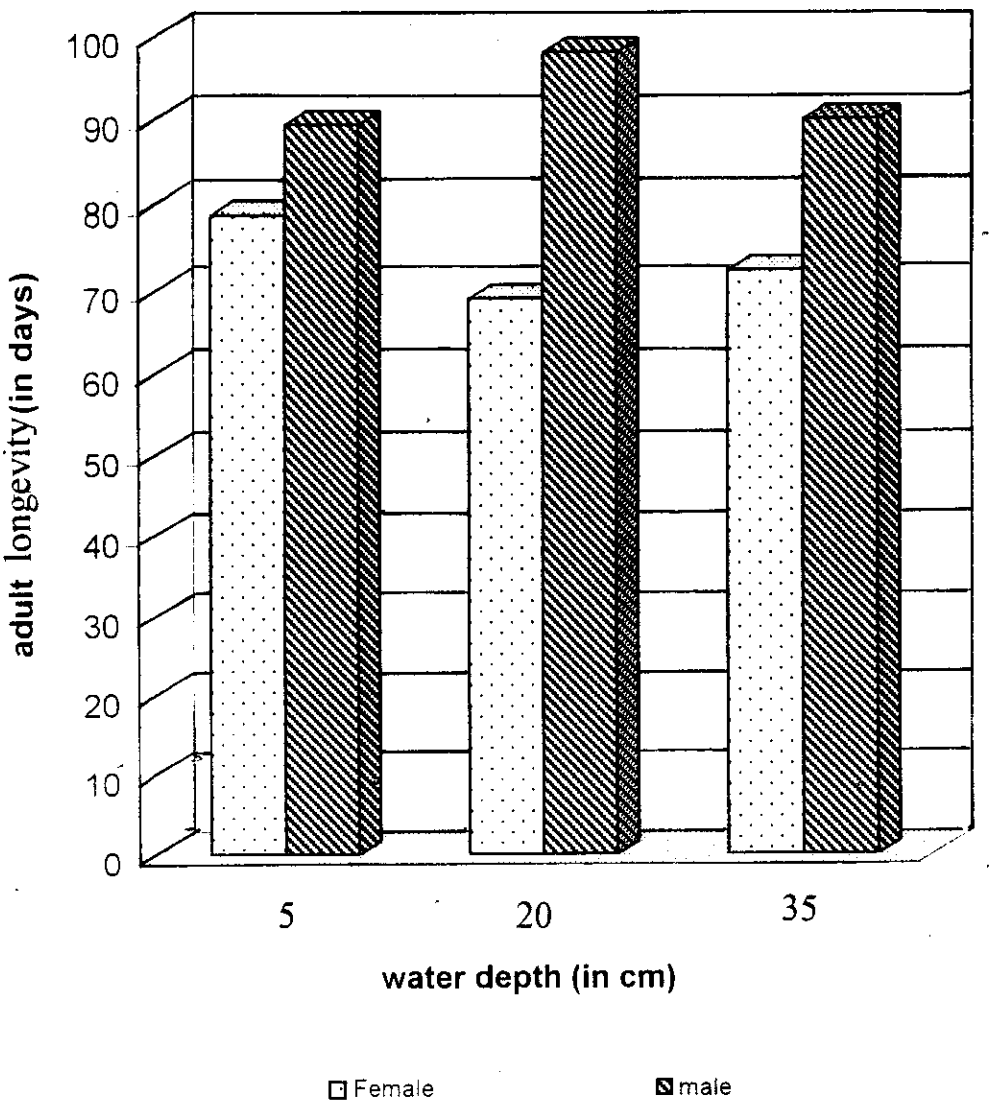


Fig. (5):Effect of water depth on the adult longevity of S. urinator

Table (6): Effect of water depth on the daily consumption of the 4th larval instar of C. pipens* by different stages of S. urinator under laboratory conditions (temp.28±2℃ and photoperiod 16L: 8D).

Water depth**	Consumption of Culex larvae/day (mean ±S.E.)			
	Nymph stage		Adult stage	
	1st	5th	Male	female
Low (5 cm)	4.43 ±0.23	16.53 ±0.28	19.66± 1.51	26.25± 2.39
Medium (20 cm)	4.42 ±0.30	17.2 ±0.19	20.92± 0.98	25.13± 0.47
High (35 cm)	4.11 ±0.25	16.42±0.62	21.8 ± 1.3	24.59± 1.85

(*) 10,25,30and 30 4th larval instar of C. pipiens were provided daily to 1st , 5th nymphal instar ,male and female of S. urinartor respectively

The statistical analyses of data in table (6) show no significant difference in the daily consumption of 4th mosquito larvae by S. urinator nymphs and adults reared in different water depths.

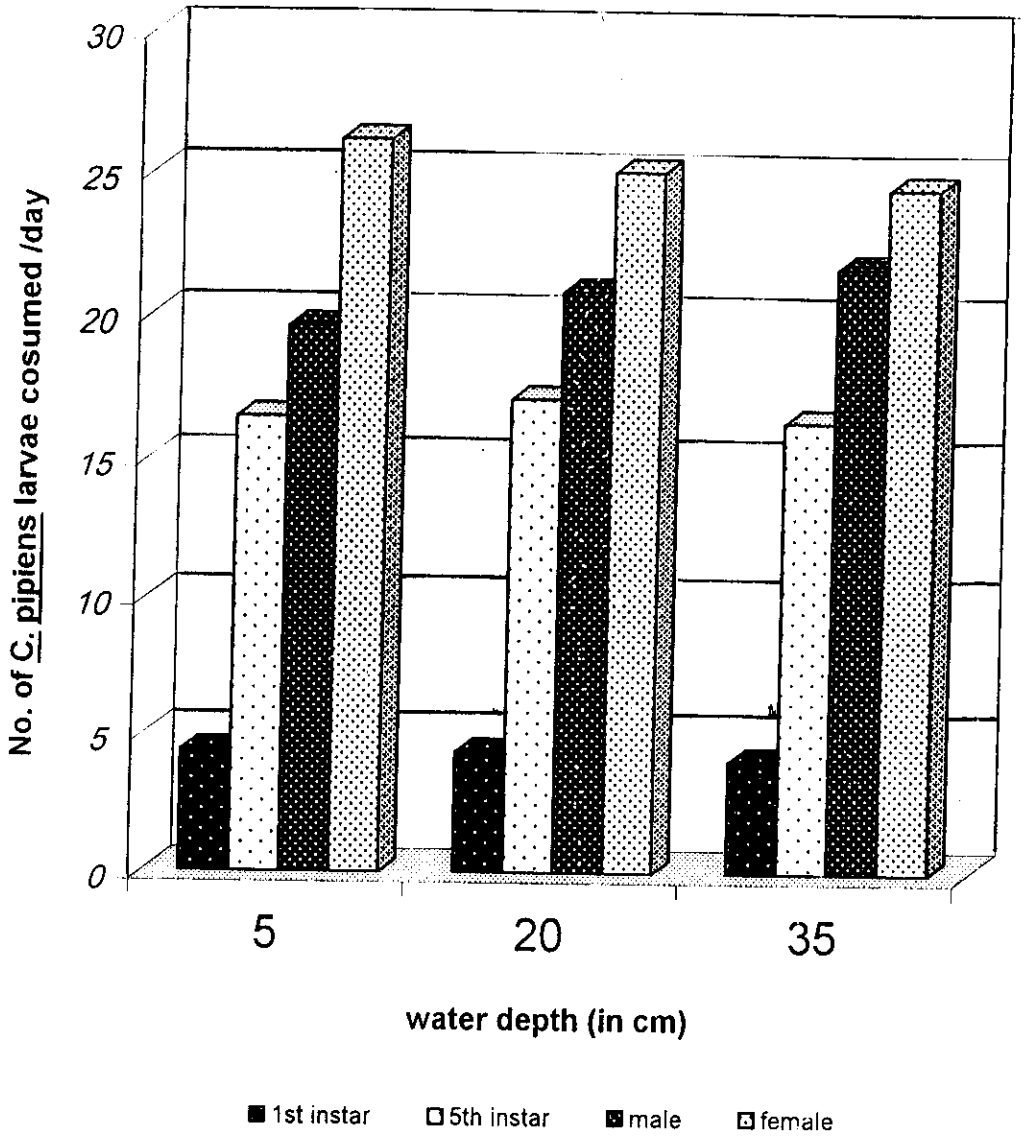


Fig.(6): Effect of water depth on the daily consumption of C. pipens larvae by different stges of S. urinator

2.water surface area:-

2.1. Effect of water surface area on the development of the immature stage :-

To study the influence of the water surface areas on the development of S. urinator nymphs, newly hatched nymphs were placed in glass aquaria with different surface areas. All aquaria were filled with tap water to 5-cm height and maintained in laboratory conditions (temperature 28±2°C and photoperiod 16L: 8D).

Duration of each nymphal instar, total duration of the nymphal stage and mortality percentage were all recorded in the following tables (7and 8) and graphically illustrated in the figures (7and8).

The statistical analyses of the data in table (7) indicate the following:

The water surface area had no significant effect on the duration of S. urinator nymphs, the duration of 1st nymphal instars reared in different three water surface areas had no significant difference.

A significant decrease in the duration of 2nd nymphal instar was observed when nymphs were reared in medium water surface area than those reared in small or large water surface areas ($P<0.05$), while a non significant difference was observed between the duration of 2nd instar nymphs reared in small and large water surface areas.

A non significant difference in the duration of 3rd and 4th instar nymphs was observed between nymphs reared in small and medium or medium and large water surface areas, but a significant decrease was observed among nymphs reared in small and large water surface areas ($P<0.05$).

In case of 5th nymphal instar, no significant difference was found among the duration of nymphs reared in different water surface areas.

The average total duration of nymphal stages reared in small, medium and large water surface areas (23.8,22.53and 23.97days respectively) were not significantly different from each other in all treatments.

Table(8): Effect of water surface on the percentage mortality of nymphal instars(*) of S. urinator under laboratory conditions of temp. 28±2°C and photoperiod 16L: 8D(water depth =5cm).

Water surface area	Mortality %					
	1st	2nd	3rd	4th	5th	Total
small (40×20cm)	4	7	12	6	0	29
Medium (40× 40cm)	9	14	9	4	0	36
large (40× 60 cm)	3	12	11	2	5	33

(*) Newly hatched nymphs were used.

The data in table (8) indicate the following:

The lowest mortality was observed in the 5th instar nymphs reared in all treatments (0, 0 and 5% for insects reared in small, and large water surface areas respectively), also it is clear from the data that the water surface area had no marked effect on the mortality % of different stages.

As a whole mortality was increased with the increase of water surface areas 29, 36 and 33% mortality % were recorded in nymphs reared in small, medium and large water surface areas.

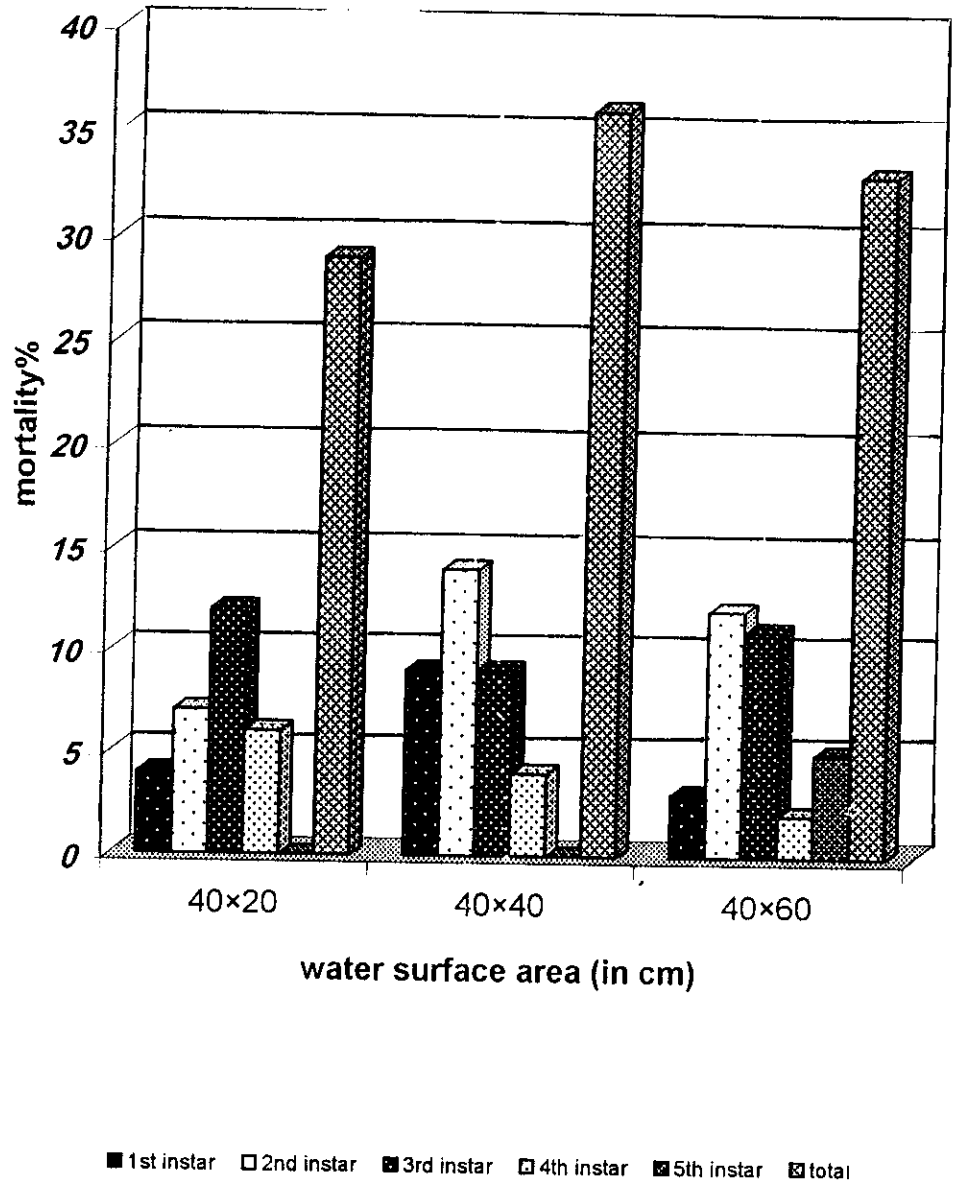


Fig.(8): Effect of water surface area on the mortality% of nymphal instar of S. urinator

2.2. Effect of water surface area on some biological aspects of the adult stage:-

To test the effect of water surface area on the sexual maturation, (preovipostion, ovipostion and postovipostion periods) fecundity (number of eggs per raft and number of rafts and eggs laid per female) and longevity of S. urinator adults, three groups of newly emerged adults were kept in glass aquaria with different surface areas (low medium and high) under laboratory conditions (temperature 28±2°C and photoperiod 16L: 8D).

The recorded data are presented in the tables (9,10 and 11) and graphically illustrated in the figures (9,10 and 11).

Table (9): Effect of water surface area on the sexual maturation of S. urinator adults(*) under laboratory conditions of temp.28±2°C and photoperiod 16L:8D (water depth =5cm).

Water surface area	Sexual maturation (in days) mean ±S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
small (40×20cm)	10.13 ± 1.14 ab	56.6 ±3.82 ab	11.46 ±2.86 a
Medium (40× 40cm)	11.27 ±1.23 ac	53.4 ±5.01 ac	9.47 ±2.03 ac
large (40× 60cm).	11.27 ± 0.64 bc	54.33 ±5.79 bc	7.22 ±0.86 c

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used

The statistical analyses of the data in table (9) indicate that:

No significant difference ($p>0.05$) in preovipostion and ovipostion periods was observed between insects reared in all treatments.

A significant decrease in postoviposition period ($p<0.01$) was observed between adults reared in small and large water surface area, whereas no significant difference was found between the postovipostion period of adults reared in small and medium or medium and large water surface area.

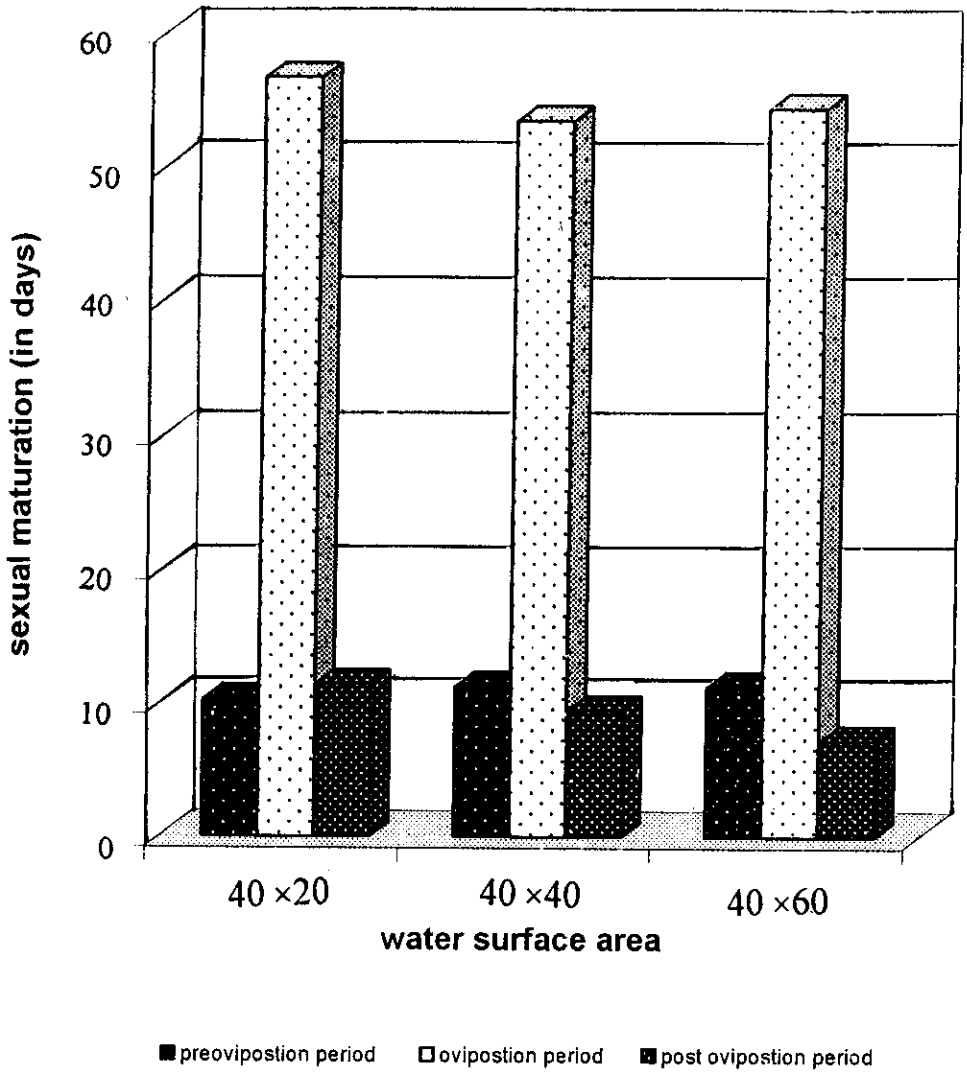


Fig.(9): Effect of water surfase area on the sexual maturation of S. urinator adults

Table (10): Effect of water surface area on the fecundity of S. urinator adults(*) under laboratory conditions of temp. 28±2°C and photoperiod 16L: 8D (water depth =5cm).

Water surface area	Fecundity mean ± S.E.		
	no of egg rafts/female	no of eggs/raft	no of eggs/female
small (40×20cm)	8.14 ±0.53 ab	78.55 ±2.77 ab	639.86 ±49.46 a
Medium (40× 40cm)	9.27 ±1.23 ac	77.45 ± 1.98 ac	718.13 ±50.61 ac
large (40× 60cm)	9.17 ±0.61 bc	80.81 ±2.27 bc	741.23 ±7.06 c

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analyses of data in table (10) indicate that:

No significant difference was found among the number of egg rafts/female and eggs/raft laid by females reared in different water surface areas. The number of eggs laid per female was significantly difference between females reared in small and large water surface areas ($p<0.05$) but not significantly different between females reared in small and medium or medium and large water surface areas.

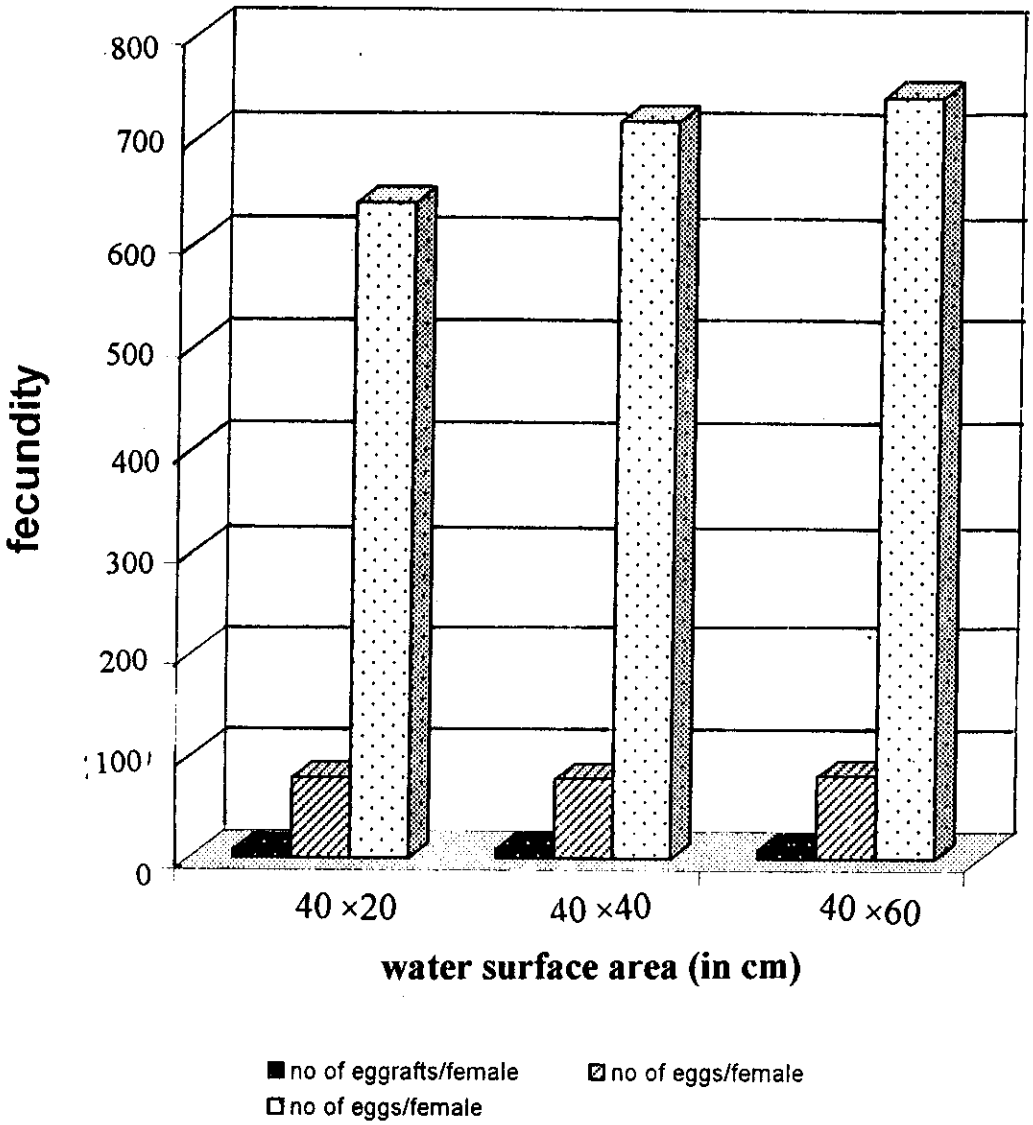


Fig.(10):Effect of water surface area on the fecundity of S. urinator adults.

Table (11): Effect of water surface area on adult (*) longevity of S. urinator under laboratory conditions of temp.28±2°Cand photoperiod 16L: 8D (water depth =5cm).

Water surface area	Longevity (in days) mean ±S.E.	
	female	male
small(40×20cm)	78.73 ±6.24^{ab}	89.33 ±5.48^{b}
Medium(40× 40cm)	74.31 ±5.79^{bc}	106.89 ±7.50^{c}
large(40×60 cm)	72.06 ±5.22^{ac}	97.07 ±8.79^{bc}

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

With respect to the influence of the water surface area on the longevity of males and females, the recorded data in table (11) indicate that the longevity of females reared in the three different water surface areas were statistically not significantly different, also the results show that no significant difference in the longevity of males reared in small and large or medium and large water surface areas. Whereas males reared in small water surface area had significantly shorter life than those reared in medium water surface area ($P<0.05$).

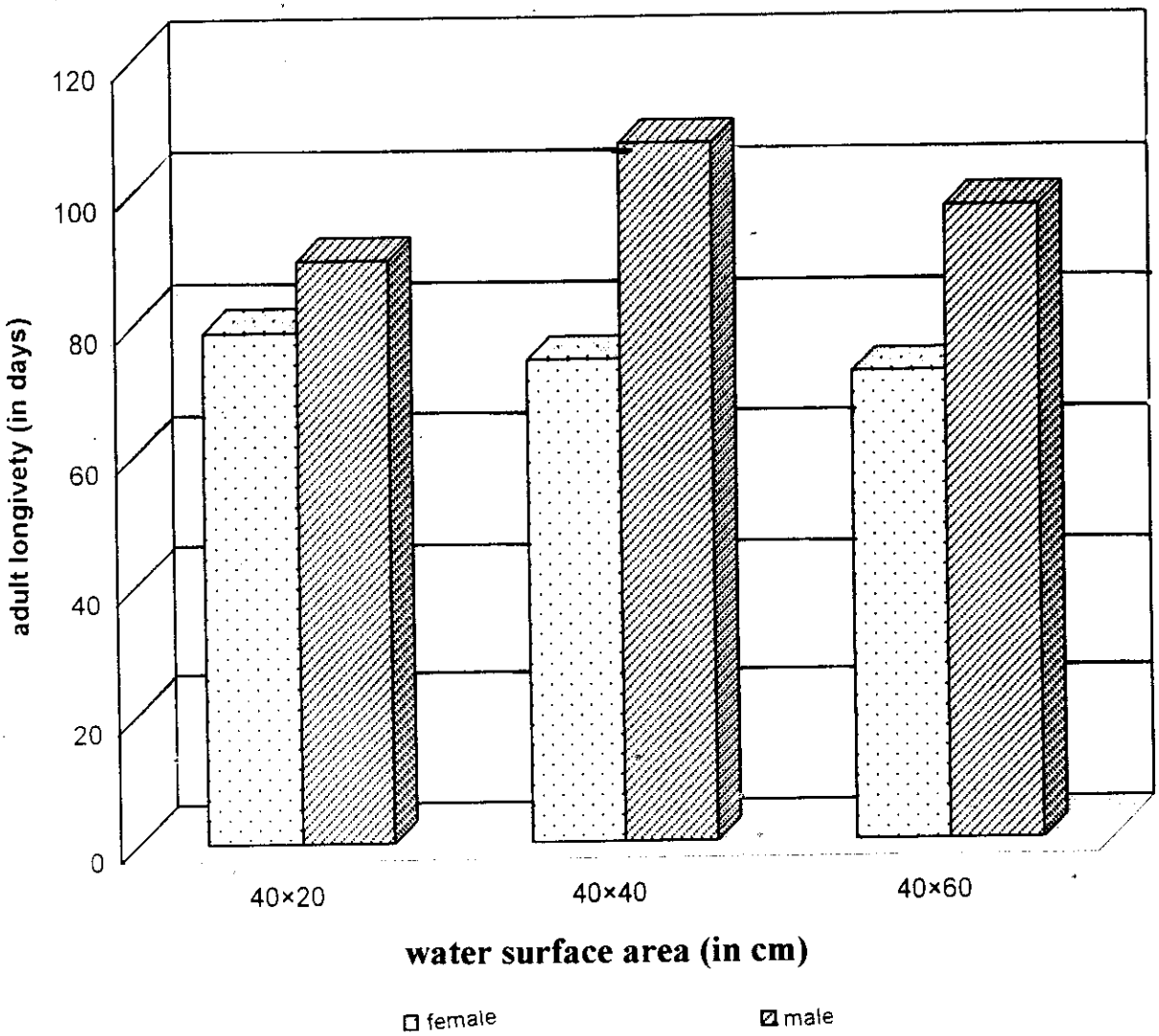


Fig. (11): Effect of water surfase area on longevityof S. urinator adults

2.3.Effect of water surface area on the daily consumption of mosquito larvae by different stages of S. urinator:-

In order to determine the effect of water surface area on the daily consumption of 4th larval instar of C. pipiens by the 1st and 5th nymphal instars, males and females of S. urinator, the following experiment was designed. Each 5 insects of tested nymphs and adults were kept in glass aquaria with different surface areas filled with tap water to 5-cm height. All aquaria were provided daily with mosquito larvae and maintained under laboratory conditions (temperature 28±2°C and photoperiod 16L: 8D).

The results obtained are given in the table (12) and graphically illustrated in the figure (12).

Table (12): Effect of water surface area on the daily consumption of the 4th larval instar of C. pipens(*) by different stages of S. urinator under laboratory conditions of temp. 28±2°C and photoperiod 16L: 8D (water depth =5cm).

Water surface area	Consumption of Culex larvae/day (mean ± S.E.)			
	Nymph stage		Adult stage	
	1st	5th	male	female
small (40×20cm)	4.43 ± 0.23	16.53±0.28	19.66±1.51	26.25 ±2.39
Medium (40× 40cm)	3.97 ± 0.48	15.56±0. 94	20.61±2.03	27.33 ±1.29
large (40× 60cm)	3.37 ± 0.55	17. 45±1.31	18.75±1.38	27.13 ±2.75

(*) 10,25,30and 30 4th larval instars of C. pipiens were provided daily to 1st, 5th nymphal instars, male and female of S. urinartor respectively

The statistical analysis of the data in table (12) indicate that:

The daily consumption of the 4th larval instar of mosquito larvae by 1st and 5th nymphal instar and adult stage of both sexes was not significantly different in all treatments of the experiment.

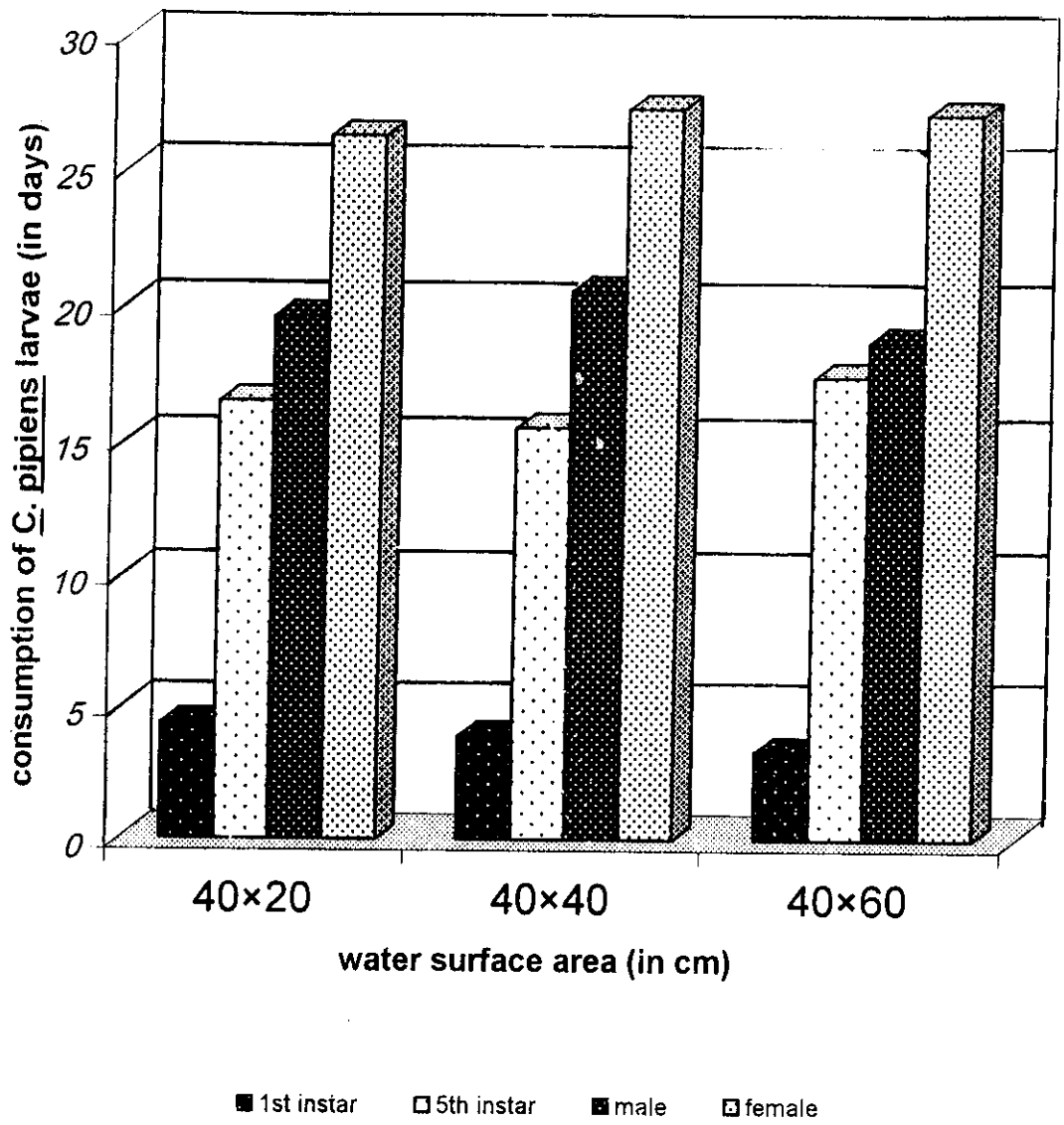


Fig.(12): Effect of water surface area on the daily consumption of C. pipiens larvae by different stages of S. urinator

3.water flora:-

3.1. Effect of water flora on the development of the immature stage :

To study the effect of water flora on the development of S. urinator nymphs, 25 newly hatched nymphs were kept individually in plastic cups containing tap water and covered with Lemna sp. Another group of 25 nymphs was treated as previously described but without water flora and was used as a check group .The experiment conducted in temperature controlled cabinet at 30 ± 1°C and 16L: 8D photoperiod. All cups were observed daily at the same time until the adult emergence.

Duration of each nymphal instar, total duration of nymphal stages and mortality were recorded in the following tables (13and14) and graphically illustrated in the figures (13and14).

Table (13): Effect of water flora on the duration of nymphal instars(*) of S. urinator under controlled conditions (temp.30±1°C and photoperiod 16L:8D).

Water flora	Duration of nymphal instar(in days) mean ±S.E.					Average total duration (in days)
	1st	2nd	3rd	4th	5th	
Water without flora	3.25± 0.1	2.65±0.11	3.25±0.12 a	4.38± 0.5 a	4.94±0.22 a	18.53 ± 0.12 a
Water covered with Lemna	3.6 ±0.05	3.41±0.12	3.46± 0.1 a	5.01±0.12 a	5.1±0.18 a	19.16 ± 0.13 a

Means in each column followed by the same letter are not significantly different.
(*) Newly hatched nymphs were used.

The statistical analysis of data in table (13) indicate the following:

The duration of 1st and 2nd nymphal instars reared in water covered with Lemna sp. was significantly longer than those reared in plantless water ($P<0.05$ and $P<0.01$ respectively).

A non-significant increase was observed in the duration of 3rd, 4th and 5th nymphal instars that reared in planted water than those reared in plantless water.

Regarding the total duration of nymphal stage, the nymphs reared in planted water had non-significant decrease (18.53 days) than those reared in plantless water (19.16 days).

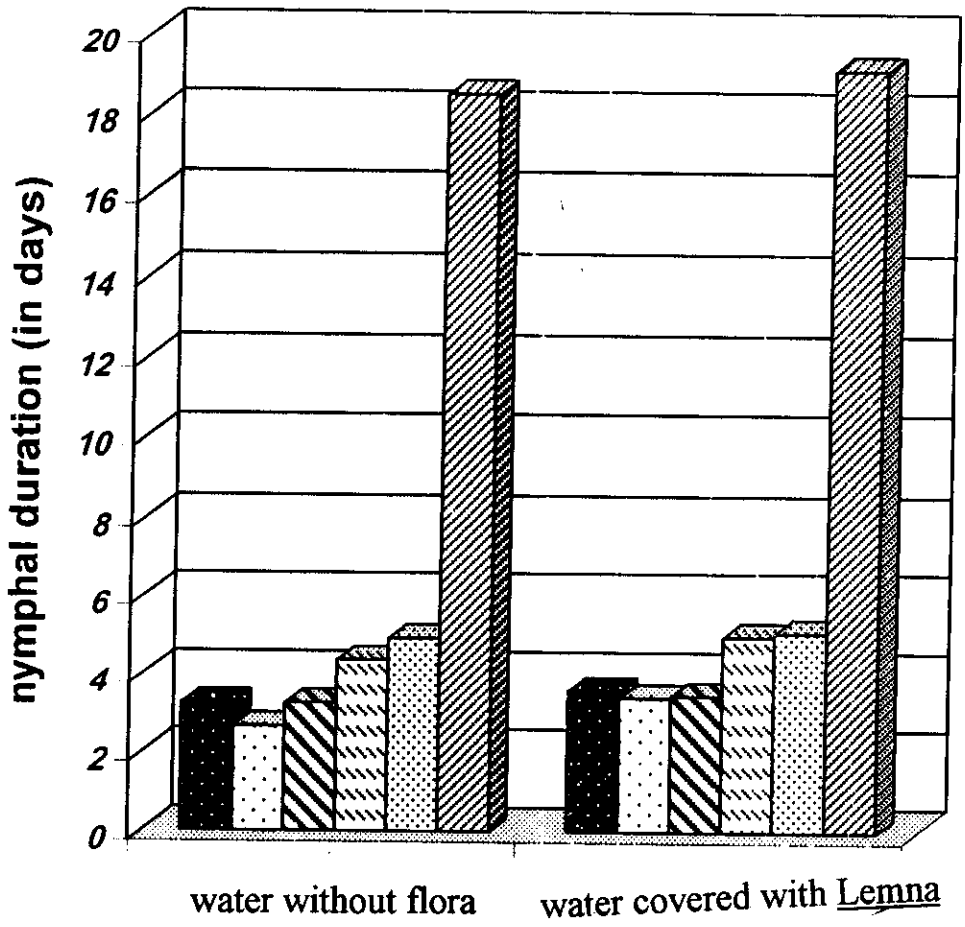


Fig.(13):Effect of water flora on nymphal instar duration of S. urinator

*Table(14):*Effect of water flora on the percentage mortality of nymphal instars (*) of S. urinator under controlled conditions (temp.30±1°C and photoperiod 16L:8D).

Water flora	Mortality %					
	1st	2nd	3rd	4th	5th	Total
Water without flora	0	0	0	16	0	16
Water covered with Lemna	4	0	4	4	0	12

(*) Newly hatched nymphs were used.

As clear from data in table (14), the mortality was observed during 1st, 3rd and 4th instar nymphs reared in planted water but no mortalites was observed during all instar nymphs reared on plantless water expect during the 4th instar (16%). As a whole the percentage mortality among nymphs reared in planted water (12%) was slightly decreased than those reared in plantless water (16%).

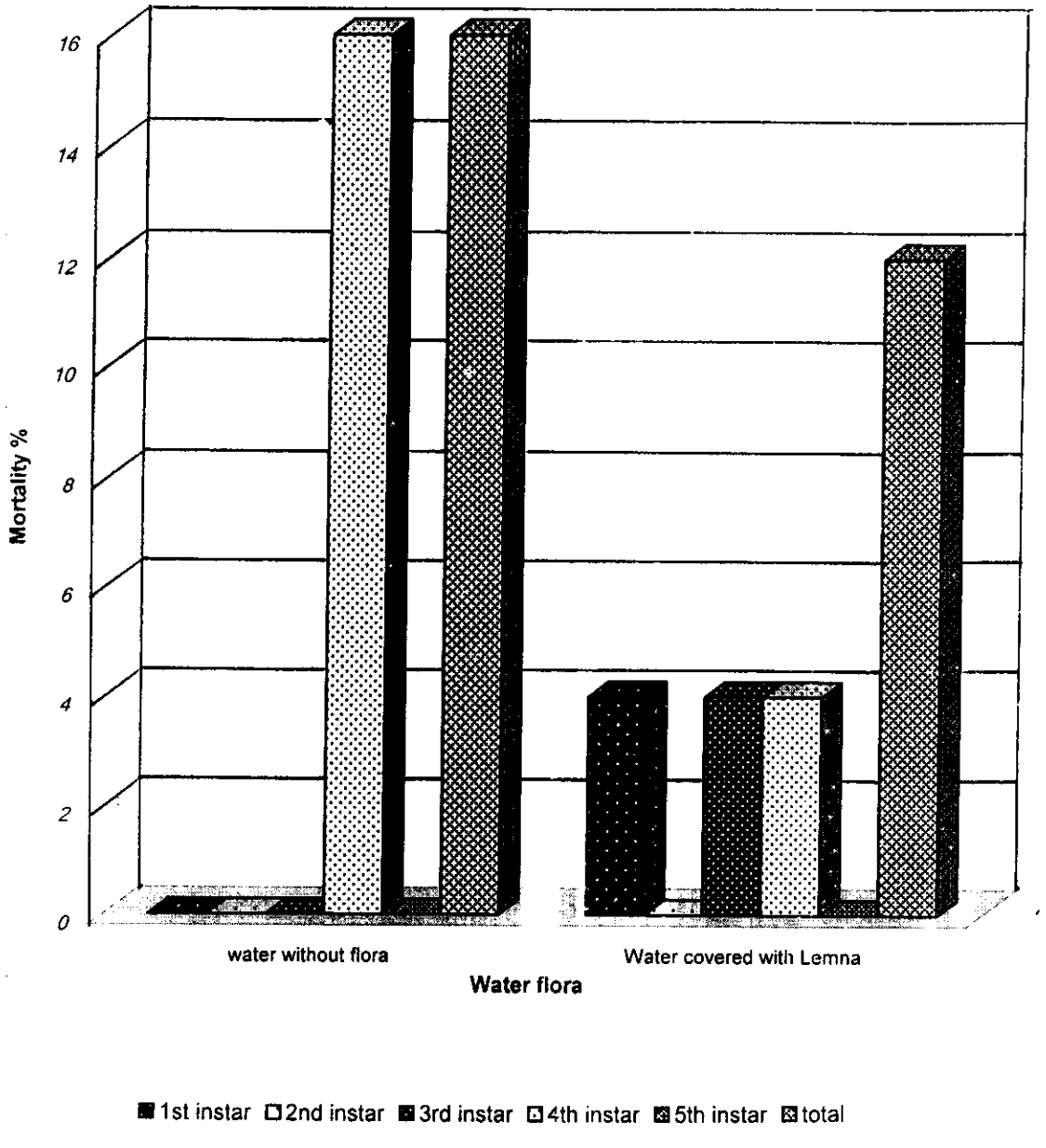


Fig. (14) : Effect of water flora on the percentage mortality of instar nymphas of S. urinator.

3.2. Effect of water flora on some biological aspects of the adult stage:-

In order to determine the effect of water flora (Lemna sp.) on the sexual maturation (preovipostion, ovipostion and postovipostion periods), fecundity (number of eggs per raft and number of rafts and eggs laid per female) and longevity of S. urinator adults, newly emerged adults were sexed and paired individually in the plastic cups covered with Lemna sp. Another group of newly emerged adults was treated as previously described but without adding water flora Lemna sp. All cups were maintained in the same conditions as previously described in 3.1.

The recorded data are presented in tables (15, 16and17) and graphically illustrated in figures (15, 16and 17).

Table (15): Effect of water flora on the sexual maturation of S. urinator adults(*) under controlled conditions(temp.30± 1°C and photoperiod 16L:8D).

Water flora	Sexual maturation (in days) mean±S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
Water without flora	9.9 ±1.02	99.6 ± 10.58[a]	9.70 ±1.13 [a]
Water covered with Lemna	12.5±2.33	82.45±7.26 [a]	9.56 ±0.27 [a]

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analyses of the data in table (15) reveal that: the preovipostion period of females reared in water covered with Lemna sp. was significantly longer than those reared in plantless water ($P<0.05$).

Non-significant decrease in the oviposition period was observed among females reared in planted water than those reared in plantless water, also the postovipostion period in both treatments was not significantly different.

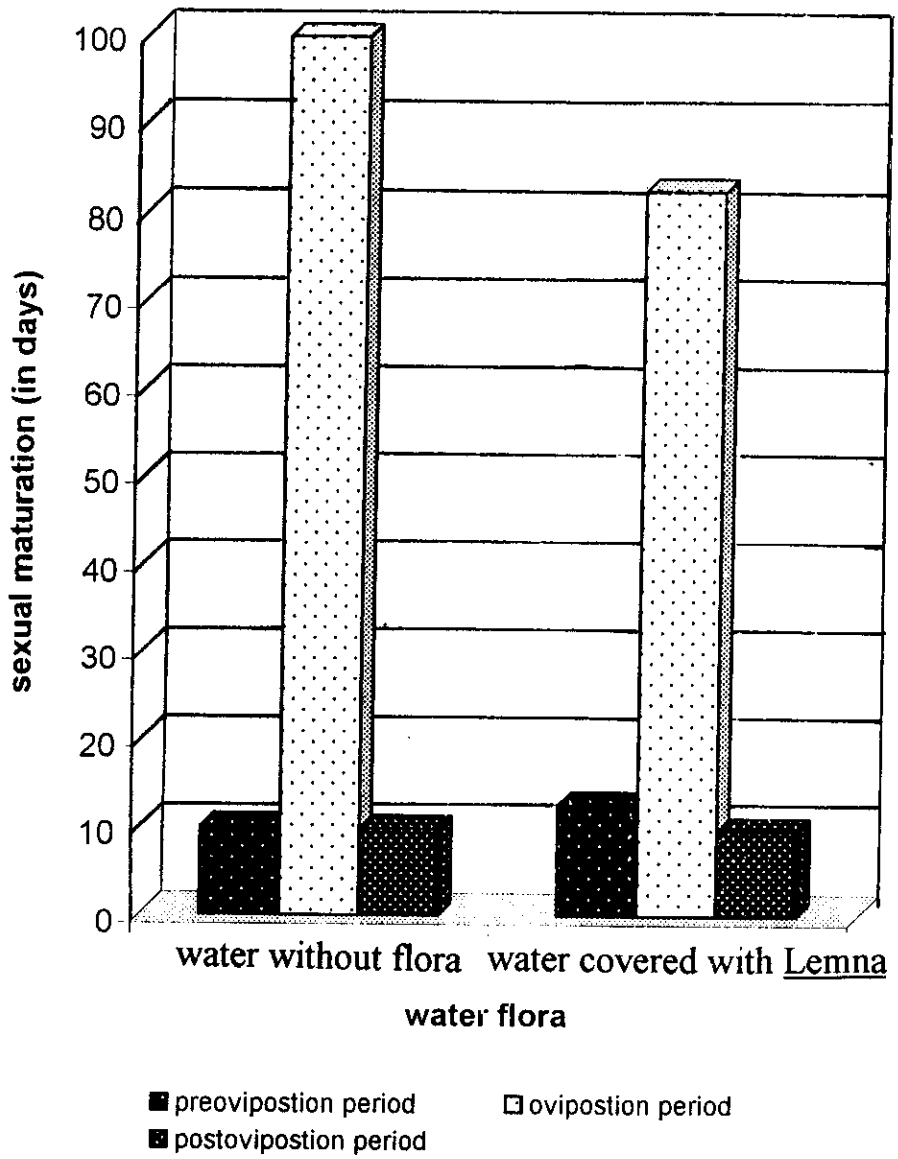


Fig.(15): Effect of water flora on the sexual maturation of S. urinator adults

Table (16): Effect of water flora on the fecundity of S. urinator adults(*) under controlled conditions (temp.30 ± 1°C and photoperiod 16L: 8D).

Water flora	Fecundity mean ± S.E.		
	no of egg rafts/female	no of eggs/raft	no of eggs/female
Water without flora	10.10 ± 0.88[a]	73.65 ± 2.59[a]	734.9 ± 64.38
Water covered with Lemna	11.05 ± 0.58[a]	62.20 ± 6.46[a]	687.26 ± 60.3

Means in each column followed by the same letter are not significantly different.
(*) Newly emerged adults were used.

The data in table (16) indicate that the fecundity of females reared in the plant covered water slightly decreased than those reared in plantless controlled water. The number of eggs per female was significantly ($P<0.05$) reduced in case of females reared in planted water (687.26egg / female) than that reared in plantless water (734.9egg / female). The data obtained also indicate that the number of egg rafts per female and number of eggs per raft were not significantly different between insects reared in planted or plantless water.

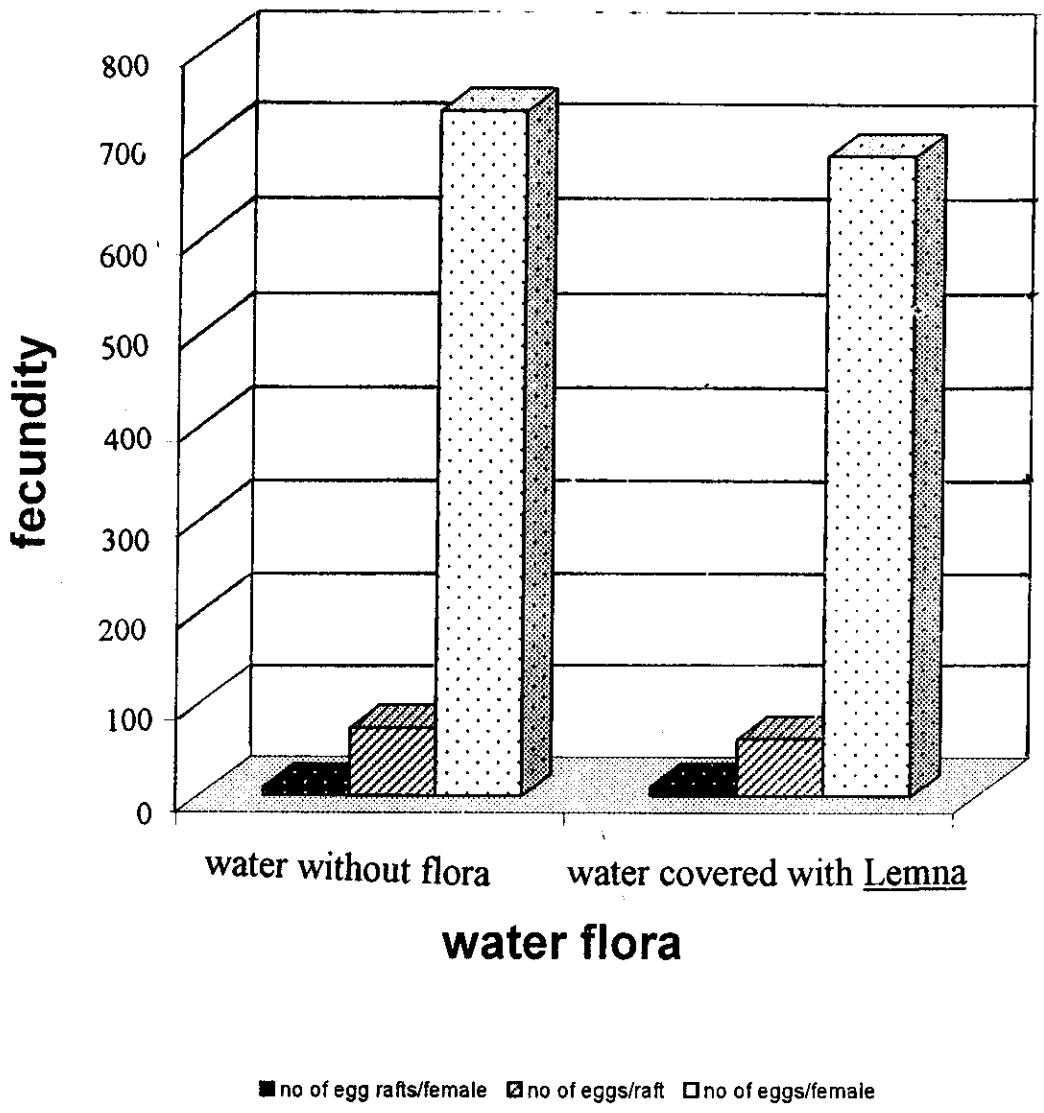


Fig. (16): Effect of water flora on the fecundity of S. urinator adults.

Table (17): Effect of water flora on adult(*) longevity of S. urinator under controlled conditions of (temp.30±1°C and photoperiod 16L: 8D).

Water flora	Longevity (in days) mean ± S.E.	
	female	male
Water without flora	116.7 ±10.41	121.50 ± 8.69
Water covered with Lemna	103.95 ± 6.44	129.63 ± 5.07

(*) Newly emerged adults were used.

The statistical analysis of data in table (17) indicate that the longevity of adult males and females of S. urinator reared in planted or plantless water were not significantly different .

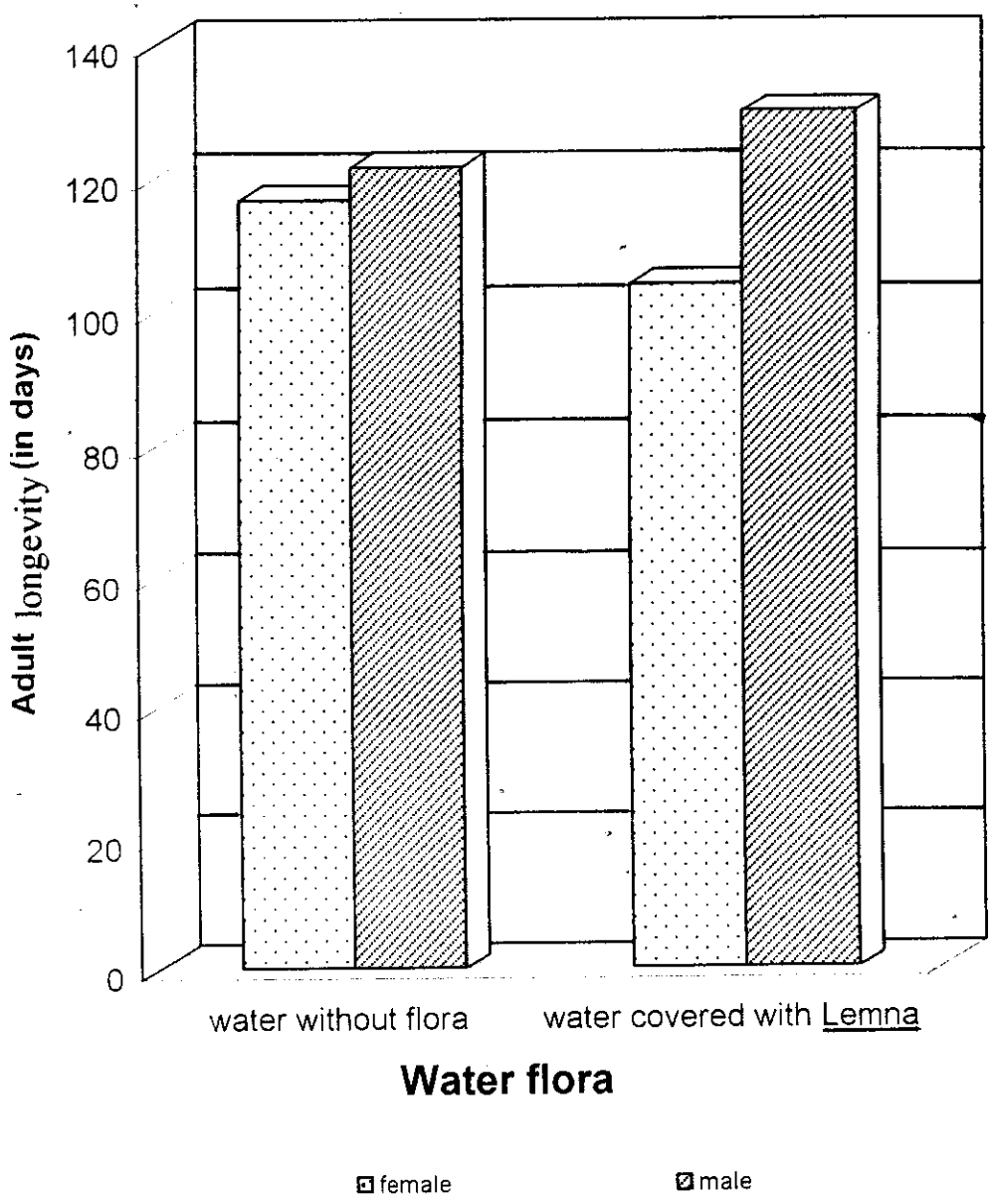


Fig.(17)Effect of water flora on adult longevity of S. urinator

3.3. Effect of water flora on the daily consumption of mosquito larvae by different stages of S. urinator:-

To study the effect of water flora on the daily consumption of 4th larval instar of C. pipiens by the 1st and 5th nymphal instars and adult male and female of S. urinator, the following experiment was designed. Each 10 insect of the tested nymphs and adults were kept individually in plastic cups containing tap water and covered with Lemna sp. Another group of insects was reared in water free from Lemna as previously mentioned. All cups were provided daily with 4th larval instar of C. pipiens (10, 25, 50, and 50 larvae) for each 1st, 5th nymphal instars, male and female respectively. The experiment was continued for 3 days and maintained under controlled conditions of temperature of 30 ± 1°C and 16L: 8D photoperiod.

The results of this experiment are presented in the table (18) and graphically illustrated in the figure (18).

Table (18): Effect of water flora on the daily consumption of the 4th larval instar of C. pipens(*) by different stages of S.urinator under controlled conditions of (temp.30± 1°Cand 16L: 8D).

Water flora	Consumption of Culex larvae/day (mean ± S.E.)			
	Nymph stage		Adult stage	
	1st	5th	male	female
Water without flora	6.44± 0.42	19.16±0.34 a	23.95±1.62 a	28.27±1.49 a
Water covered with Lemna	4.87±0.52	19.32±0.41 a	24.32±1.11 a	27.68±0.71 a

Means in each column followed by the same letter are not significantly different.

(*) 10,25,50and 50 4th larval instars of C. pipiens were provided daily to 1st , 5th nymphal instars ,male and female of S. urinartor respectively

It is clear from data in table (18) that: the dialy consumption of mosquito larvae by the 5th nymphal instar, male and female was not significantly different among insects reared in planted or plantless water. In the same time a significant reduction in the number of mosquito larvae consumed by the 1st instar nymphs reared in planted water than those reared in controlled plantless water ($p<0.05$).

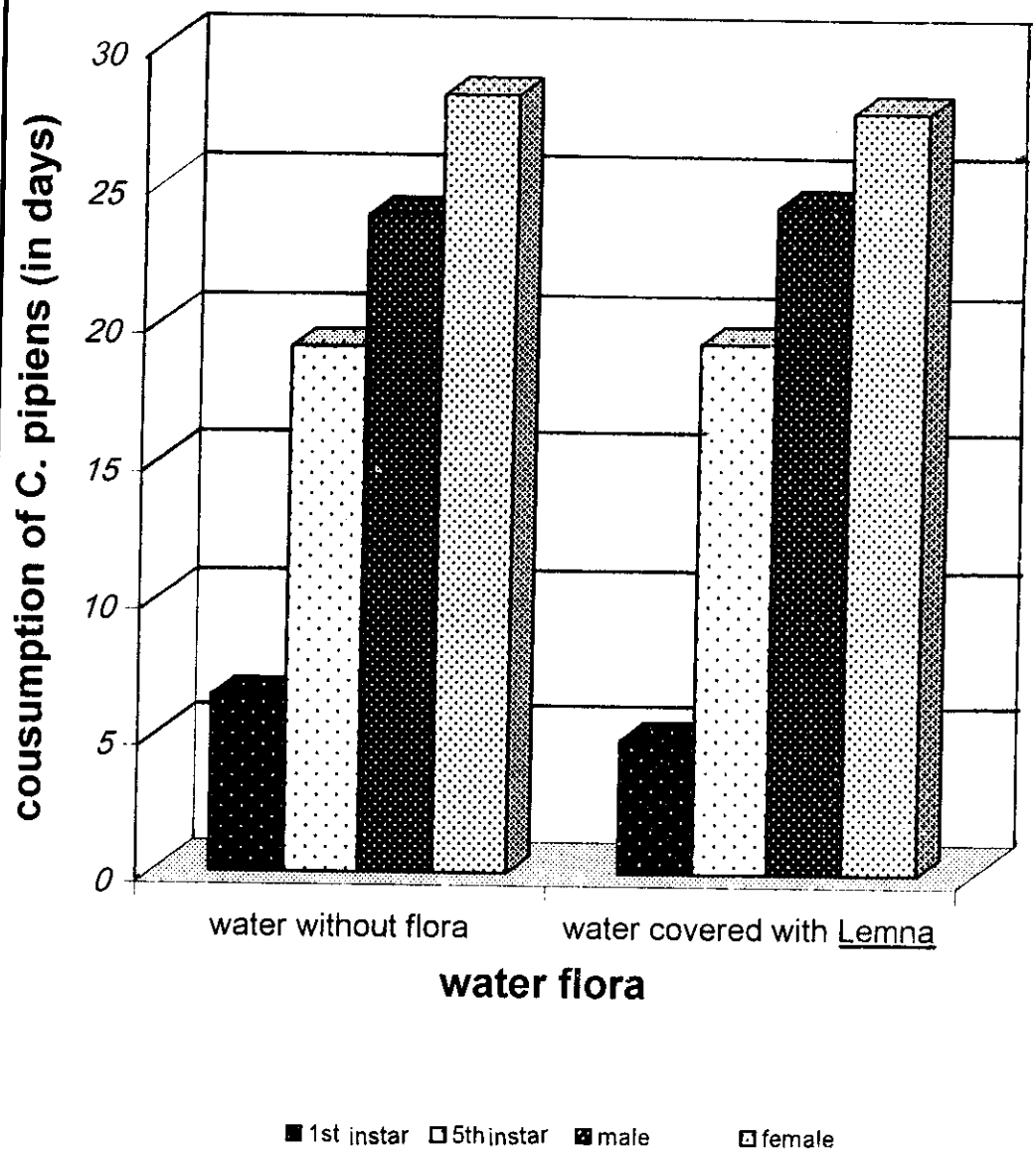


Fig.(18): Effect of water flora on the daily consumption of C. pipiens larvae by different stages of S. urinator

4.Water quality: -

4.1. Effect of water quality on the development of the immature stage .: -

To determine the effect of water quality on the development of the nymphal stage of S. urinator, three water sources from breeding sites of mosquito and S. urinator were used. Three groups of newly hatched nymphs were kept individually in plastic cups half field with water collected from the following sources, flax fermentation basins , Meet El Attar and Beltan irrigation canals.

All cups were maintained under laboratory conditions of temperature 28± 2°C and photoperiod of 16 L: 8D.

The duration of each nymphal instar, total nymphal duration of nymphal stage and mortality percent as well as sex ratio of emerged males and females were all recorded in the following tables (19 and 20) and graphically illustrated in the following figures (19 and 20).

Table (19) : Effect of the water quality on the development of the immature stage* of S. urinator under laboratory conditions (temp.28±2°C and photoperiod 16L:8D).

Water sources	Duration of nymphal instar(in days) mean ± S.E.					Average total Durations (in days)
	1st	2nd	3rd	4th	5th	
Beltan irrigation canal	3.6 ± 0.11 ab	3.4 ± o.12	3.95±0.14 a	5.22±0.20 ab	5.6 ±0.16 a	20.9± 0.334 a
Meet El Attar irrigation canal	3.55±0.11 a	4.79±0.10	3.89±0.08 a	4.94±0.16 a	5.88±0.15 a	21.38± 0.22 a
Flax fermentation basins	3.89 ±0.8 b	3.8 ± 0.14	4.47±0.12	5.39±0.16 b	6.4± 0.16	22.20 ±0.46

Means in each column followed by the same letter are not significantly different.

(*) Newly hatched nymphs were used.

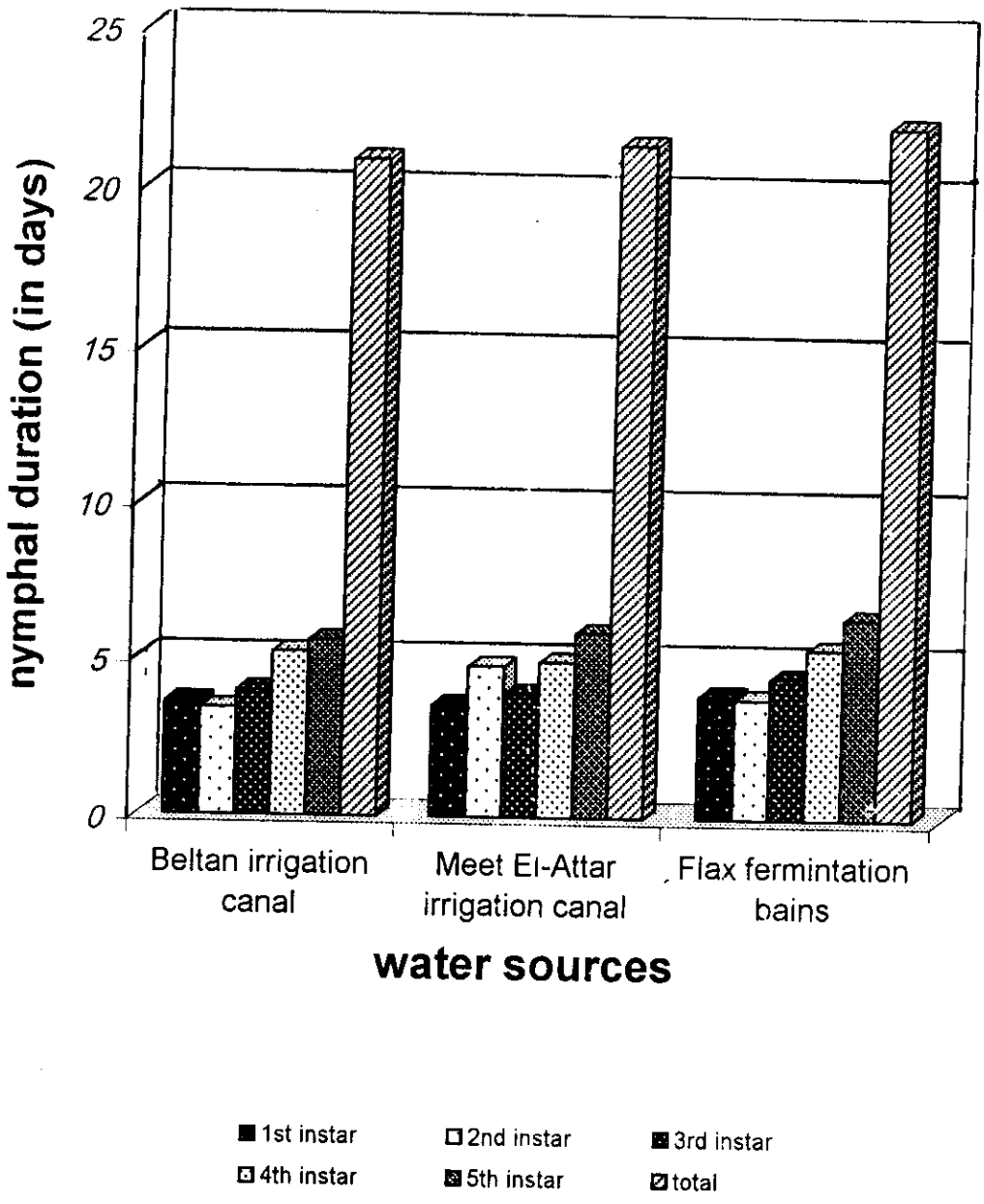


Fig.(19): Effect of water quality on the duration of nymphal instars of S. urinator

The statistical analyses of data in table (19) indicate that: -

The duration of 1st nymphal instars reared in water of Meet El-attar irrigation canal and flax fermentation basin was not significantly different than those reared in water of Beltan irrigation canal.

A significant increase was observed in the duration of 2nd nymphal instar reared in the stagnant polluted water of Meet El-Attar irrigation canal and flax fermentation basins than those reared in the running water of Beltan irrigation canal. ($P<0.001$ and 0.05 respectively).

The duration of 3rd nymphal instar reared in water of flax fermentation basins was significantly longer than those reared in water of Beltan irrigation canal ($P<0.01$), whereas no significant difference was found between the duration of nymphs reared in water of Meet El Attar and Beltan irrigation canals.

A non-significant difference in the duration of 4th nymphal instar of insects reared in all treatments of the experiment.

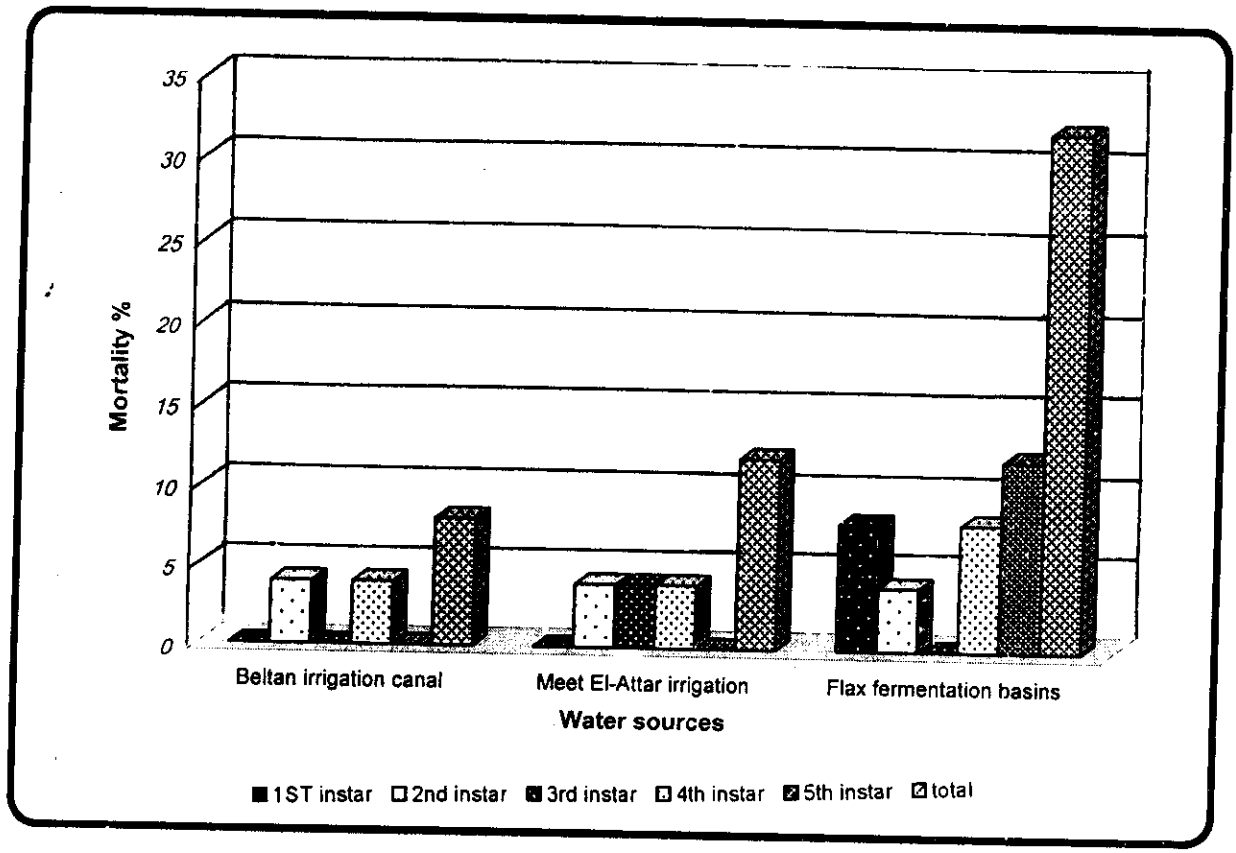
In case of 5th nymphal instar, a significant difference ($P<0.01$) was found between the duration of nymphs reared in water of flax fermentation basins and Beltan irrigation canal and no significant difference in this duration was observed between insects reared in Meet El Attar and Beltan irrigation canals.

The average total duration of the nymphal instars reared in flax fermentation basins (22.20 days) was significantly longer ($P<0.05$) than those reared in Beltan irrigation canal (20.9days). In the same time, the duration of nymphal instars reared in Meet El- Attar irrigation canal (21.38days) was not significantly different than those reared in water of Beltan irrigation canal.

Table (20): Effect of water quality on the percentage mortality of nymphal instars(*) and sex ratio of emerged adults of S. urinator under laboratory conditions (28 ± 2°Cand photoperiod 16L:8D).

Water sources	Mortality %						Sex ratio female : male
	1st	2nd	3rd	4th	5th	total	
Beltan irrigation canal	0	4	0	4	0	8	1: 1.43
Meet El Attar irrigation canal	0	4	4	4	0	12	1 : 1.3
Flax fermentation basins	8	4	0	8	12	32	1 : 1

(*) Newly hatched nymphs were used.



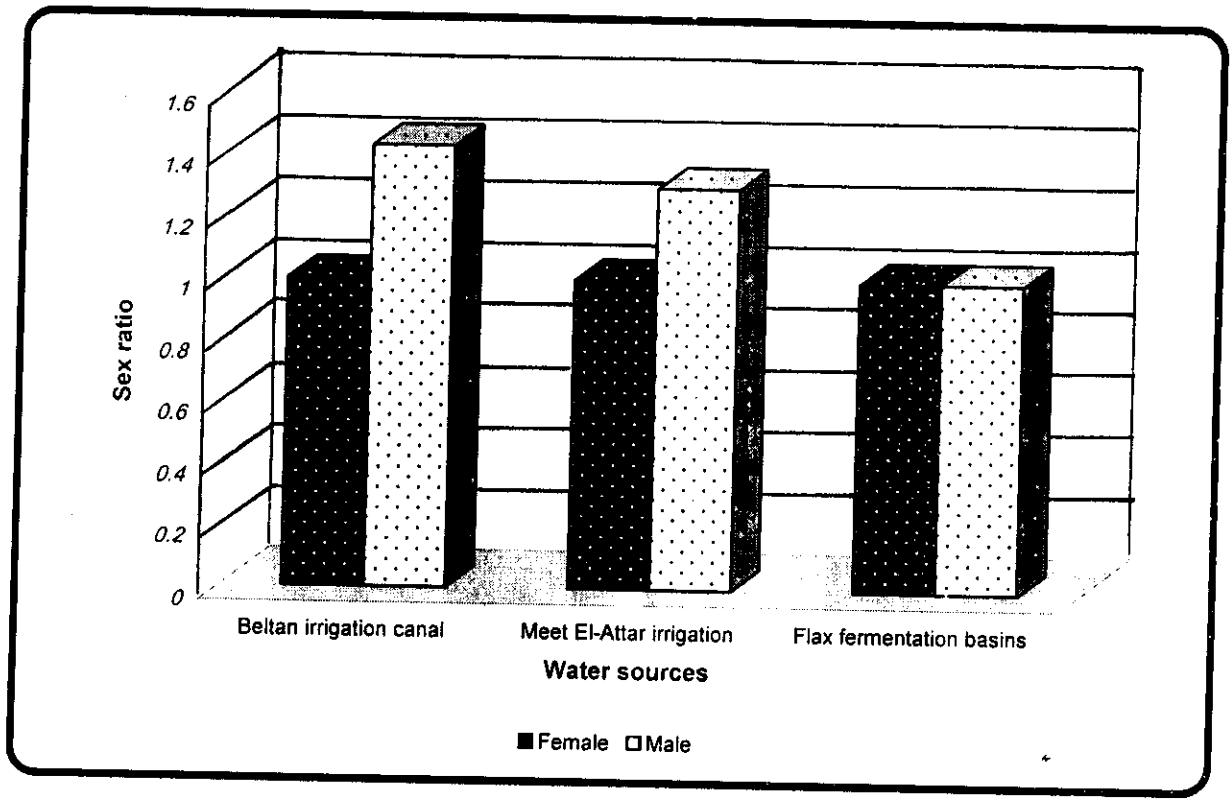


Fig. (20) : Effect of water quality on the percentage mortality of nymphal instal and sex ratio of emerged adults of S. urinator.

As shown from data in table (20): The highest rate of morality was observed during nymphal instars reared in water of flax fermentation basin, also it was observed that most of mortalities occurred during the molting.

As a whole, the mortality was higher in case of nymphs reared in flax fermentation basin than those reared in Meet El Attar and Beltan irrigation canals. 8,12 and 32%mortalities were observed respectively.

The sex ratio of emerged adults from nymphs reared in Meet El Attar and Beltan irrigation canals were 1:1.43 and 1: 1.3 (females: males) respectively. It is clear that the sex ratio skewed towards males when insects reared in water of Meet El Attar and Beltan irrigation canals whereas in case of nymphs reared in flax fermentation basin the sex ratio was equal (1:1).

4.2. Effect of water quality on some biological aspects of the adult stage: -

To determine the effect of water quality on the sexual maturation (preovipostion, ovipostion and postovipostion periods), fecundity (number of eggs per raft and number of rafts and eggs laid per female) and longevity of adult as well as fertility and incubation period of eggs of S. urinator, three groups of newly emerged adults were reared in water collected from different three sources of breeding sites, flax fermentation basins and Meet El Attar and Beltan irrigation canals under laboratory conditions of 28 ±°C and photoperiod 16L: 8D .

The recorded data are presented in tables (21,22 and 23) and graphically illustrated in figures (21,22 and 23)

Table (21): Effect of water quality on the sexual maturation of S. urinator adults(*)under laboratory conditions (temp.28±2°Cand photoperiod 16L:8D) .

Water sources	Sexual maturation (in days) mean±S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
Beltan irrigation canal	5.4 ±0.43 [a]	78 ±9.29 [a]	7.7 ± 1.16 [ab]
Meet El Attar irrigation canal	6 ±0.67 [a]	67.75 ±7.68 [a]	7.89 ±1.68 [a]
Flax fermentation basins	9.8 ±1.38	42.56 ±5.83	6.89 ± 0.82 [b]

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

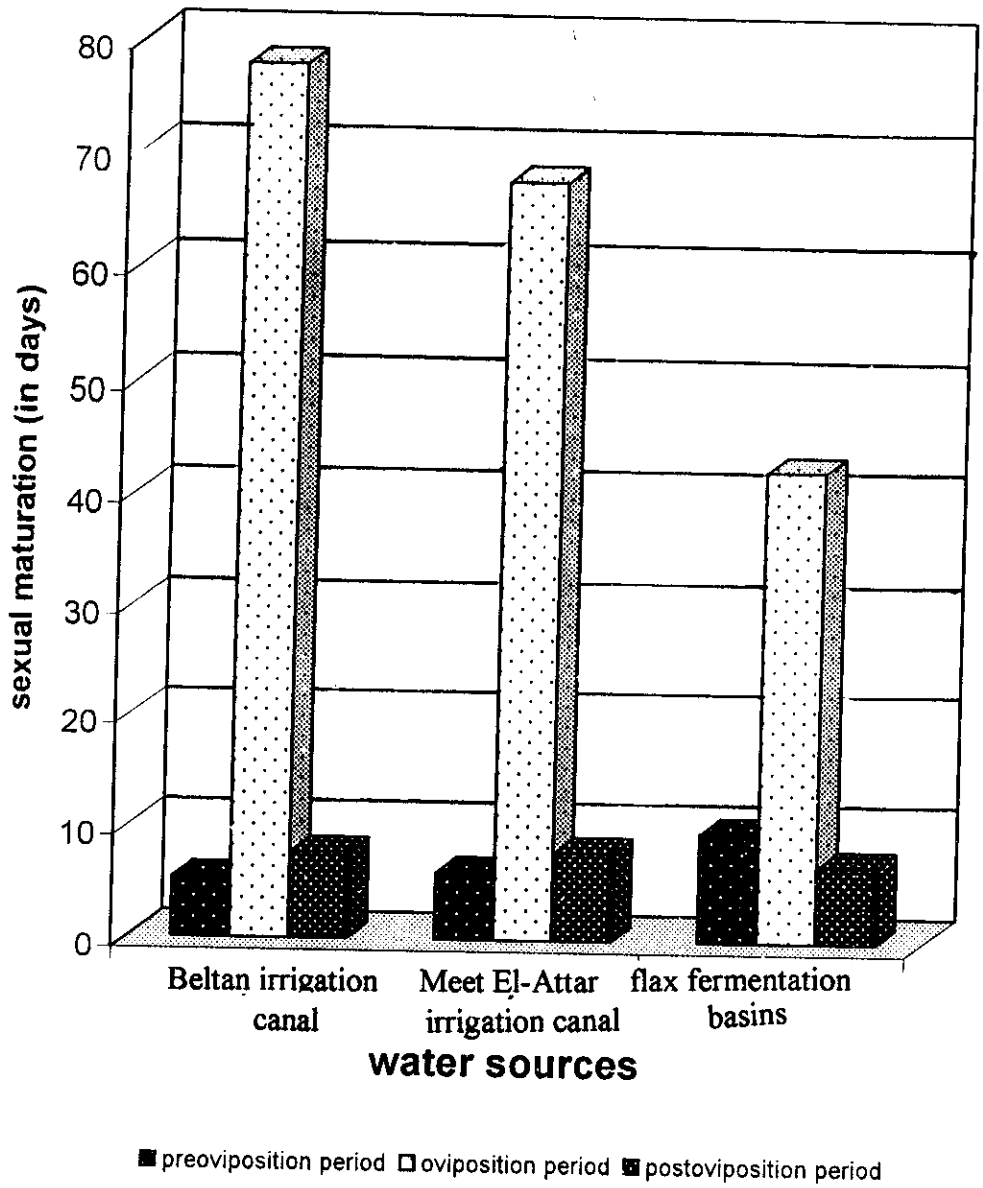


Fig.(21): Effect of water quality on the sexual maturation of S. urinator adults

The statistical analysis of data in table (21) indicate the following:

The preovipostion periods of females reared in water of flax fermentation basins was longer than those reared in water of Beltan irrigation canal ($p<0.05$), whereas a non-significant difference was observed between preovipostion periods of females reared in water of Meet El Attar and Beltan irrigation canals

A significant decrease in ovipostion period was observed between females reared in water of flax fermentation basins than those reared in water of Beltan irrigation canal ($P<0.01$). While no significant difference was observed between insects reared in water of Meet El Attar and Beltan irrigation canals.

The three groups of females reared in the different water sources had no significant difference in the postoviposition periods.

Table (22): Effect of water quality on the fecundity , fertility and incubation period of eggs of S. urinator adults(*) under laboratory conditions (temp.28±2°C and photoperiod 16L: 8D).

Water sources	Fecundity mean ± S.E.			Incubation period mean±S.E.	Fertility %
	no of egg rafts/female	no of eggs/raft	no of eggs/female		
Beltan irrigation canal	10.78 ± 1.09	84.92 ±2.21	902.1± 87.56	6.5 ± 0.22 ab	96.46
Meet El Attar irrigation canal	7.5 ± 0.71	77.32 ±2.75	579.00 ±56.0	6.33 ±0.24 a	94.23
Flax fermentation basins	7.33 ±0.67	72.26 ± 2.88	549.44±52.0	6.17 ± 0.29 b	70.5

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

Table (23): Effect of water quality on the longevity of S.urinator adults* under laboratory conditions (temp. 28±2°C and photoperiod 16L: 8D).

Water sources	Longevity (in days) mean ± S.E.	
	female	male
Beltan irrigation canal	91.6 ± 10.92	112.1 ± 7.28^{ab}
Meet El Attar irrigation canal	80.22 ± 10.56	98.5 ± 9.53^{a}
Flax fermentation basins	59.33 ± 5.50	83.33 ± 12.39^{b}

Means in each column followed by the same letter are not significantly different.
(*) Newly emerged adults were used.

The statistical analysis of the data in table (23) indicate that:

The longevity of females reared in Meet El-Attar irrigation canal was significantly shorter than those reared in Beltan irrigation canal ($P<0.05$) but females reared in flax fermentation basin water had very high significant shorter duration than those reared in Beltan irrigation canal ($P<0.001$), whereas a non significant reduction in the longevity was observed among males reared in all treatments.

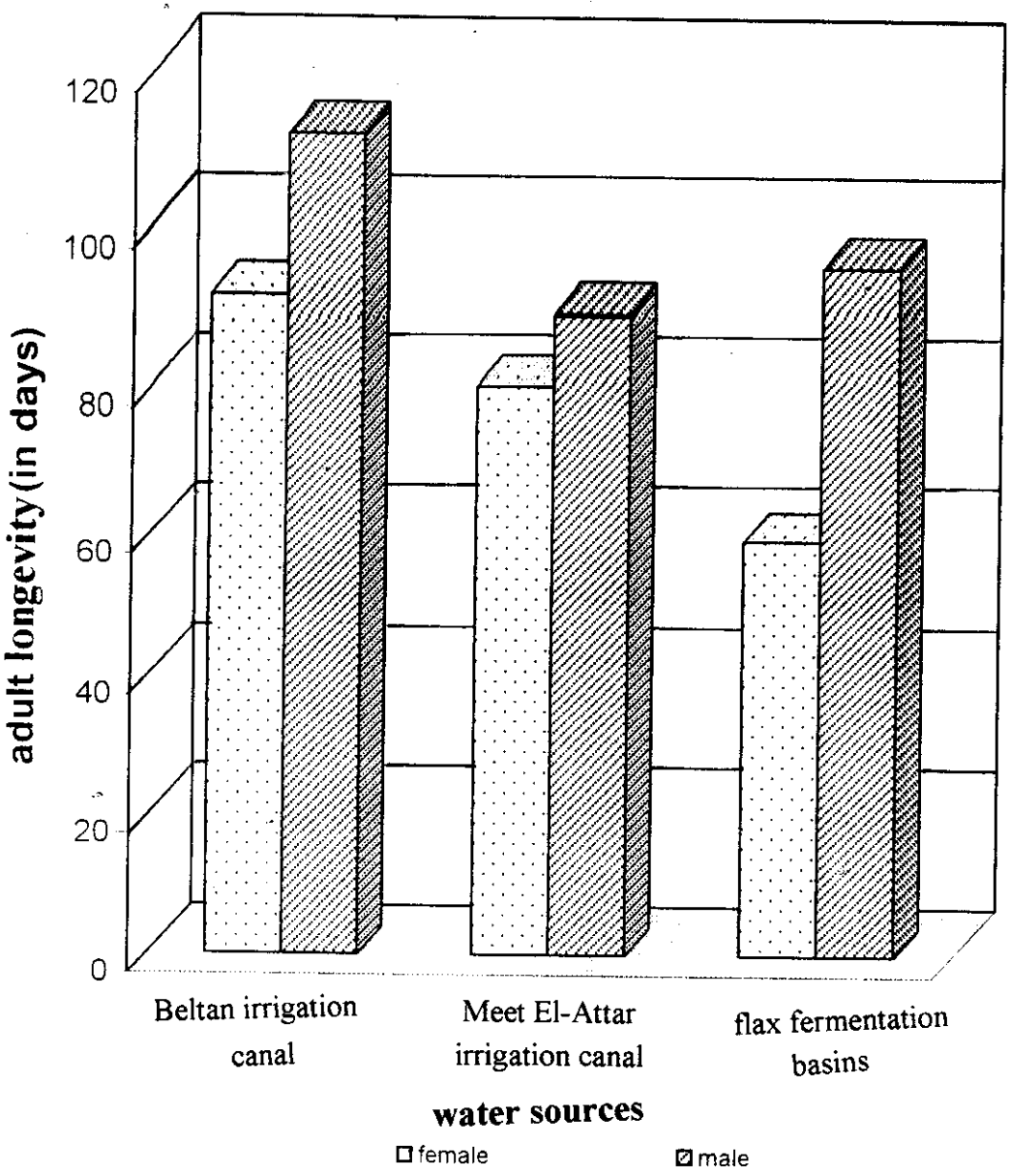


Fig.(23): Effect of water quality on the longevity of S. urinator adults

4.3. Effect of water quality on the daily consumption of mosquito larvae by different stages of S. urinator:-

In order to determine the effect of water quality on the daily consumption of 4th larval instar of C. pipiens mosquito by the 1st, 5th nymphal instars and adult stage (male and female) of S. urinator, each 10 nymphs and adults were kept individually in plastic cups filled with water collected from the three sources of breeding sites of mosquitoes and water bugs. All cups were provided daily with 4th larval instar of C. pipiens (10, 25, 50, and 50 larvae) for each 1st, 5th nymphal instars, male and female respectively. The experiment was continued for 3days and maintained under laboratory conditions of temperature 28± 2°C and photoperiod of 16 L: 8D.

The main daily consumption of mosquito larvae by the different stages of S. urinator was tabulated in table (24) and graphically illustrated in fig. (24).

Table (24): Effect of the water quality on the daily consumption of the 4th larval instar of C. pipens(*) by different stages of S. urinator under laboratory conditions (temp.28±2°C and photoperiod 16L: 8D).

Water sources	Consumption of Culex larvae/day mean± S.E.			
	Nymph stage		Adult stage	
	1st	5th	male	female
Beltan irrigation canal	3.97±0.08	20.82±0.97	22.75±1.49	24.66±1.47
Meet El Attar irrigation canal	4.15±0.22	18.83±1.56	23.38±0.84	23.29±2.23
Flax fermentation basins	4.38±0.51	18.9±2.26	20.14±1.22	24.89±2.98

(*) 10,25,50and 50 4th larval instars of C. pipiens were provided daily to 1st ,5th nymphal instars ,male and female of S. urinartor respectively

The statistical analyses of the data in table (24) indicate that. The type of water had no significant effect on the daily consumption of mosquito larvae by different stages of the water bug S. urinator.

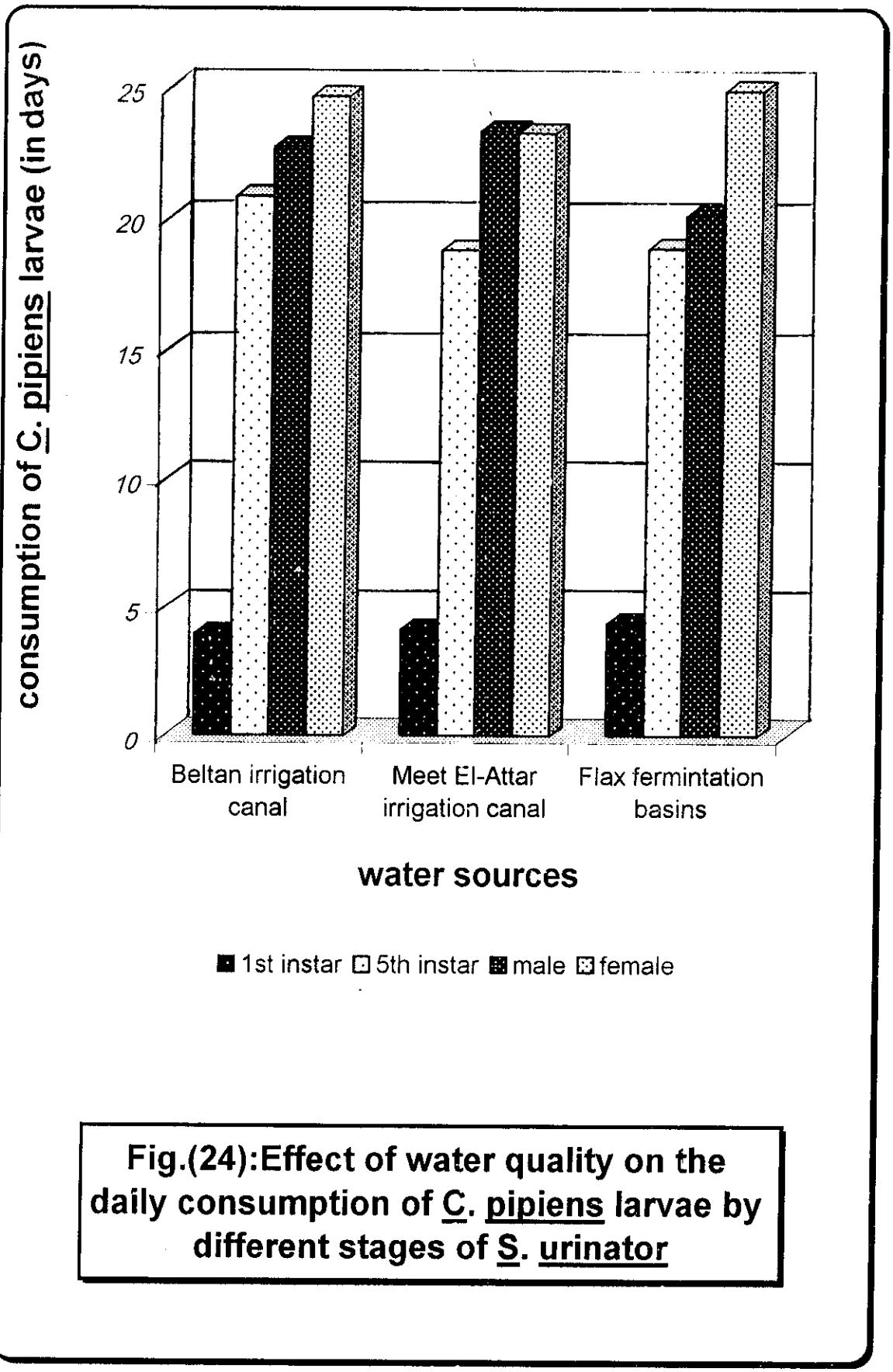


Fig.(24):Effect of water quality on the daily consumption of C. pipiens larvae by different stages of S. urinator

5.Water temperature

5.1. Effect of water temperature on the development of the immature stage :

Three groups of newly hatched nymphs were maintained in incubators with different temperature regimes (25, 30 and 35°C) combined with constant photoperiod (16L: 8D).

Duration of each nymphal instar, total duration of nymphal stage and mortality percentage as well as sex ratio of emerged males and females were recorded.

The data of these experiments are presented in tables (25and 26) and graphically illustrated in the figures (25 and 26).

Table (25): Effect of water temperature on the duration of nymphal instars (*) of S. urinator under controlled photoperiod (16L: 8D).

Water temp.	Duration of nymphal instar (in days) mean ± S.E.					Average total duration of nymphal instars
	1st	2nd	3rd	4th	5th	
25°C	4.05±0.05	3.8±0.15	4.61±0.22	6.71±0.36	7.46±0.22	26.7±0.64
30°C	3.25±0.1	2.65±0.11	3.25±0.12	4.38±0.5	4.94±0.19	18.53±0.12
35°C	2.89±0.11	2.15±0.20	2.20±0.09	3.00±0.08	5.01±0.08	15.28±0.2

Means in each column followed by the same letter are not significantly different.

(*) Newly hatched nymphs were used.

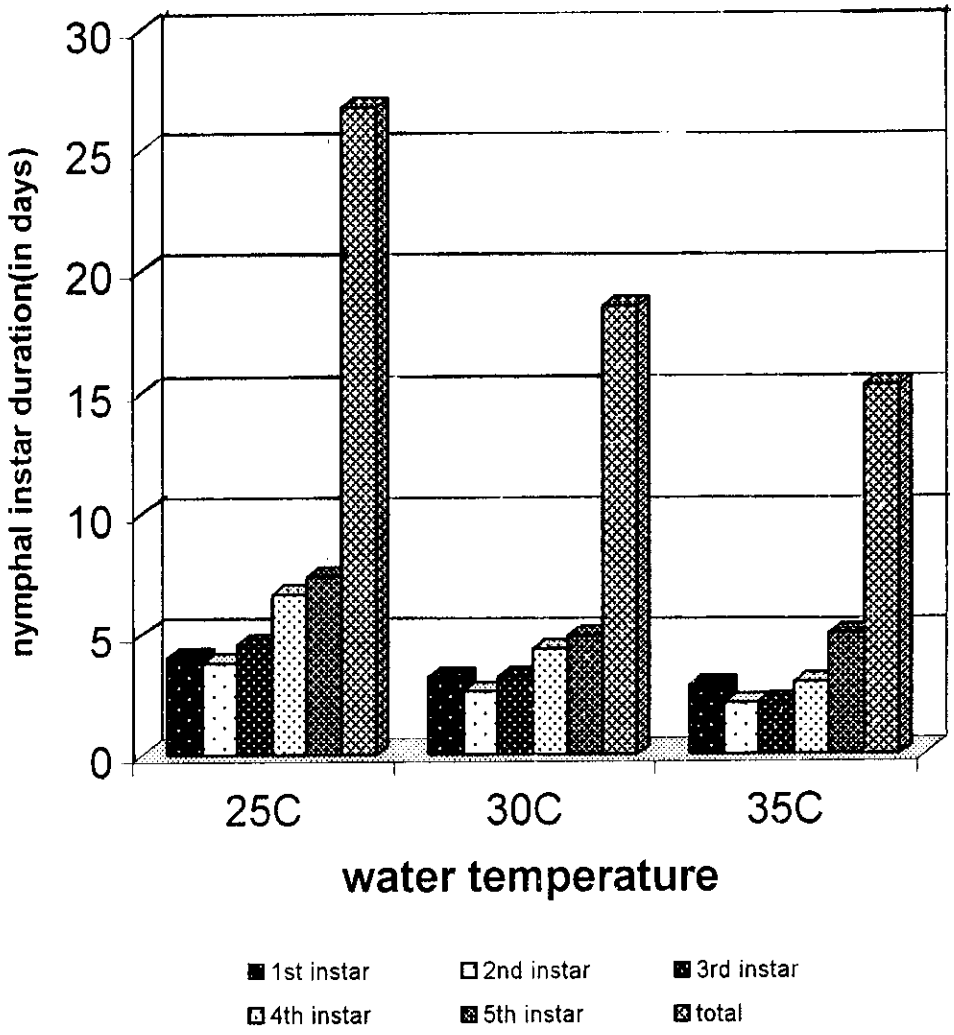


Fig.(25): Effect of water temperature on the duration of nymphal instars of S. urinator

The statistical analyses of the data in table (25) indicate the following: The water temperature had a marked effect on the duration of S. urinator nymphs. A very high significant difference ($P<0.001$) in the duration of both 1st and 2nd nymphal instars reared in water temperature of 25°C than those reared in 30 and 35°C. Whereas a significant difference in the 1st instar nymphs ($P<0.05$) and a high significant difference ($P<0.01$) in the 2nd instar nymphs were observed between nymphs reared under 30 or 35°C temperature regimes.

A very high significant difference was observed in the duration of 3rd nymphal instars in all treatments of the experiment ($P<0.001$).

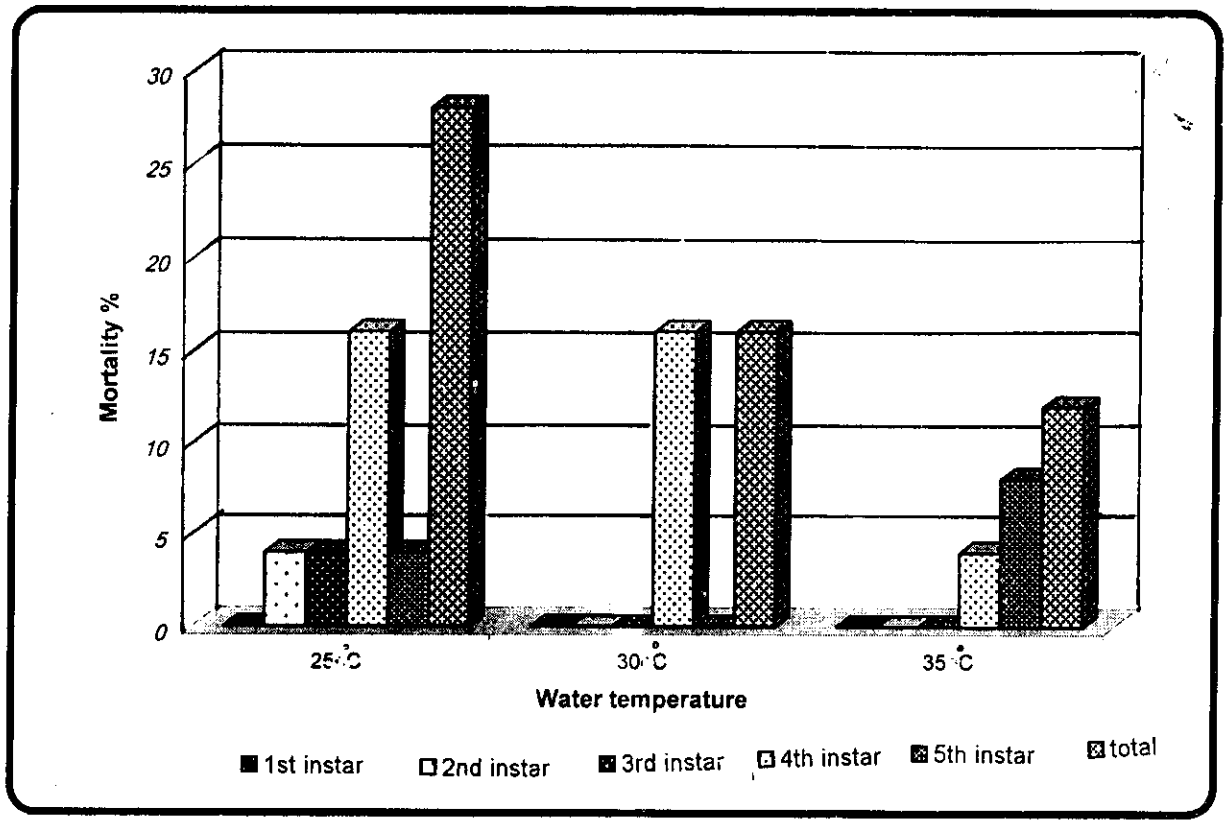
In case of 4th and 5th nymphal instar durations a very high significant reduction was observed when nymphs were reared in 25 ,30 and 35°C, but a significant ($P<0.05$) and a non significant ($P>0.05$) difference in the duration of 4th and 5th nymphal instar duration respectively reared in 30and 35°C.

Accordingly, the total duration of nymph stage was decreased with the increase of water temperature. A very high significant difference was observed in the duration of nymphal stage in all treatments of the experiment ($P<0.001$). The average total duration of nymphs reared under 25, 30 and 35°C was 26.7, 18.53 and 15.28 days respectively.

Table (26): Effect of water temperature on the percentage mortality of nymphal instars(*)of S. urinator under controlled conditions of photoperiod (16L: 8D).

Water temp.	Mortality%						Sex ratio female:male
	1st	2nd	3rd	4th	5th	Total	
25°C	0	4	4	16	4	28	1.4 : 1
30°C	0	0	0	16	0	16	1 : 1.1
35°C	0	0	0	4	8	12	1 : 1.43

(*) Newly hatched nymphs were used.



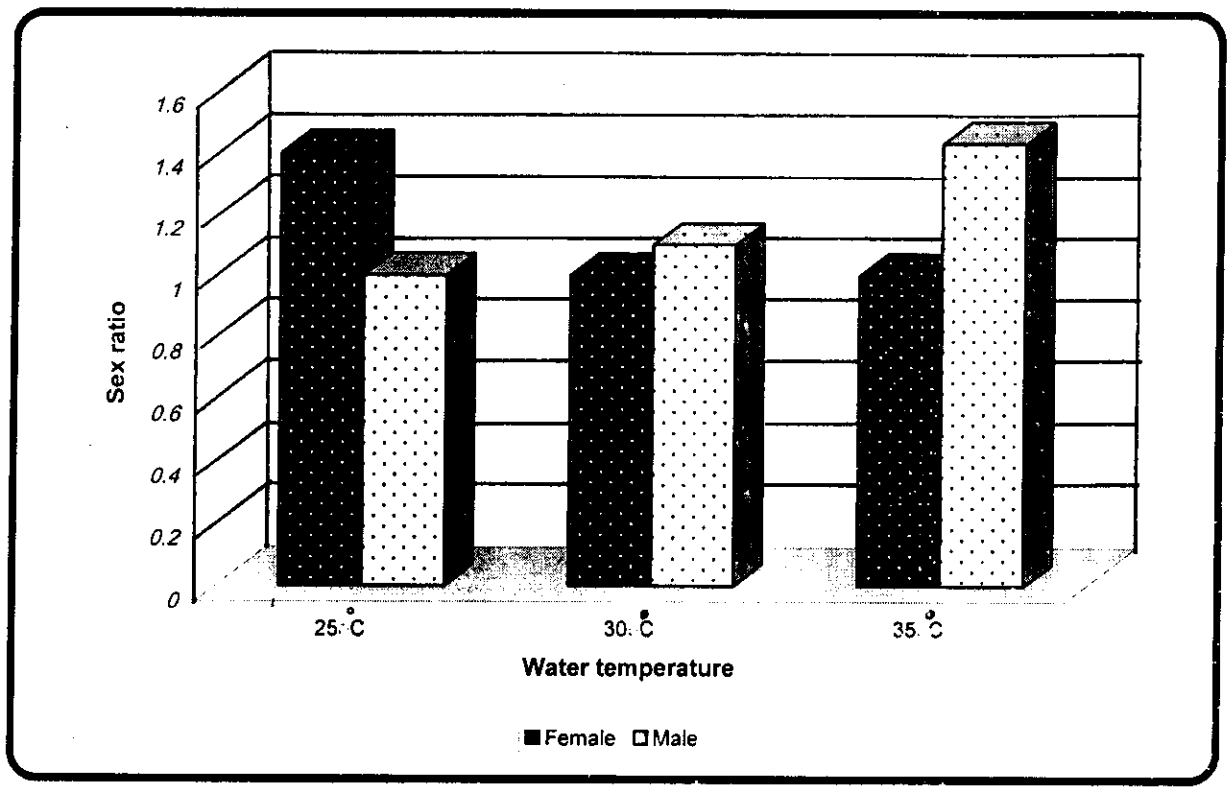


Fig. (26) : Effect of water temperature on the percentage mortality of nymphal instars of S. urinator.

The data in table (26) reveal the following: Mortality of S. urinator nymphs was decreased with the increase of the water temperature. No mortalities were recorded during the 1st instar in all treatments, among 2nd, and 3rd nymphal instars reared under 30 and 35°C and in 5th nymphal instar reared under 30°C.

The highest percentage mortality was recorded during 4th nymphal instar reared under 25 and 30°C(16%).

The total mortalities observed during the nymphal stage reared under 25, 30 and 35°C were 28, 16 and 12% respectively.

The data in the same table show that the sex ratio of adults reared under different water temperatures was skewed towards male when the temperatures increase.

Table (27): Effect of water temperature on the sexual maturation of S. urinator adults(*) under controlled conditions of photoperiod (16L: 8D).

Water temperature	Sexual maturation (in days) mean±S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
25°C	9.5 ±1.23 ab	92.77 ±9.70 a	10.13 ±3.54 ab
30°C	9.9 ±1.02 ac	99.6 ±10.58 a	9.7 ±1.13 ac
35°C	8.6 ±1.72 bc	26.5 ±2.33	11.12 ± 2.43 bc

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analysis of the data in table (27) indicate that:

No significant difference was found in the preoviposition and post-oviposition periods among females reared under different temperature regimes.

The oviposition period in females reared at 35°C was very high significantly decreased (26.5 days) than those reared at 25 and 30 °C (92.77and 99.6 days respectively). Whereas no significant difference in this period between adult females reared at 25and 30°C.

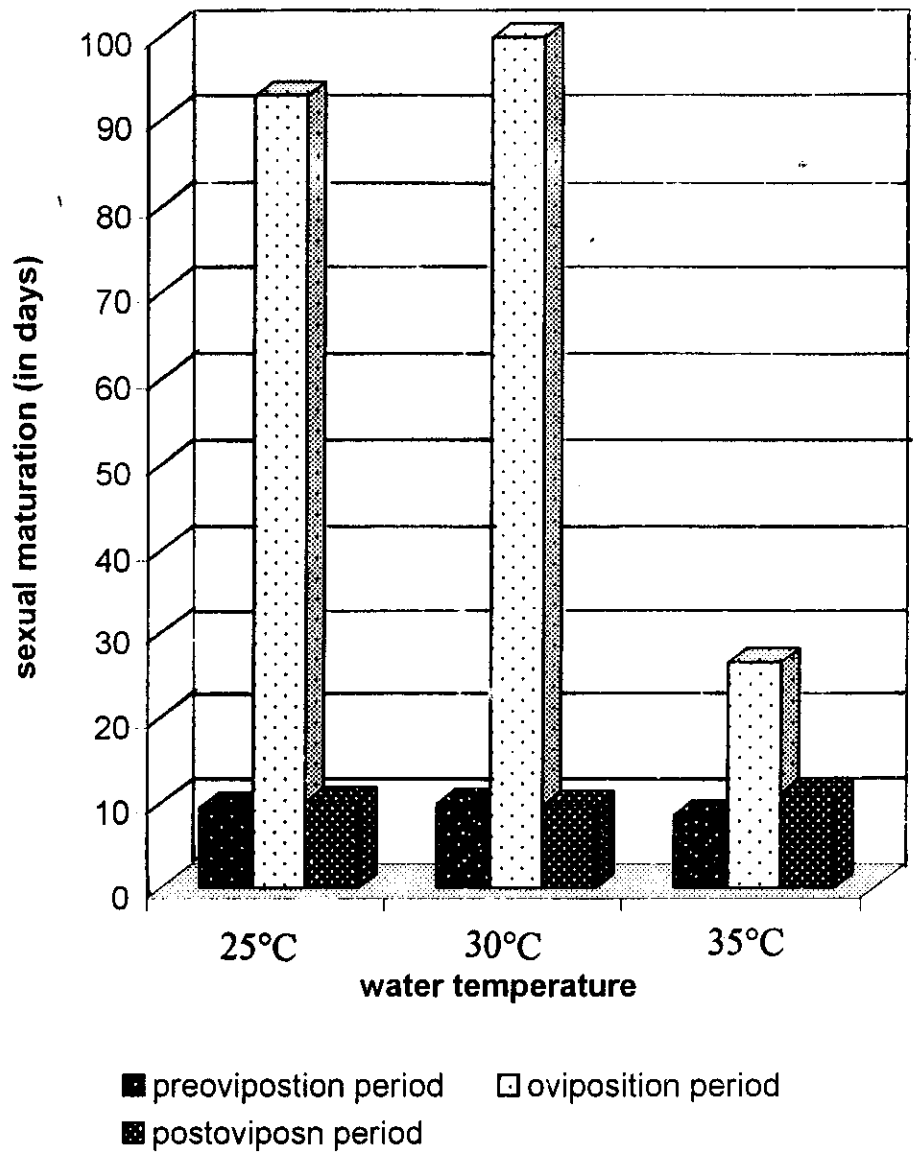


Fig.(27): Effect of water temperature on the sexual maturation of S. urinator adults

Table (28): Effect of water temperature on the fecundity as well as incubation period and fertility of eggs of S. urinator adults* under controlled conditions of photoperiod (16L: 8D).

Water temp.	Fecundity mean ± S.E.			Incubation period (in days) mean ± S.E.	Fertility%
	no of egg rafts/female	no of eggs/raft	no of eggs/female		
25°C	9.75 ± 1.13 [a]	88.92 ±4.36 [a]	866.3±91.77 [a]	8.77 ±0.26	93.09
30°C	10.1 ±0.88 [a]	73.65 ±2.59 [a]	734.9±64.38 [a]	7.2 ± 0.17	92.92
35°C	3.88 ± 0.42	62.56 ±8.22	241.0±37.95	6.17 ± 0.40	56.92

Means in each column followed by the same letter are not significantly different.

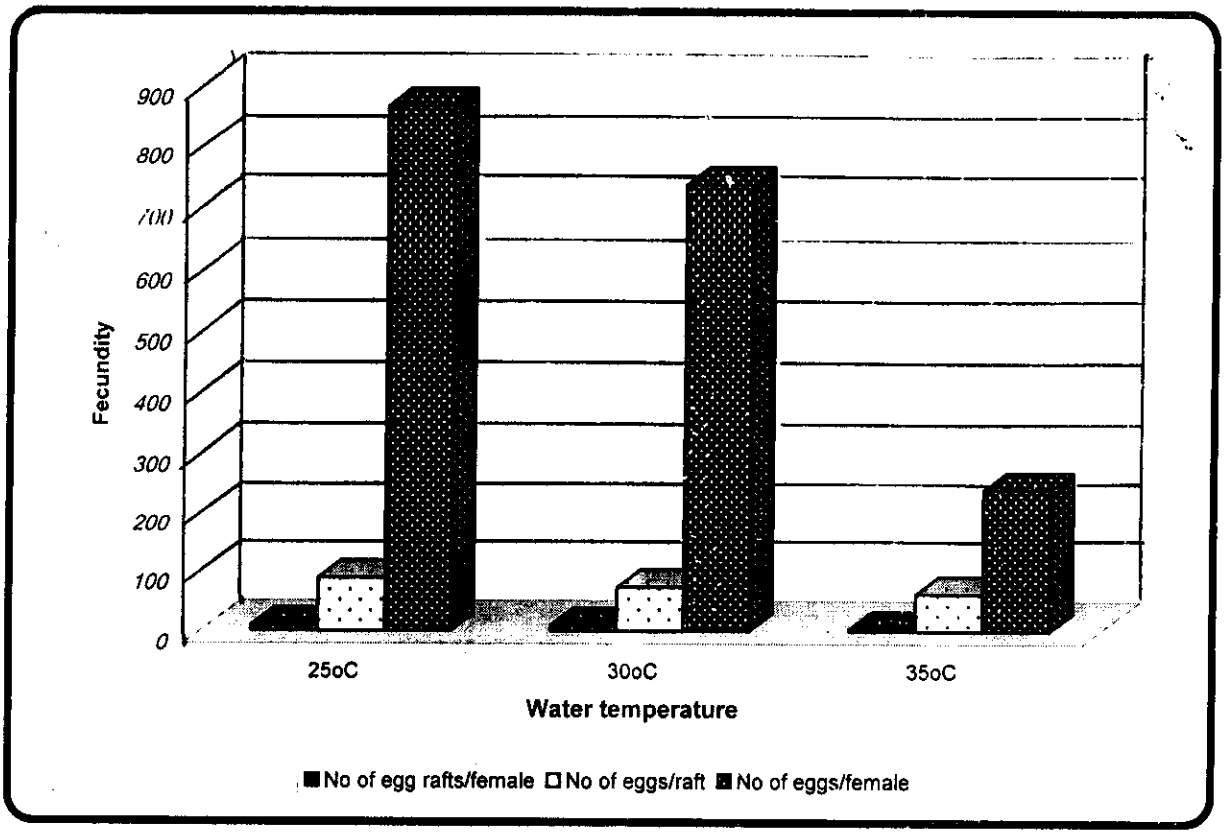
(*) Newly emerged adults were used.

Table (28): Effect of water temperature on the fecundity as well as incubation period and fertility of eggs of S. urinator adults*, under controlled conditions of photoperiod (16L: 8D).

Water temp.	Fecundity mean ± S.E.			Incubation period (in days) mean ± S.E.	Fertility%
	no of egg rafts/female	no of eggs/raft	no of eggs/female		
25°C	9.75 ± 1.13 a	88.92 ±4.36 a	866.3±91.77 a	8.77 ±0.26	93.09
30°C	10.1 ±0.88 a	73.65 ±2.59 a	734.9±64.38 a	7.2 ± 0.17	92.92
35°C	3.88 ± 0.42	62.56 ±8.22	241.0±37.95	6.17 ± 0.40	56.92

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.



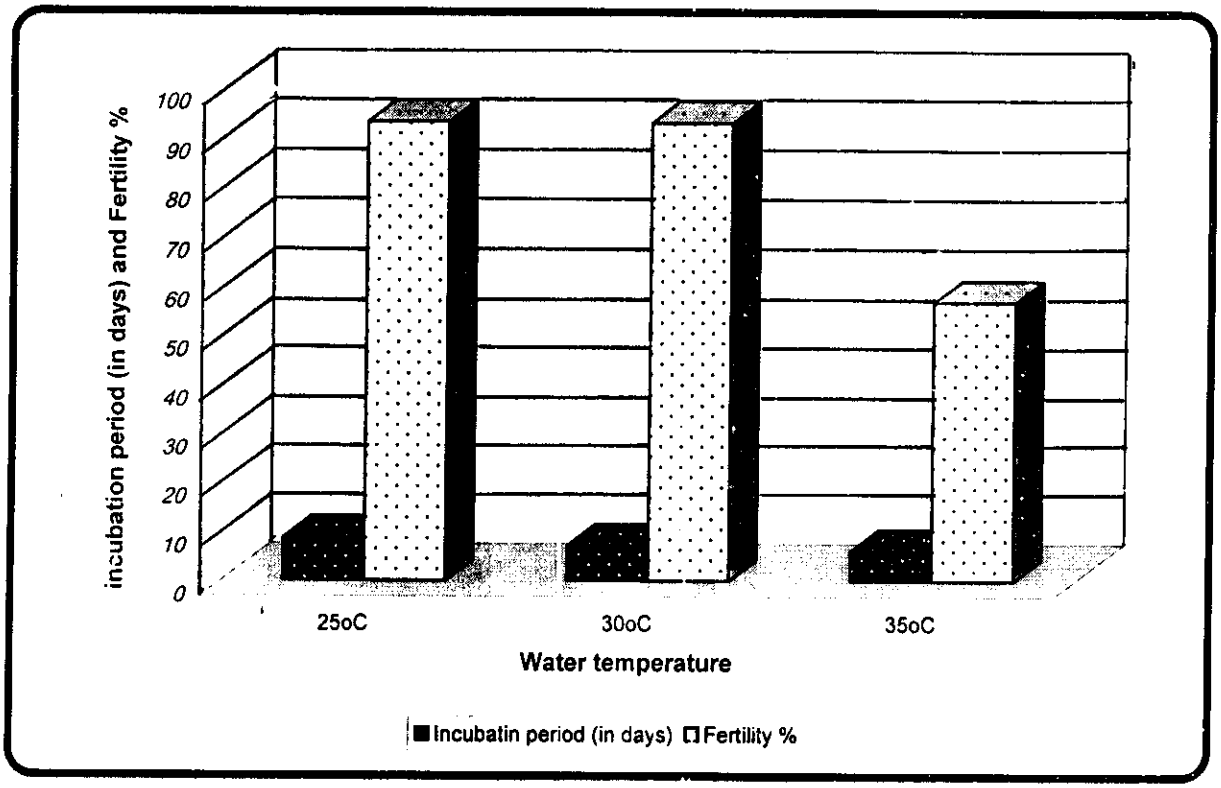


Fig. (28) : Effect of water temperature on the fecundity as well as incubation period and fertility of eggs of S. urinator adults.

The statistical analysis of the data in table (28) indicate the following: Females reared at 35 °C gave lower egg productivity than those reared at other temperatures .At this temperature, lower numbers of egg rafts 3.88 rafts /female were recorded including 241.0 egg/female and the number of eggs per raft was 62.56. Females reared at 25 and 30°C produced higher number of eggs as the number of egg rafts per female was 9.75 rafts/female including 856.25eggs for 25°C and 10.1egg rafts/female including 734.9 eggs was recorded for females reared at 30°C.

Statistical analysis of data given for the egg productivity of females showed a very high significant increase ($P<0.001$) in number of egg rafts /female and number of eggs /female and high significant ($P<0.01$) increase in number of eggs per raft among data reported for 30and 25°C than that reported for 35°C. also the data showed that no significant difference ($P<0.05$) existed between the fecundity of females reared under 25 and 30°C.

Statistical analysis also showed a high significant different ($p<0.01$) existing between the incubation period of eggs at 35°C than those recorded at 30and 25°C and a significant difference ($P<0.05$) at temperature 30and 25°C. The rate of hatchability of S. urinator eggs decreased as temperature increased .The lower rate of hatchability was recorded at temperature 35°C(56.92%).

Table (29): Effect of water temperature on the adult longevity of S. urinator(*) under controlled conditions of photoperiod (16L:8D)

Water temperature	Longevity (in days) mean ±S.E.	
	female	male
25°C	111.5± 10.07 [a]	126.4± 6.28 [a]
30°C	116.7 ±10.41 [a]	121.5 ±8.69 [a]
35°C	45.78 ±4.13	49.2 ±4.0

Means in each column followed by the same letter are not significantly different.
(*) Newly emerged adults were used.

As seen in table (29) females and males reared at 25 and 30°C survive a longer period than those reared at 35°C. Statistically high significant difference ($P<0.001$) existed between records reported for longevity of the two sexes under 35°, 30 and 25°C. On the other hand non significant difference was found between 25 and 30°C.

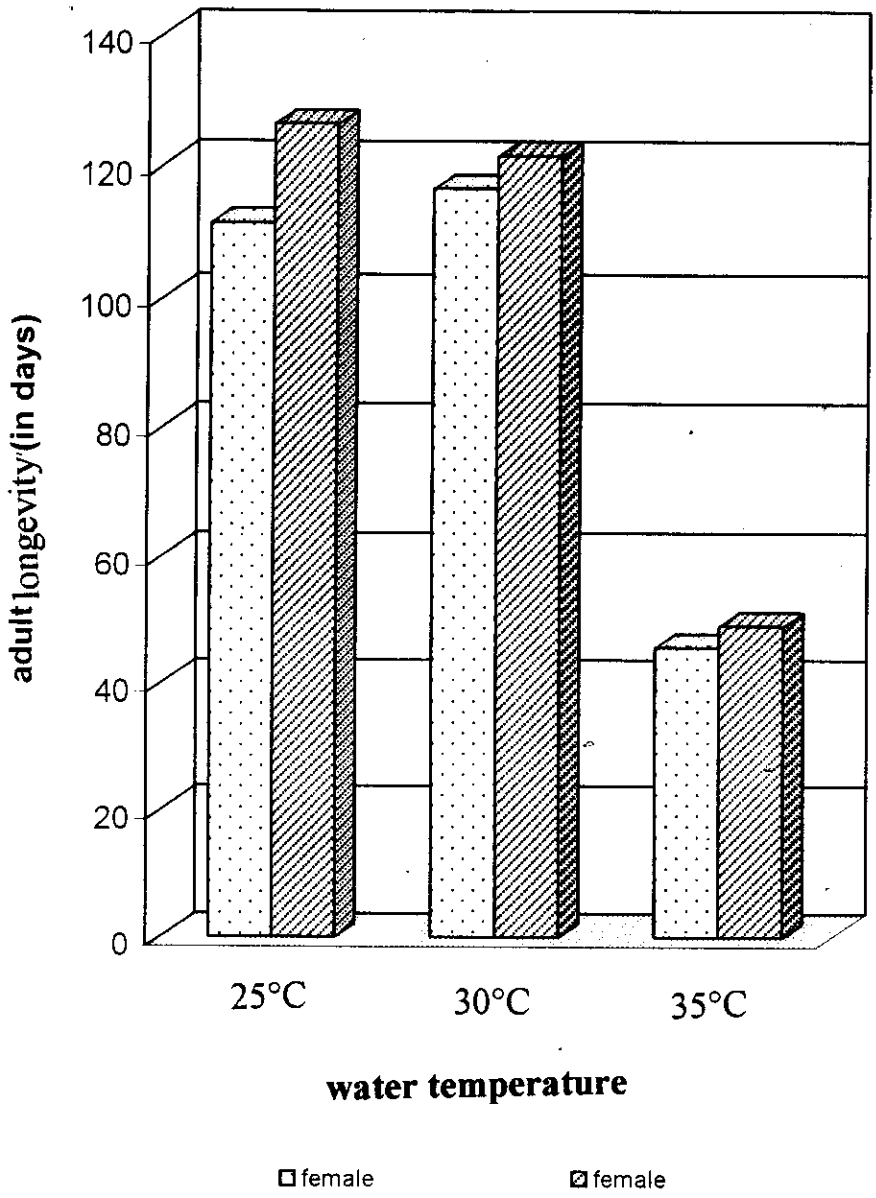


Fig.(29): Effect of water temperature on the longevity of S. urinator adults

5.3. Effect of water temperature on the daily consumption of mosquito larvae by different stages of S. urinator:-

To study the effect of different regimes of temperature (25, 30, and 35°C) combined with constant photoperiod of 16L: 8D cycle on the daily consumption of C. pipiens larvae by 1st and 5th nymphal instars and the adult stage (male and female) of S. urinator, the following experiment was designed, 10 insects from each nymphal instar and adult stage were kept individually in plastic cups. All cups were provided daily with 4th larval instar of mosquito (10, 25, 50, and 50 larvae) for each 1st, 5th, male and female respectively. The experiment was continued for 3days .

Results of this experiment are shown in table (30) and graphically illustrated in fig. (30).

Table (30): Effect of water temperature on the daily consumption of the 4th larval instar of C. pipens(*) by different stages of S. urinator under controlled conditions of photoperiod (16L:8D).

Water temperature	Consumption of Culex larvae/day mean ±S.E.			
	Nymph stage		Adult stage	
	1st	5th	male	female
25°C	3.68 ±0.25	16.09±0.54	20.83±2.33[a]	22.67±0.65
30°C	6.44±0.42	19.16±0.34	23.95±1.62[a]	28.27±1.49
35°C	8.76±0.38	25.00±1.71	30.4±2.73	37.8±3.25

Means in each column followed by the same letter are not significantly different.

(*) 10,25,50and 50 4th larval instars of C. pipiens were provided daily to 1st, 5thd nymphal instars, male and female of S. urinartor respectively

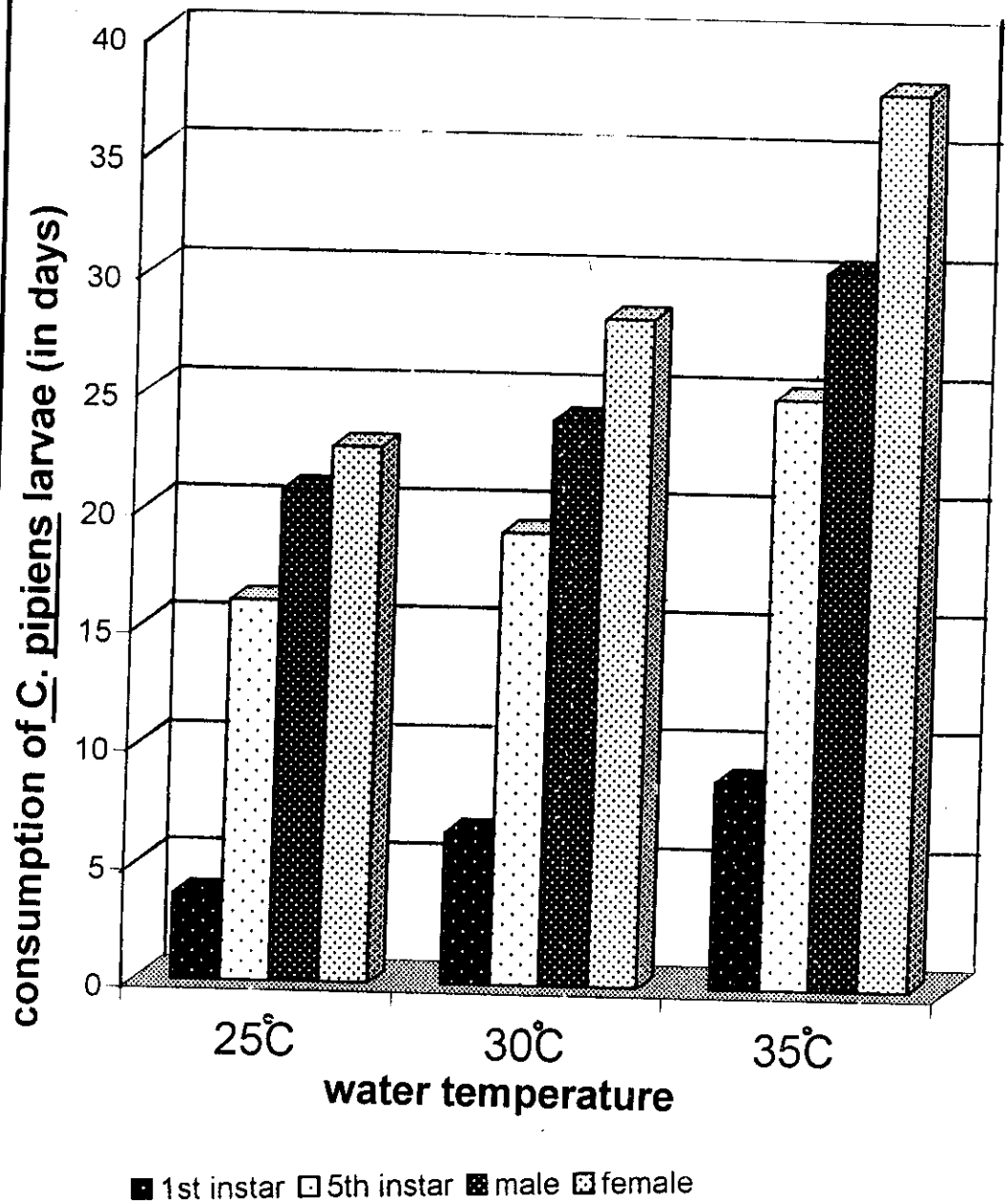


Fig.(30):Effect of water temperature on the daily consumption of C. pipiens larvae by different stages of S. urinator

The statistical analyses of data in table (30) indicate that: The daily consumption of the instar nymphs was significantly increased with the increase of the temperature. A very highe significant increase ($P<0.001$) in number of mosquito larvae consumed by 1^{st} and 5^{th} nymphal instars reared at 35°C than those reared at 30 or 25°C. That is true also for nymphs reared at 25and 30°C.

The daily consumption by males reared at 25°C was not significantly different ($P>0.05$) than those reared in 30°C, whereas a high significant reduction ($P<0.01$) was found in the daily consumption of preys by the males exposed to 25and 35°C while a significant difference ($p<0.05$)was observed between males reared in 30and 35°C.

A very high significant increase ($P<0.001$) in number of mosquito larvae consumed by females reared in 35°C than those reared in 25and 30°C.whereas a high significant ($P<0.01$) increase in this number was observed among females exposed to 25and 30°C.

6.Photoperiod: -

6.1. Effect of photoperiod on the development of the immature stage:-

To study the effect of the photoperiod on the duration of each nymphal instar, total nymphal duration and mortality percentage as well as sex ratio of emerged adults, two groups of newly hatched nymphs were reared under different photoperiod regimes (16L: 8D, long day and 8L: 16D, short day) combined with constant temperature 25±1°C.

The results of this experiment are presented in tables (31and 32) and graphically illustrated in figures (31and 32).

Table (31): Effect of photoperiod on the duration of nymphal instars (*) of S. urinator under controlled temperature (25±1°C).

Photoperiod	Duration of nymphal instar (in days) mean ± S.E.					Average total duration of nymphal instar
	1st	2nd	3rd	4th	5th	
Long day (16 L: 8D)	4.05±0.05	3.8 ± 0.15	4.61±0.22	6.71±0.36	7.46±0.22	26.7 ± 0.64
Short day (8L: 16D)	5.2 ± 0.17	5.17± 0.2	5.4± 0.16	7.9 ±0.28	8.54±0.88	31.23±0.41

Means in each column followed by the same letter are not significantly different.
(*) Newly hatched nymphs were used.

The statistical analyses of data in table (31) indicate that: The duration of the 1st and 2nd nymphal instars reared in long day was significantly shorter than those reared in short day ($P<0.001$).

A high significant ($P<0.01$) reduction in the duration of 3rd, 4th and 5th nymphal instars reared in long day than those reared in short day.

Accordingly, the total duration of the nymph stage was decreased with the increase of the photoperiod. Nymphs reared in long day had significantly shorter ($P<0.001$) duration (26.70days) than those reared in short day (31.23days).

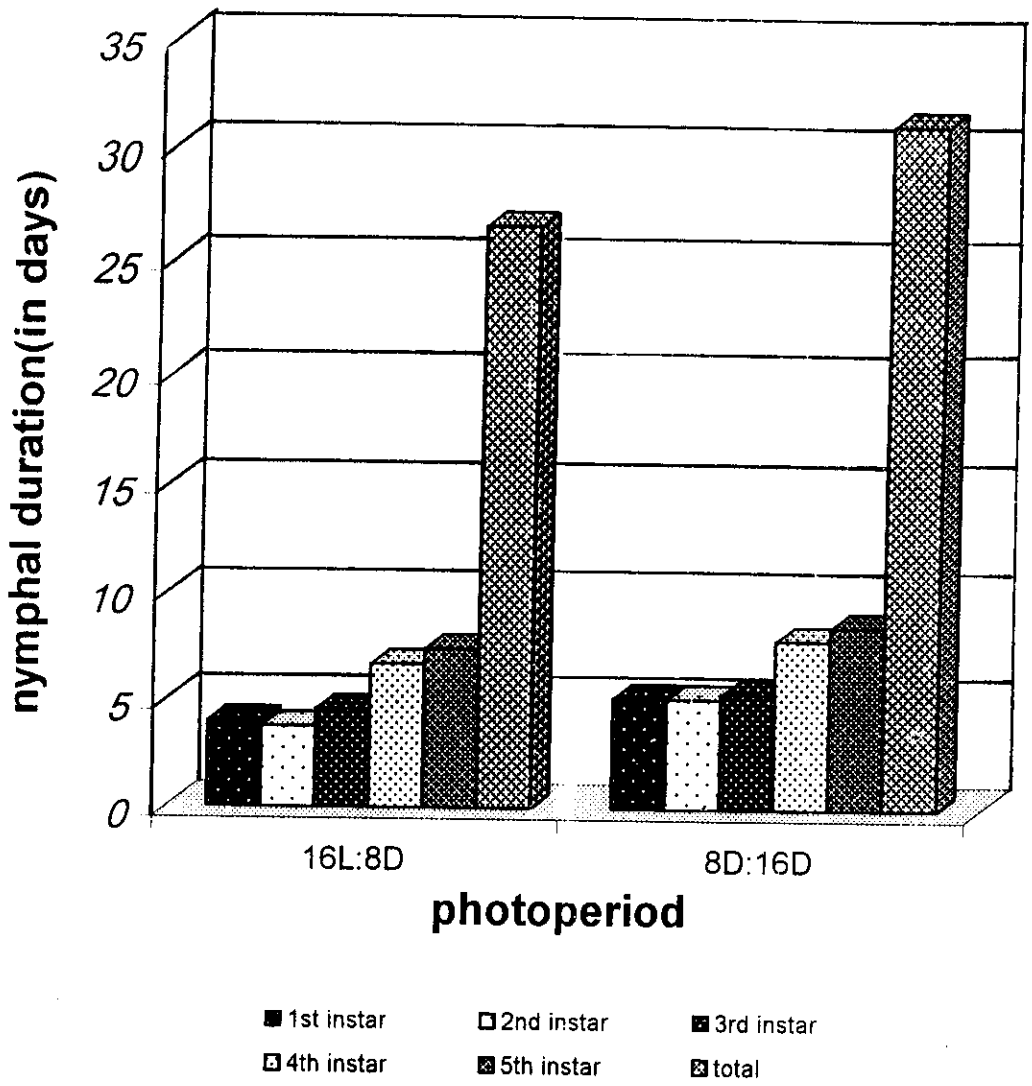


Fig.(31):Effect of photoperiod on the duration of nymphal instars of S. urinator

Table (32): Effect of photoperiod on the percentage mortality of nymphal instars (*) and sex ratio of emerged adults of S. urinator under controlled temperature (25±1°C).

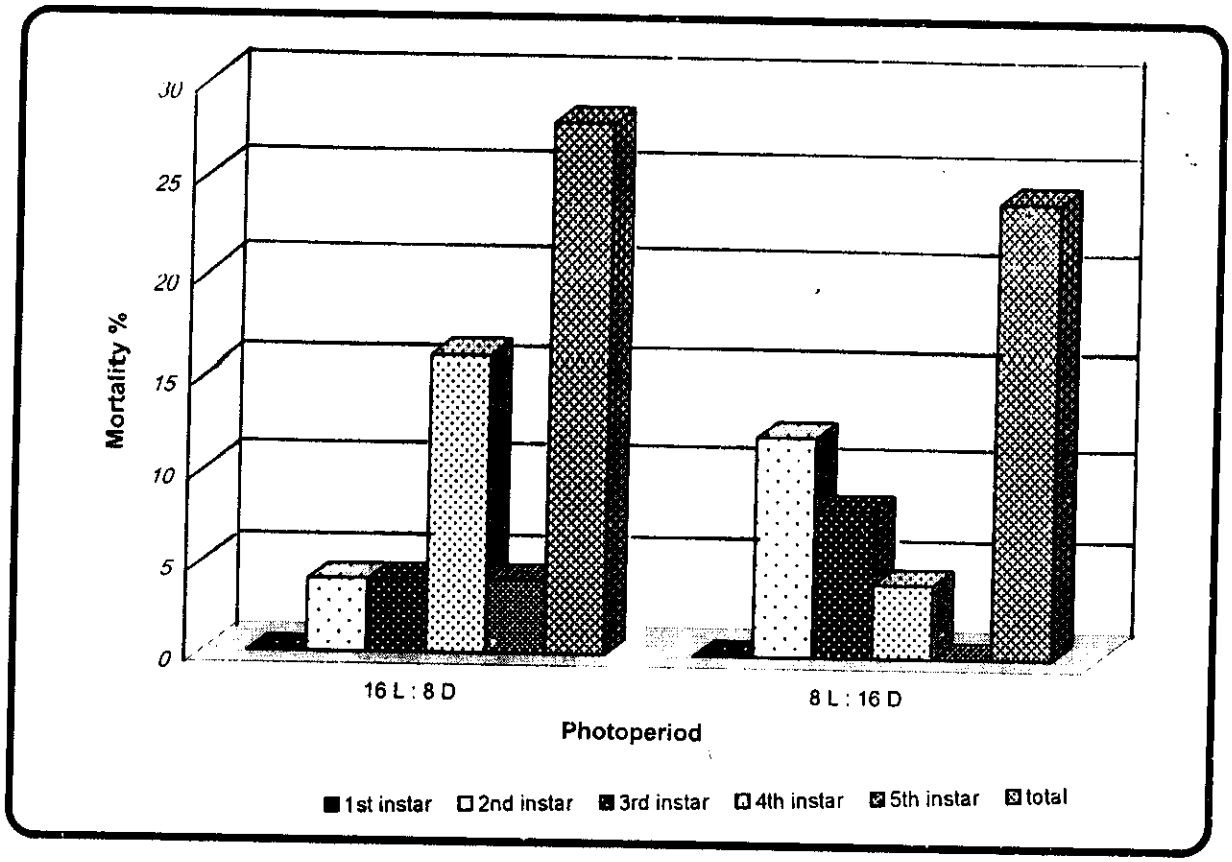
Photoperiod	Mortality%						Sex ratio female : male
	1st	2nd	3rd	4th	5th	total	
Long day (16 L: 8D)	0	4	4	16	4	28	1 : 1.4
Short day (8L: 16D)	0	12	8	4	0	24	1.75 : 1

(*) Newly hatched nymphs were used.

As shown from data in table (32), the percentage mortalities among 1st, 2nd, 3rd, 4th and 5th nymphal instars reared in long day were 0, 4, 4, 16 and 4% respectively, whereas mortalities for the same instars reared in short day photoperiod were 0, 12, 8, 4and 0% respectively.

The total percentage mortalities were decreased with the decrease of the photoperiod. The total mortality observed during nymphal stage reared in long and short day photoperiod was 28 and 24 %respectively.

The data in the same table show that the sex ratio of adult emerged from nymphs reared in long day photoperiod was slightly skewed towards male (1:1.4 female: male), but this ratio was skewed towards female in case of insects reared in short day photoperiod (1.75 : 1 female: male).



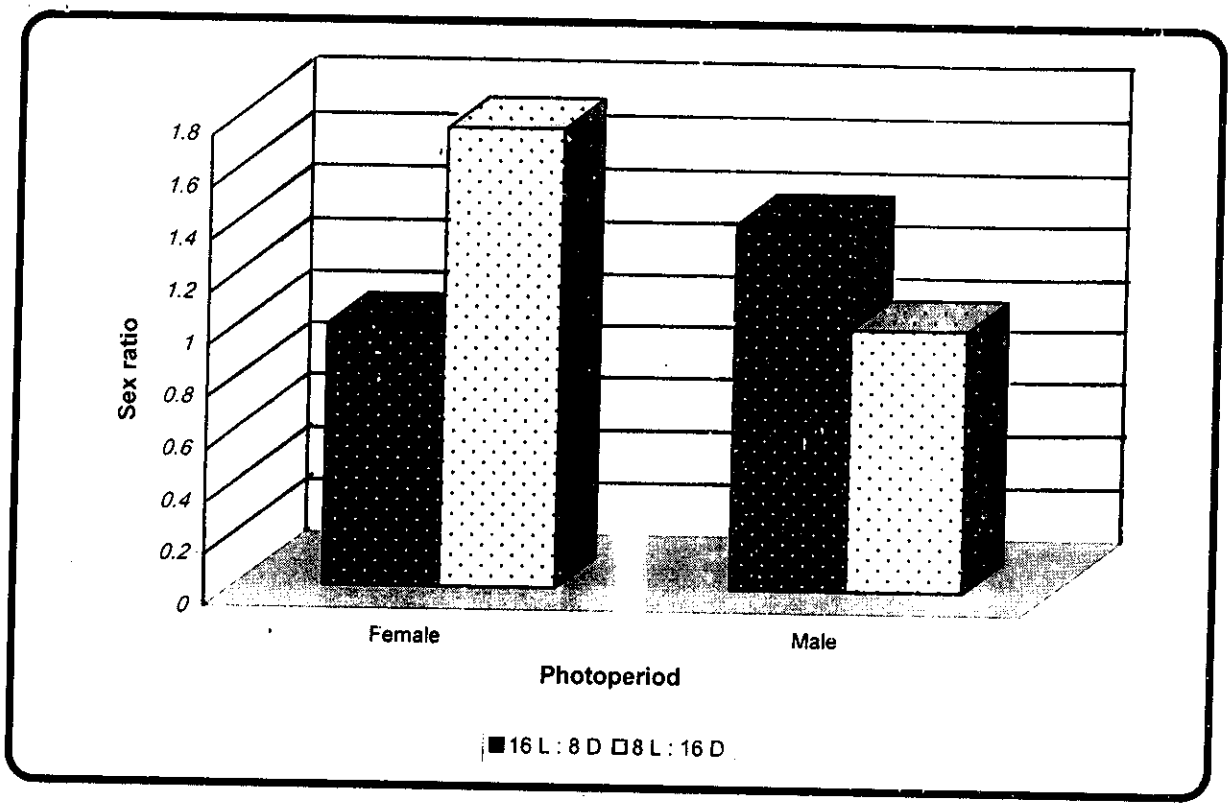


Fig. (32) : Effect of photoperiod on the percentage mortality of nymphal instar and sex ratio of emerged adults of S. urinator.

6.2. Effect of photoperiod on some biological aspects of the adult stage: -

To determine the effect of photoperiod on the sexual maturation (preovipositopn, oviposition and postoviposition periods), fecundity (number of eggs per raft and number of rafts and eggs laid per female), and longevity of adult s of S. urinator as well as fertility and incubation period of eggs laid by females, two groups of newly emerged adults were reared under controlled photoperiod(long day , 16L: 8D and short day ,8D: 16L) and constant temperature of 25 ± 1°C.

The results obtained are given in tables (33,34and 35) and graphically illustrated in figures (33, 34and35).

Table(33): Effect of photoperiod on the sexual maturation of S. urinator adults (*) under controlled temperature(25±1°C) .

Photoperiod	Sexual maturation (in days) Mean ± S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
Long day(16 L: 8D)	9.5 ±1.23	92.77 ± 9.70	10.13 ± 3.54[a]
Short day(8L: 16D)	14.67 ± 1.86	124.22 ±11.67	11.22 ±1.31[a]

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analysis of the data in the table (33) indicate that:

A significant increase ($P<0.05$) in the preoviposition and oviposition periods was observed between females reared in short day than those reared in long day.

A non-significant difference was observed in postovipostion period between females reared in long day and short day photoperiod ($P>0.05$).

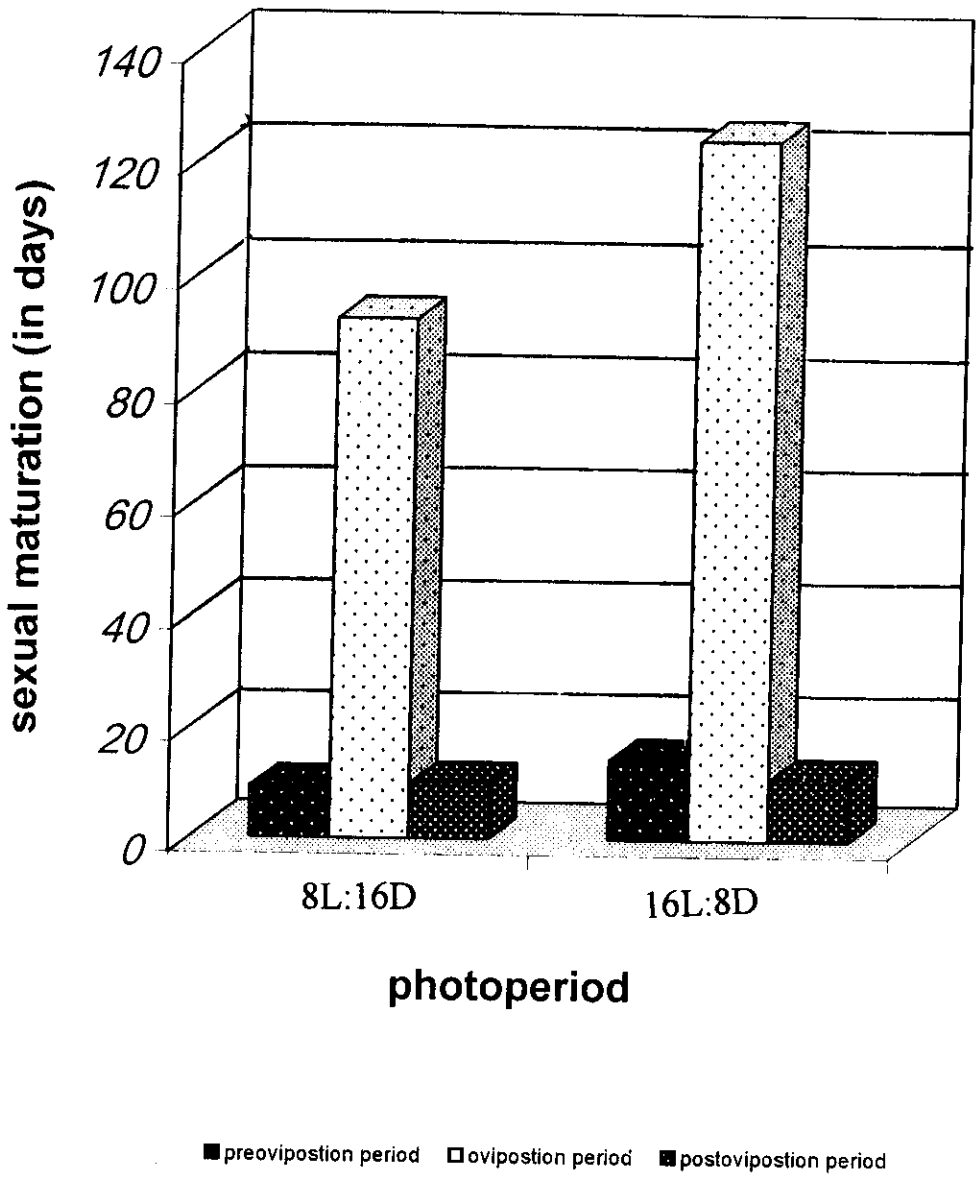


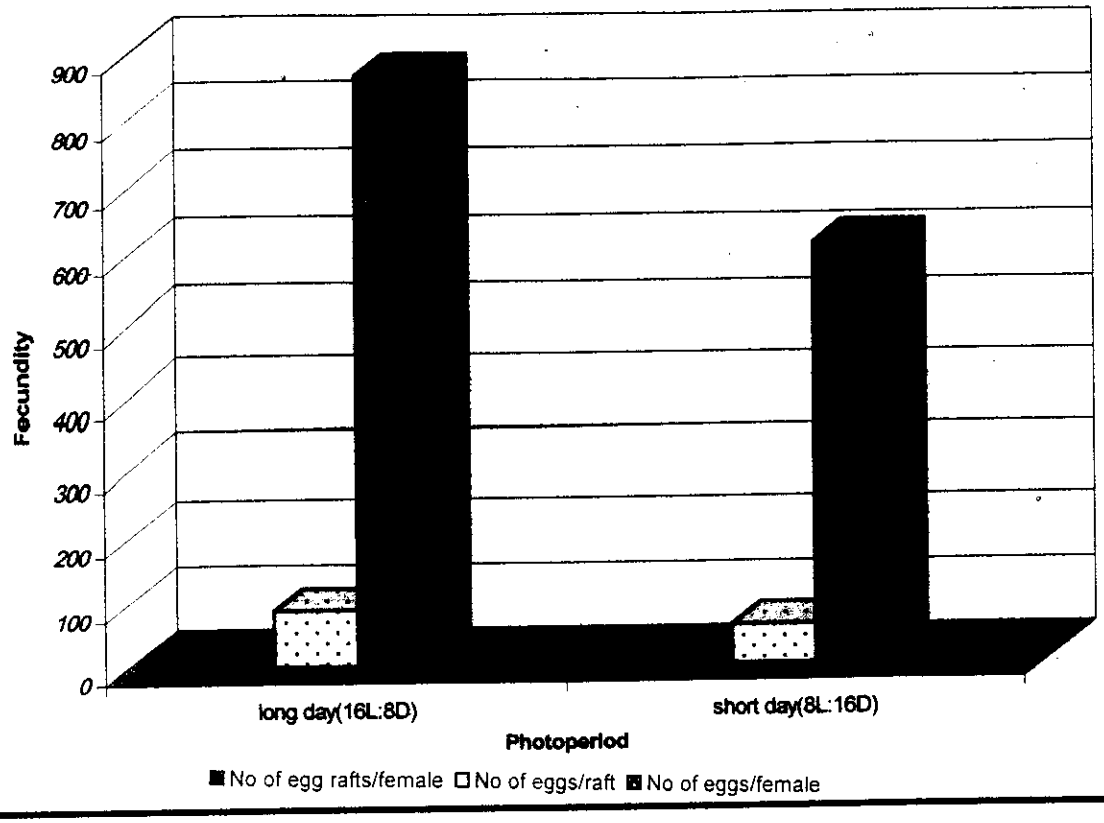
Fig.(33): Effect of photoperiod on the sexual maturation of S.urinator adults

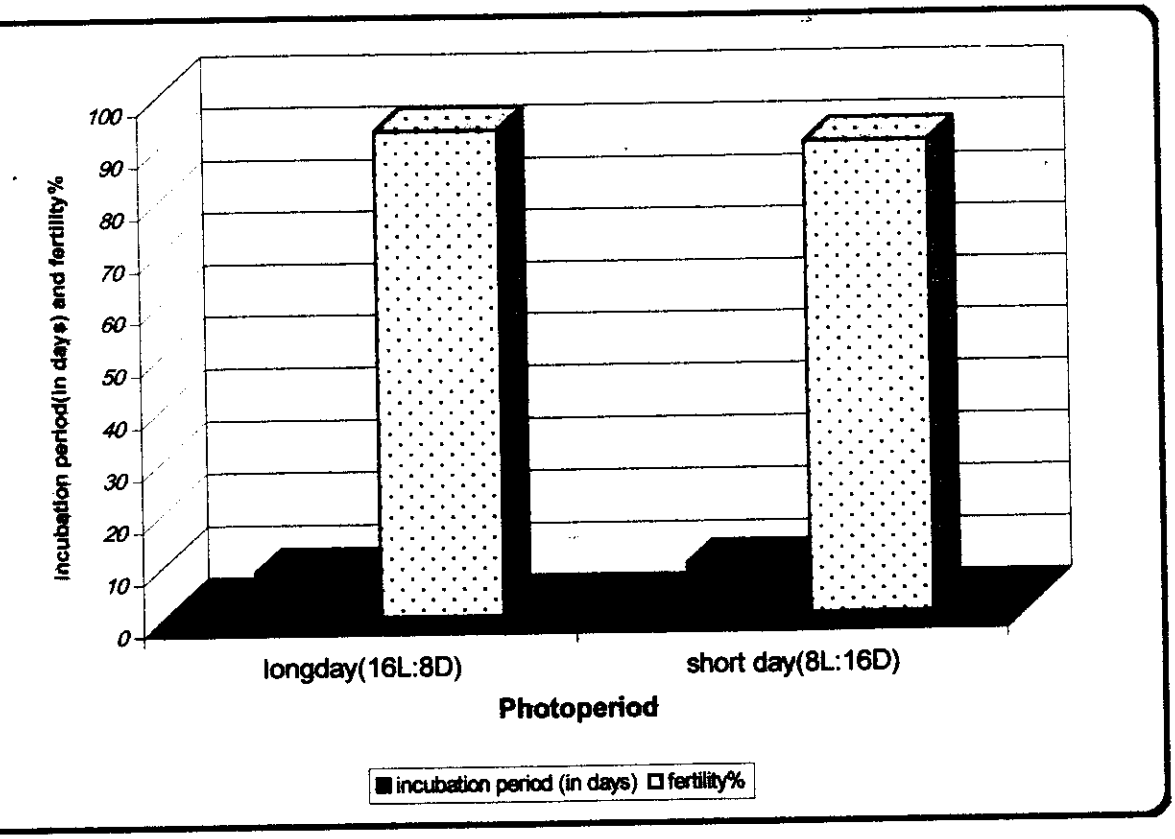
Table (34): Effect of photoperiod on the fecundity, fertility and incubation period of eggs of S. urinator adults(*) under controlled temperature (25±1°C).

Photoperiod	Fecundity mean ± S.E			Incubation period (in days)	Fertility %
	no of egg rafts/female	no of eggs/raft	no of eggs/female		
Long day (16 L: 8D)	9.75 ± 1.13	88.92 ± 4.36	866.25±91.8	8.77 ± 0.26[a]	93.09
Short day (8L: 16D)	11.22 ±1.09	61.46 ± 8.41	613.78±52.1	9.62 ± 0.64[a]	9o.34

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.





ig.(34): Effect of Photoperiod on the fecundity, fertility and incubation period of eggs of S. urinator adults

From the statistical analysis of data in table (34) it is clear that:
A non significant difference was observed in number of egg rafts laid per female reared in short and long day photoperiod (11.22 and 9.75 days respectively).

The number of eggs per raft was significantly larger, when females were reared in long day photoperiod than those reared in short day ($P<0.001$). A high significant ($P<0.01$) reduction in the number of eggs laid per female was observed when females reared in short day (613.78 eggs/female) than those reared in long day photoperiod (856.25 day).

A slight non-significant increase in the incubation periods of eggs was observed between the eggs produced by females reared in short day than those reared in long day.

The highest percentage of egg hatchability was observed in females reared in long day (93.09%) than those reared in short day photoperiod (90.34%).

Table (35): Effect of photoperiod on the adult longevity of S. urinator* under controlled temperature (25±1°C).

Photoperiod	Longevity (in days) mean ± S.E.	
	Female	Male
Long day(16 L: 8D)	111.5 ± 10.07	126.4 ± 6.28
Short day(8L: 16D)	149.11 ± 12.82	161.22 ± 9.33

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

As shown from table (35) females reared in long day had significantly shorter duration than those reared in short day photoperiod ($P<0.05$).

A high significant reduction ($P<0.01$) in longevity of males was observed among males reared in long day than those reared in short day photoperiod.

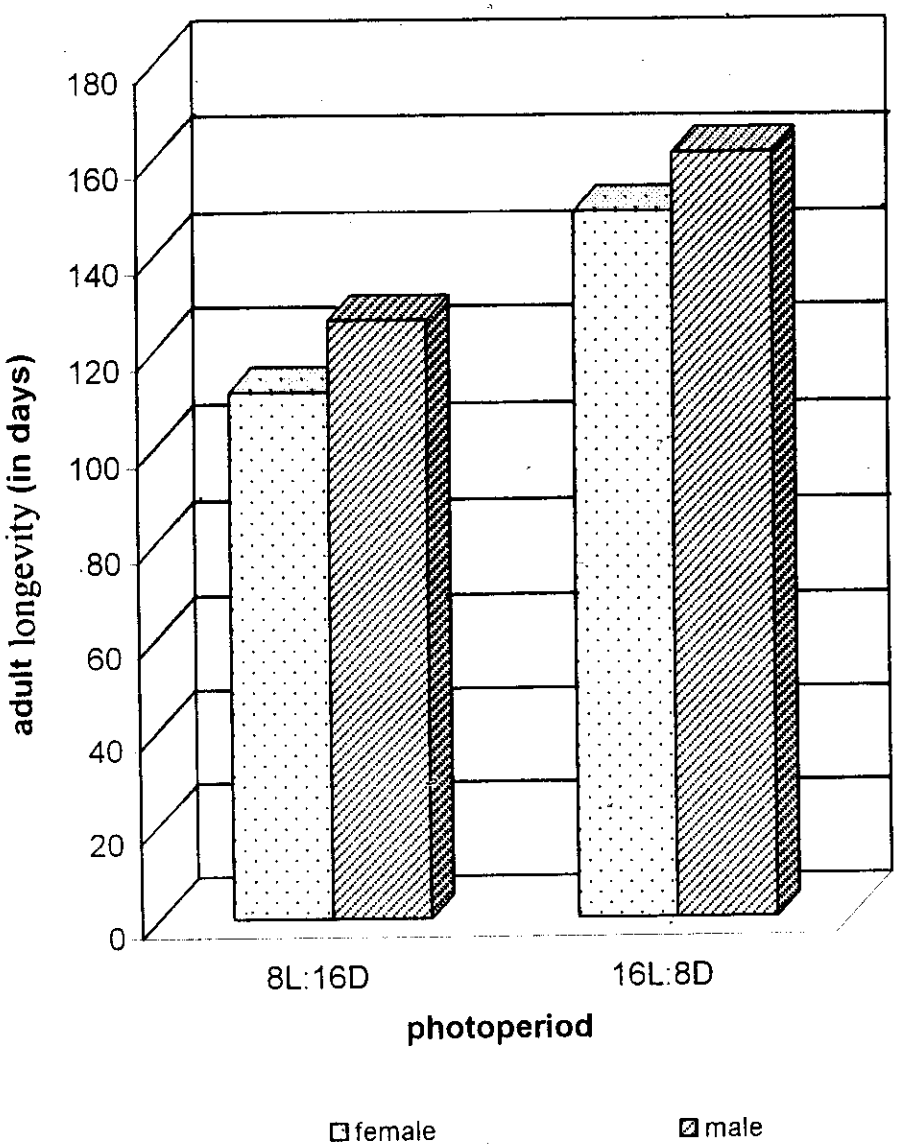


Fig.(35): Effect of photoperiod on longevity of S. urinator adults

6.3.Effect of photoperiod on the daily consumption of mosquito larvae by different stages of S. urinator:-

To study the effect of different photoperiod regimes(long day, 16L: 8D and short day, 8L: 16D), at constant temperature of 25 ±1°C on the daily consumption of C. pipiens larvae by 1st and 5th nymphal instars and the adult stage (male and female) of S. urinator, the following experiment was designed, 10 insects from each nymphal instar and adult stage were kept individually in plastic cups. All cups were provided daily with 4th larval instar of mosquito (10, 25, 50, and 50 larvae) for each 1st and 5th nymphal instars, male and female respectively. The experiment was continued for 3days and maintained in conditions as described viz. 1.6.1.

The data of this experiment are presented in table (36) and graphically illustrated in figure (36).

Table (36): Effect of photoperiod on the daily consumption of the 4th larval instar of C. pipens by different stages of S. urinator under controlled conditions of temperature (25±1°C).

Photoperiod	Consumption of Culex larvae/day (mean ±S.E.)			
	Nymph stage		Adult stage	
	1st	5th	male	female
Long day (16 L: 8D)	3.68±0.25	16.09±0.52 a	20.83±2.33 a	22.67±1.65 a
Short day (8L: 16D)	2.9±0.13	14.61±1.17 a	19.40±1.48 a	21.16±1.49 a

Means in each column followed by the same letter are not significantly different.

(*) 10,25,50and 50 4th larval instars of C. pipiens were provided daily to 1st, 5th nymphal instars ,male and female of S. urinartor respectively.

The statistical analysis of the data in table (36) indicate the following:

A significant increase in number of preys consumed by 1st instar nymphs reared under long day than those reared under short day ($P<0.05$).

A slight non-significant increase was observed in the daily consumption of mosquito larvae that consumed by 5th instar nymph, male and female of S. urinator reared under long day than those reared under short day.

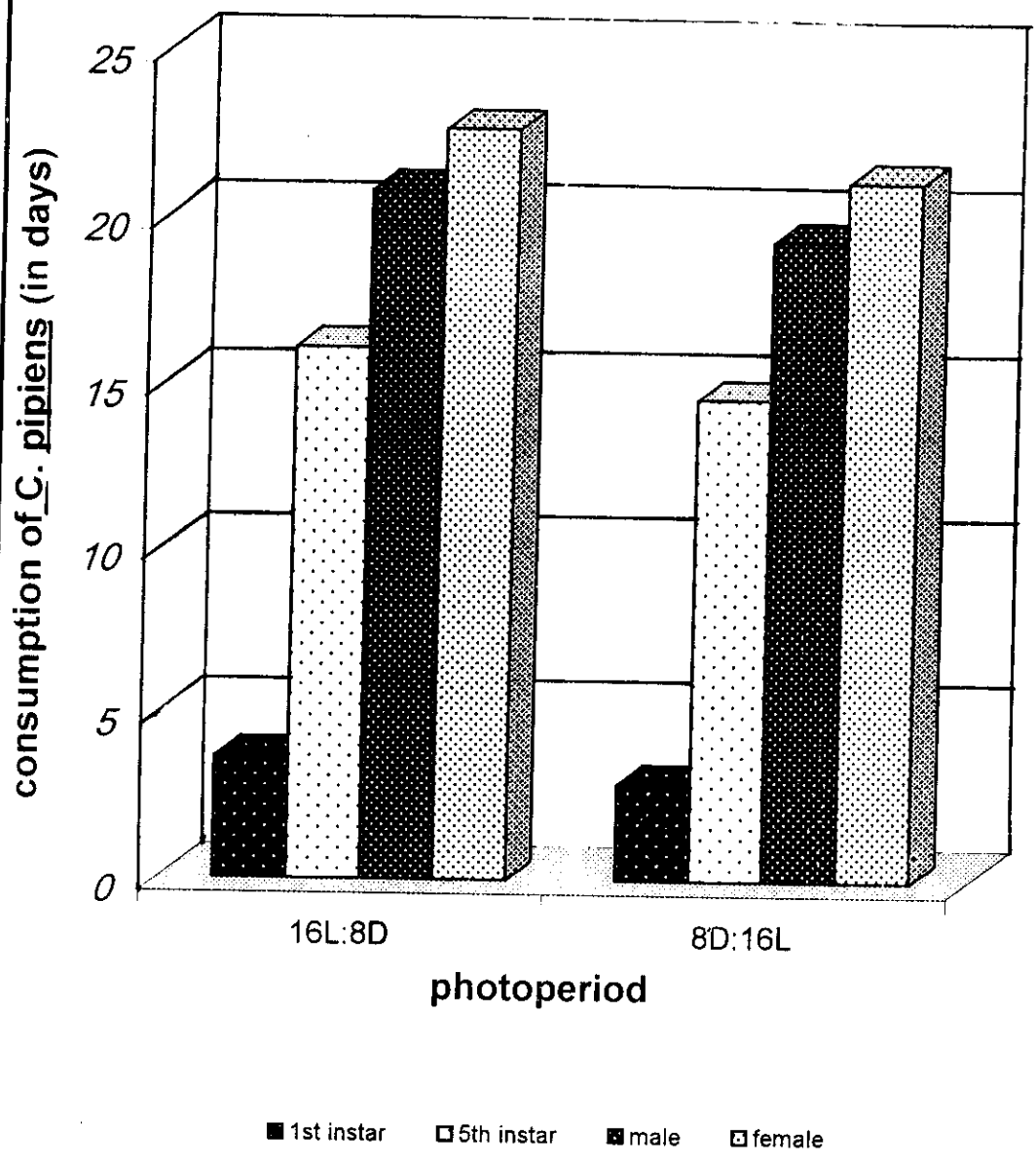


Fig.(36):Effect of photoperiod on the daily consumption of C. pipiens larvae by different stages of S. urinator

7.Light intensity: -

7.1. Effect of light intensity on the development of the immature stage: -

To determine the effect of light intensity on the development of S. urinator nymphs, three groups of newly hatched nymphs were kept in three different light intensities (681.8, 1484.4 and 2698.5 lux) combined with constant temperature (25±1°C) and a photoperiod of 16L: 8D.

Duration of each nymphal instar, total duration of nymphal stage , mortality percentage and sex ratio of emerged males and females were recorded in tables (37and38) and graphically illustrated in figures (37and38).

Table (37): Effect of light intensity on the duration of nymphal instars of S. urinator under controlled conditions (temp. 25 ±1°C and photoperiod 16L: 8D).

Light intensity	Duration of nympal instars (in days) mean ± S. E.					Average total duration of nymphal instar
	1st	2nd	3rd	4th	5th	
Low (681.8 lux)	a 4.55± 0.1	a 3.72±0.13	3.71±0.18	ab 6.31±0.6	a 7.15±0.22	a 27.17 ± 0.64
Medium (1484.4 lux)	ac 4.05±0.05	ac 3.8± 0.15	c 4.61±0.22	bc 6.71±0.36	c 7.46±0.22	c 26.7 ± 0.64
High (2698.5 lux)	c 3.9± 0.21	c 4.25±0.15	c 3.16±0.09	ac 6.27±0.24	ac 6.00±0.13	ac 24.99 ± 0.49

Means in each column followed by the same letter are not significantly different.

(*) Newly hatched nymphs were used.

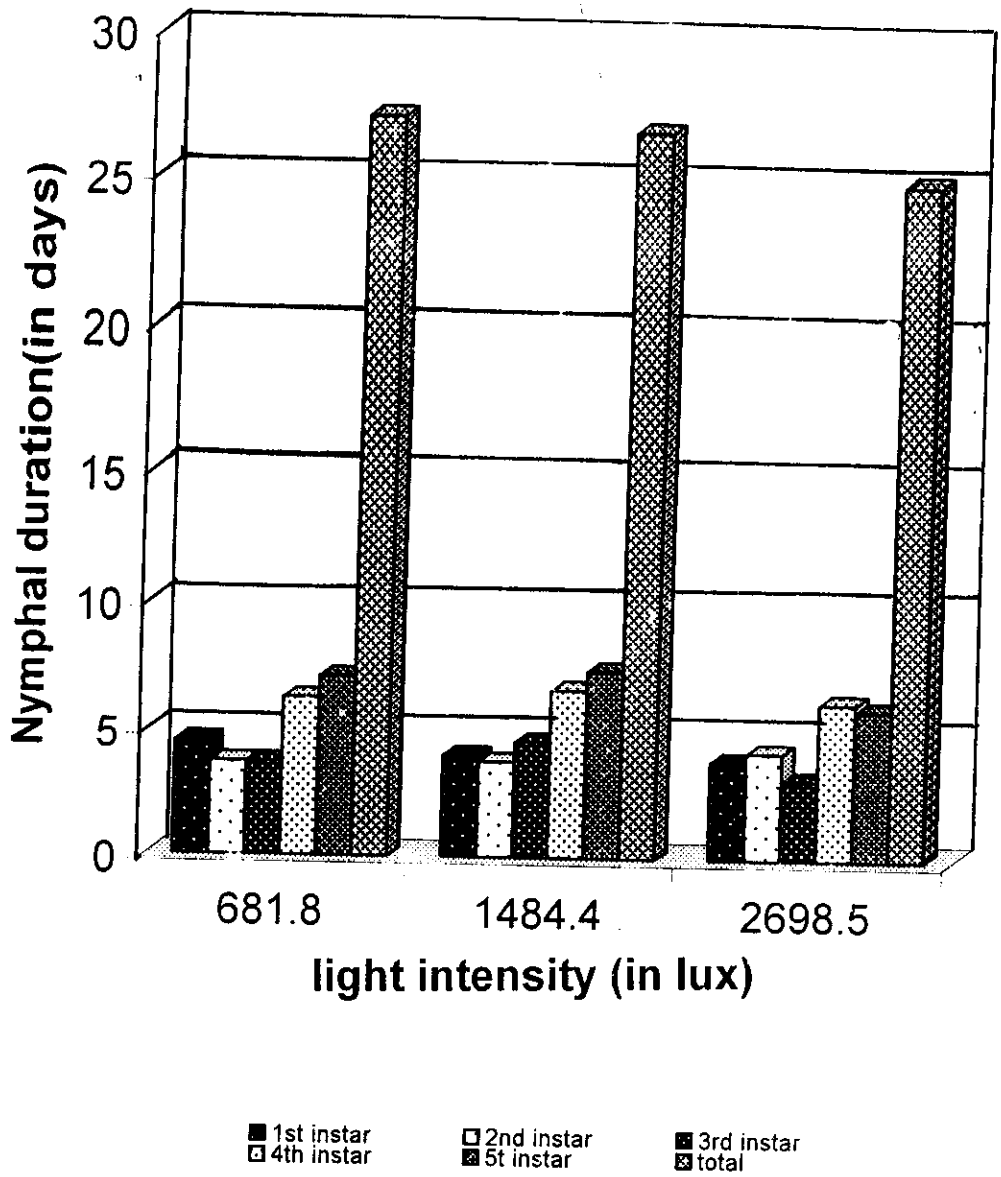


Fig. (37):Effect of light intensity on the duration of nymphal instars of S. urinator

The statistical analysis of data in table (37) indicate the following: A non-significant difference was observed between the duration of 1st nymphal instars reared under low and medium or medium and high light intensities. Whereas a high significant difference was found in the duration of nymphs reared under low and high light intensities ($P<0.01$).

The duration of 2nd nymphal instar reared under low light intensity was longer than those reared under high light intensity ($P<0.05$), whereas no significant difference was found between the duration of nymphs reared under low and medium or medium and high light intensities.

The 3rd instar nymphs reared under low light intensity had significantly longer duration than those reared under medium or high light intensities ($P<0.05$ and 0.01respectively). A non-significant difference was found between the duration of nymphs reared under medium and high light intensities.

In case of 4th nymphal instar, a non-significant difference was found among nymphs reared under the three different conditions of light intensity.

The duration of 5th nymphal instar had significant difference between insects reared under medium and high light intensities ($P<0.05$). Whereas a non-significant difference in this nymphal duration of insects

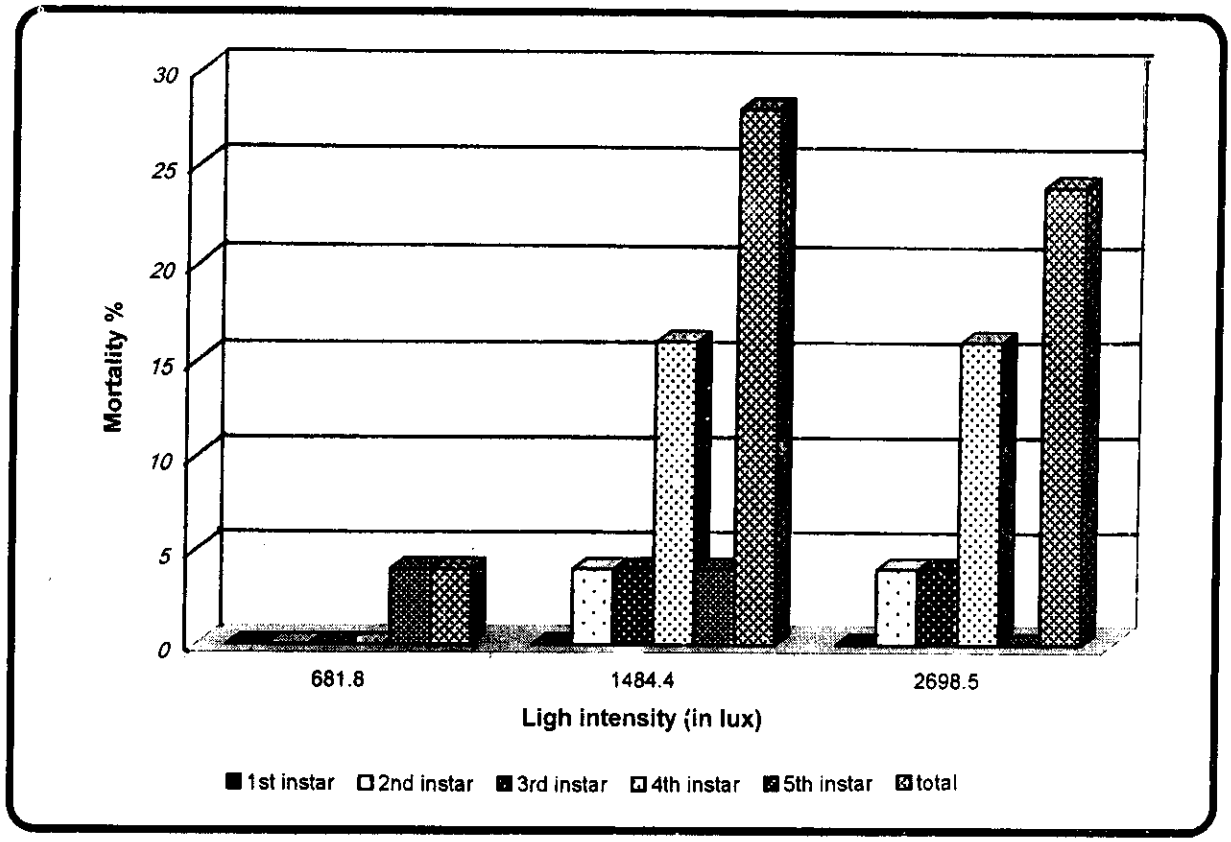
reared under low and medium or high light intensities was observed.

The average total duration of the nymphal stage reared under low light intensity (27.17days) was significantly longer ($P<0.05$) than those reared under high light intensity (24.99days). In the same time the duration of nymphs reared in medium light intensity (26.7days) was not significantly different than those reared in low or high light intensities.

Table (38) : Effect of light intensity on the percentage mortality of nymphal instars(*) as well as sex ratio of emerged adults of S. urinator under controlled conditions (temp. 25 ±1°C and photoperiod 16L: 8D).

Light intensity	Mortality%						Sex ratio Female:male
	1st	2nd	3rd	4th	5h	total	
Low (681.8 lux)	0	0	0	0	4	4	1 : 2.5
Medium (1484.4 lux)	0	4	4	16	4	28	1.4 : 1
High (2698.5 lux)]	0	4	4	16	0	24	1 : 1.5

(*) Newly emerged adults were used.



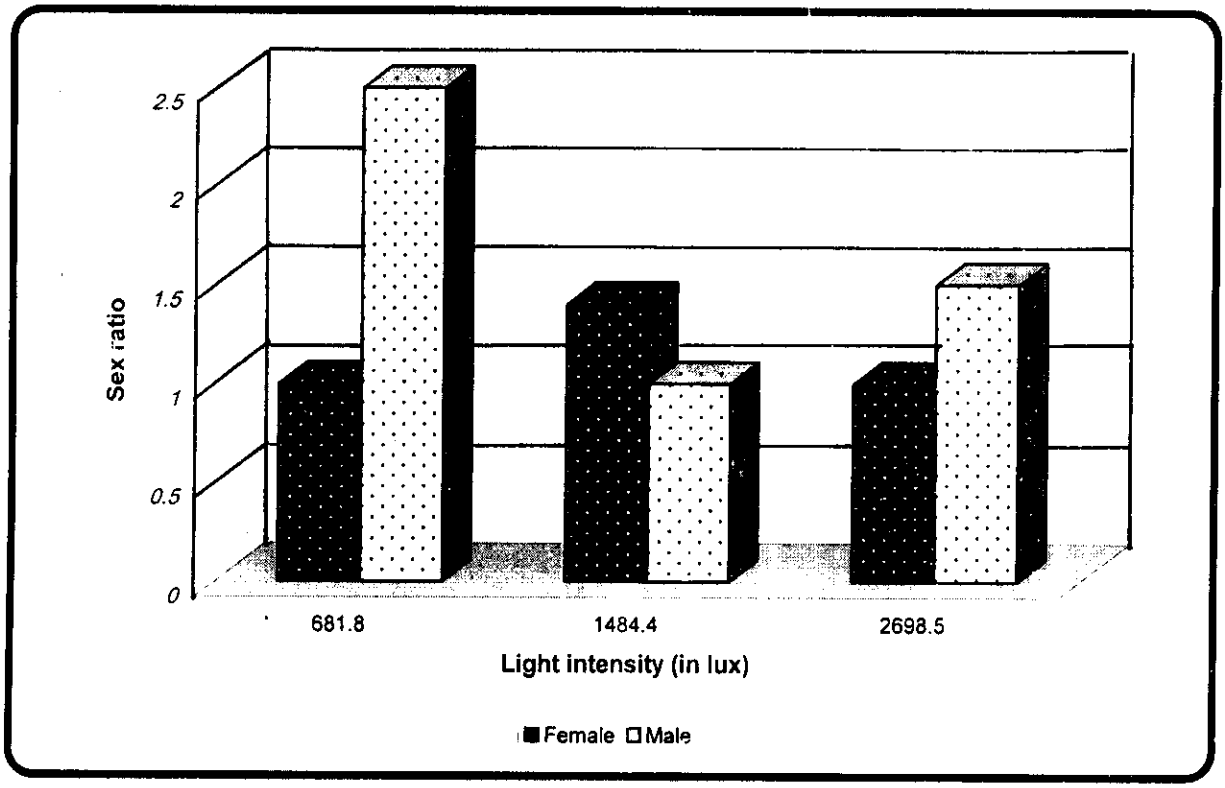


Fig. (38) : Effect of light intensity on the percentage mortality of nymphal instarts as well as sex ratio of emerged adults of S. urinator.

The data in table (38) reveal the following:

Mortality of S. urinator nymphs was increased with the increase of light intensity. No mortalities were recorded during the 1st instar in all treatment, also no mortalities were recorded among 2nd, 3rd and 4th nymphal instars reared in low light intensity and 5th instars reared under high light intensity.

The total mortalities observed during the nymphal stage reared in low, medium and high light intensities were 4, 28 and 24% respectively.

The sex ratio of adults emerged from nymphs reared under low light intensity was skewed greatly towards male (1: 2.5 female: male). In case of adults emerged from nymphs reared under medium and high light intensities the sex ratios were 1.4 : 1 and 1:1.5 (female: male) respectively.

7.2. Effect of light intensity on some biological aspects of the adult stage: -

To study the effect of three level of light intensities (681.8, 1484.4 and 2698.5 lux), combined with constant temperature (25°1±C) and photoperiod of 16L: 8D on different biological aspects of S. urinator adults, 3groups of newly emerged adults were sexed and paired individually in plastic cups then maintained in incubators at the same conditions as described viz. 1.5.1.

Sexual maturation (preovipositopn, oviposition and postoviposition periods), fecundity (number of eggs per raft and number of rafts and eggs laid per female) as well as fertility and incubation periods of eggs were recorded.

The results obtained are given in tables (39, 40 and 41) and graphically illustrated in figures (39,40 and 41).

Table (39): Effect of light intensity on the sexual maturation of S. urinator adults(*) under controlled conditions (temp. 25 ±1°C and photoperiod 16L: 8D).

Light intensity	Sexual maturation (in days) mean ±S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
Low (681.8 lux)	10.1 ±0.87 ab	112.9 ±4.82	9.03 ±1.03 ab
Medium (1484.4 lux)	9.5 ±1.23 ac	92.77± 9.72	10.13± 3.45 ac
High (2698.5 lux)	9.6 ±0.55 bc	85.56 ±9.54	9.51 ±1.27 bc

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analysis of data in table (39) indicate the following:

No significant difference in preovipotion and postovipostion periods was recorded among females reared in different experimental conditions.

Statistically females reared in low light intensity had longer oviposition periods than those reared in high light intensity ($P<0.05$), while no significant difference was observed among females reared in low and medium or medium and high light intensities.The recorded oviposition periods were 112.9,92.77 and 85.56 days for females reared under low, medium and high light intensities respectively.

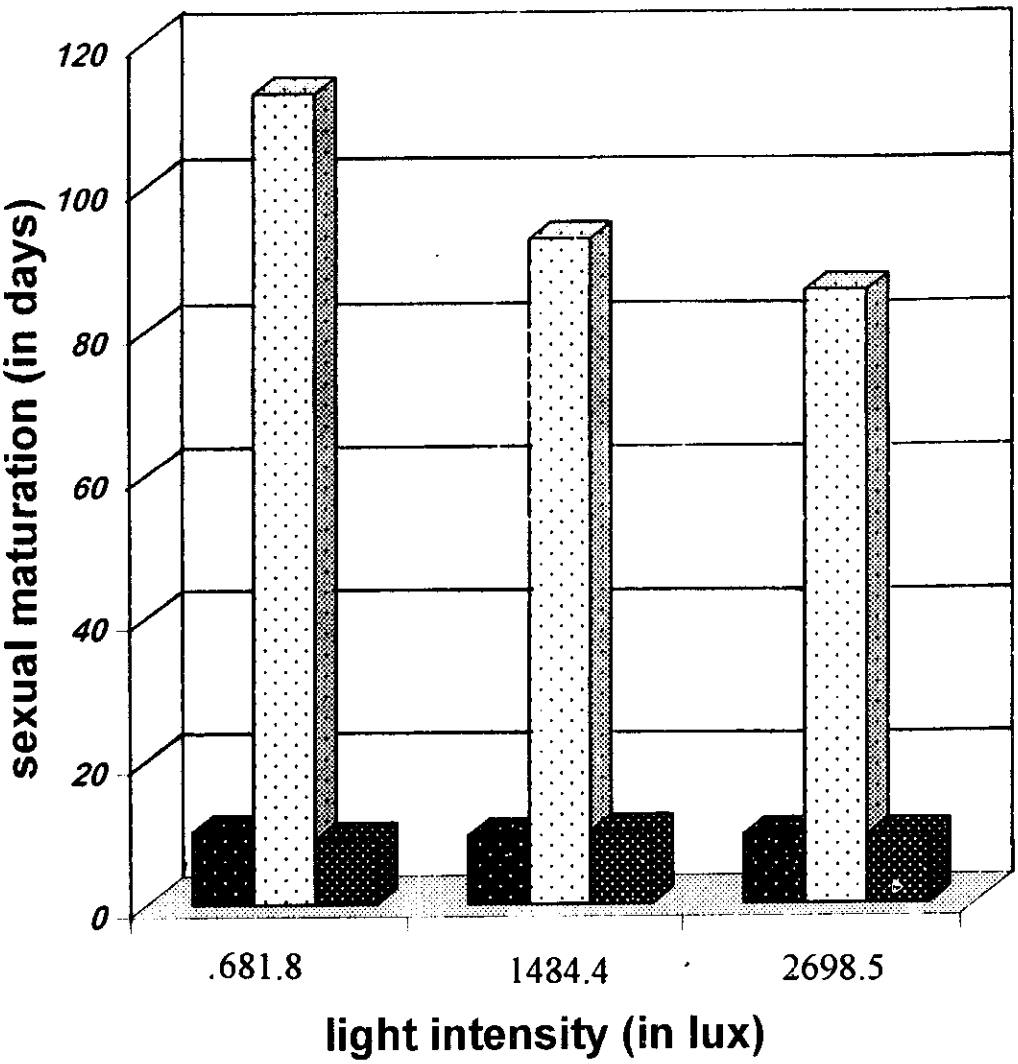


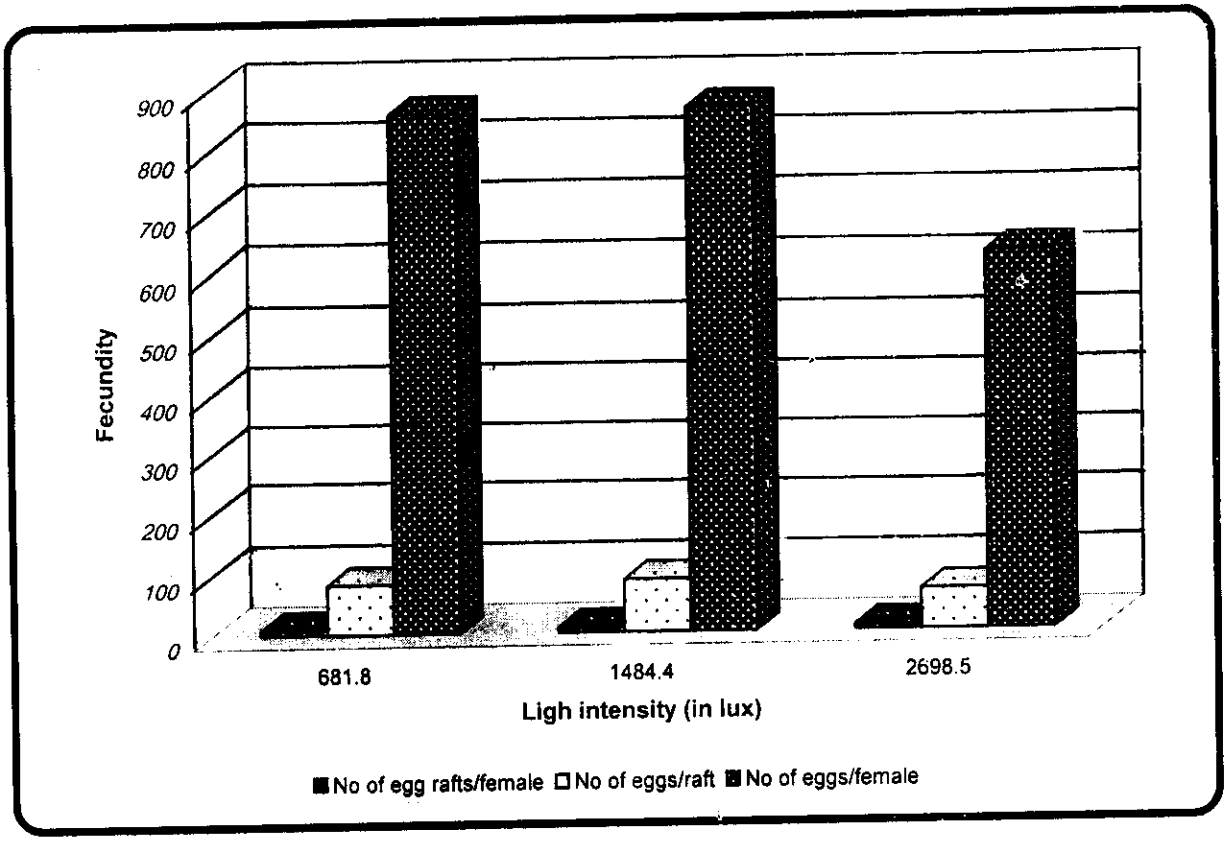
Fig.(39): Effect of light intensity on the sexual maturation of S. urinator adults

Table (40): Effect of light intensity on the fecundity, fertility and Incubation period of eggs of S. urinator adults* under controlled conditions (temp.25±1°C and photoperiod16L: 8D).

Light intensity	Fecundity (mean ± S.E)			Incubation period (in days)	Fertility%
	no of egg rafts/female	no of eggs/raft	no of eggs/female		
Low (681.8 lux)	10.15±0.77 ab	84.62±5.67 a	860.5±61.84 a	8.56±0.31 ab	94.2
Medium (1484.4 lux)	9.75±1.13 ac	88.92±4.36 a	866.25±91.77 a	8.77±0.26 ac	93.09
High (2698.5 lux)	9.21±0.32 bc	68.1±7.34	627.3±32.21	9.27±0.37 bc	91.72

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.



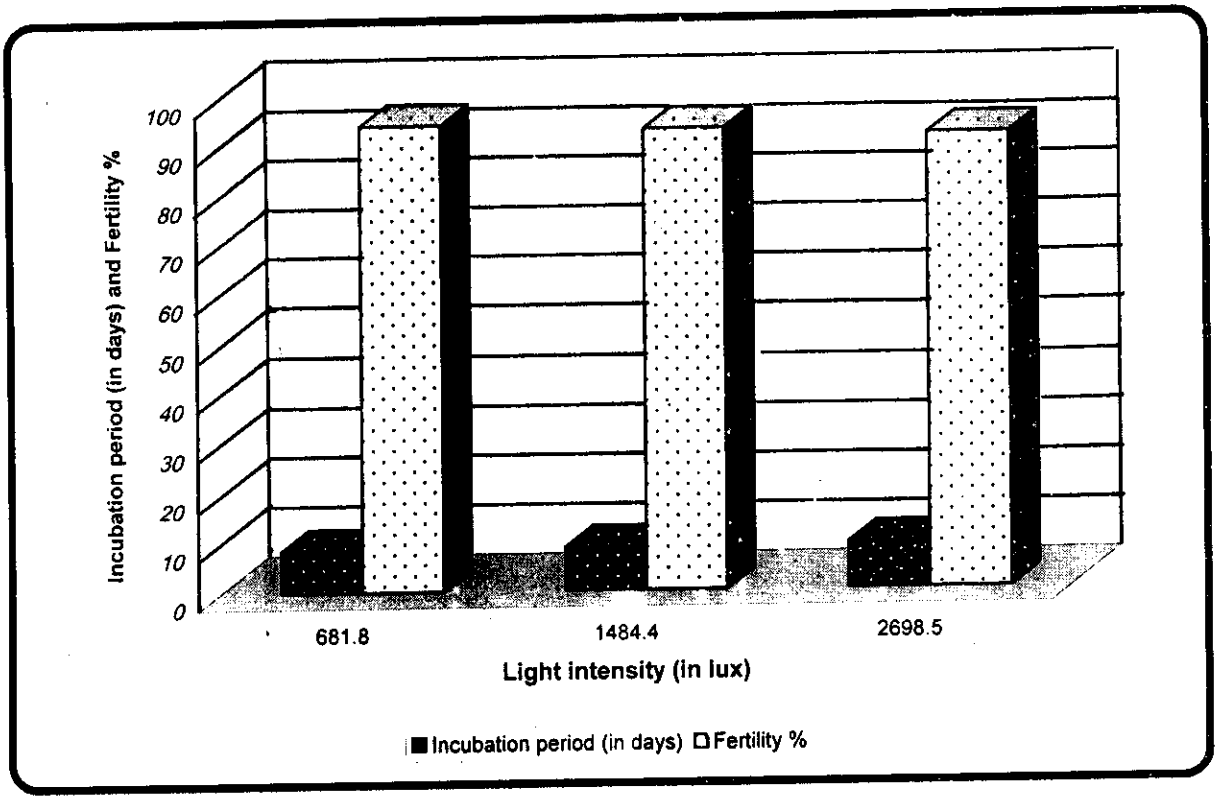


Fig. (40) : Effect of light intensity on the fecundity, fertility and incubatin period of eggs of S. urinator adults

As shown from table (40) females reared in low light intensity gave higher egg-productivity than those reared in medium and high light intensity.

Statistically, no significant difference ($P>0.05$) existed in number of egg rafts /female among recorded data for females reared in all treatments of the experiment.

A significant difference ($P<0.01$) was observed in number of eggs/raft among females reared in low and medium light intensity than those reared under high light intensity, but no significant different was observed between insects reared in low and medium light intensities.

Number of eggs per female was significantly decreased between females reared in low and high ($P<0.001$) or medium and high light ($P<0.05$) intensities but no significant difference was observed between females reared in low and medium light intensities.

Slight non-significant increase in the incubation period of eggs produced by females reared under high light intensity than those produced by females reared under low or medium light intensities.

Table (41): Effect of light intensity on the adult (*) longevity of S. urinator under controlled conditions of (temp.25±1°C and photoperiod 16L: 8D).

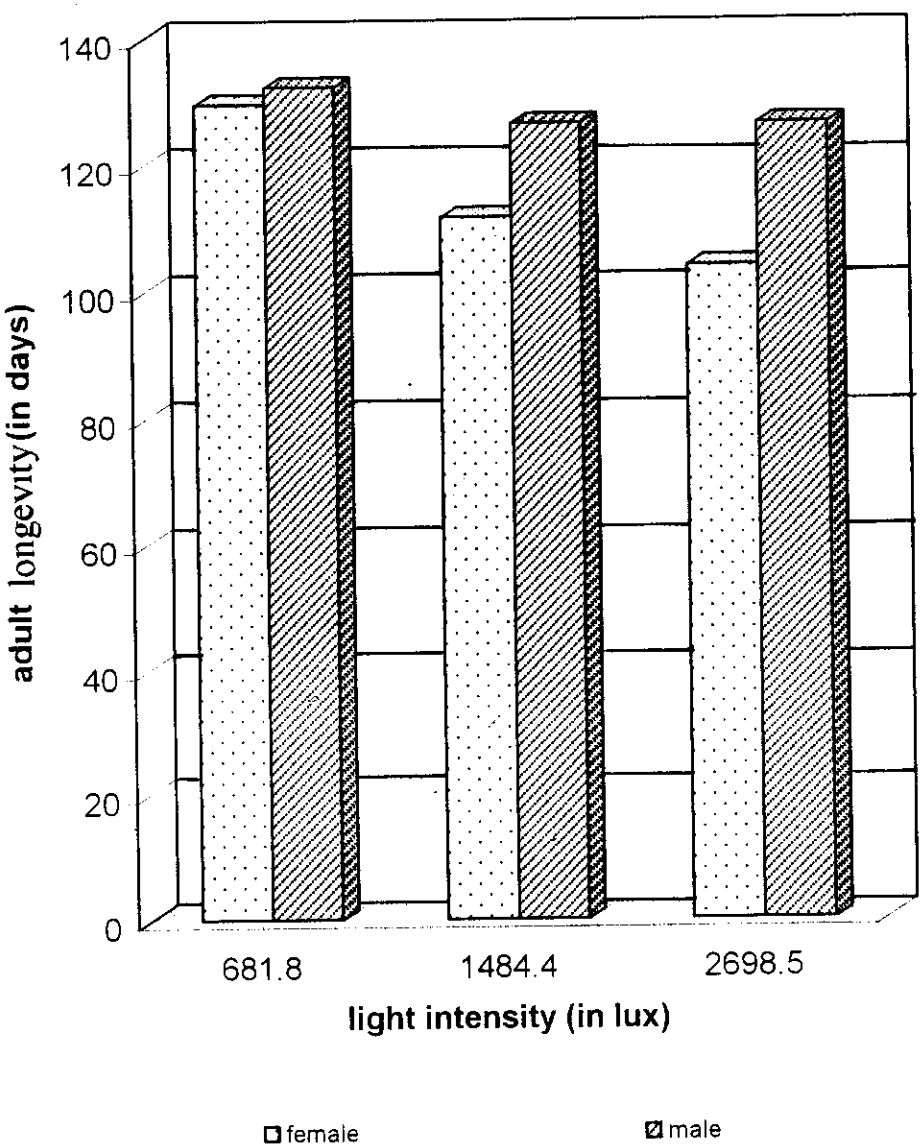
Light intensity	Longevity (in days) mean ± S.E.	
	female	male
Low(681.8 lux)	129.6 ±12.42 ^{b}	132.28 ±10.39 ^{ab}
Medium(1484.4 lux)	111.5 ±10.0.07 ^{bc}	126.40 ± 6.28 ^{ac}
High(2698.5 lux)	103.9 ± 9.81 ^{c}	126.31 ± 5.28 ^{bc}

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

The statistical analyses of the data in table (41) indicate that: Longevity of females reared in low light intensity was significantly prolonged ($P<0.05$) than those reared in high light intensity. On the other hand non-significant difference was existed between females reared in low and medium or medium and high light intensity. The longevity of females reared under low, medium and high light intensities were 129.6,111.5and 103.9 days respectively.

No significant difference in the longevity of males reared in different experiment regimes. The longevity of males reared under low, medium and high light intensities were 132.28,126.4and 126.31 days respectively.



Fig(41): Effect of light intensity on the longevity of S. urinator adults

8.Insecticides used as mosquito larvicides:-

8.1. Toxicity of insecticides to different stages of S. urinator :-

Sumithion (organophosphorus) and NeemAzal (botanical extract) were applied in the laboratory to determine their toxicity to 1st, 5th nymphal instar and adult stage of the water bug. The used doses in this experiment were 0.014ml/l and 2ml/l for Sumithion and NeemAzal respectively according to the recommended doses for mosquito larvae.

Toxicity of Dimilin and Sumilarve was tested in laboratory to egg stage, nymphal stage (1st and 5th instars) according to the LC_{90} of 4th larval instar of C. pipiens mosquito in the laboratory, Sumilarve 0.0003mg/L and Dimilin 0.002mg/L. the experiment was maintained as described viz.1.8.1.

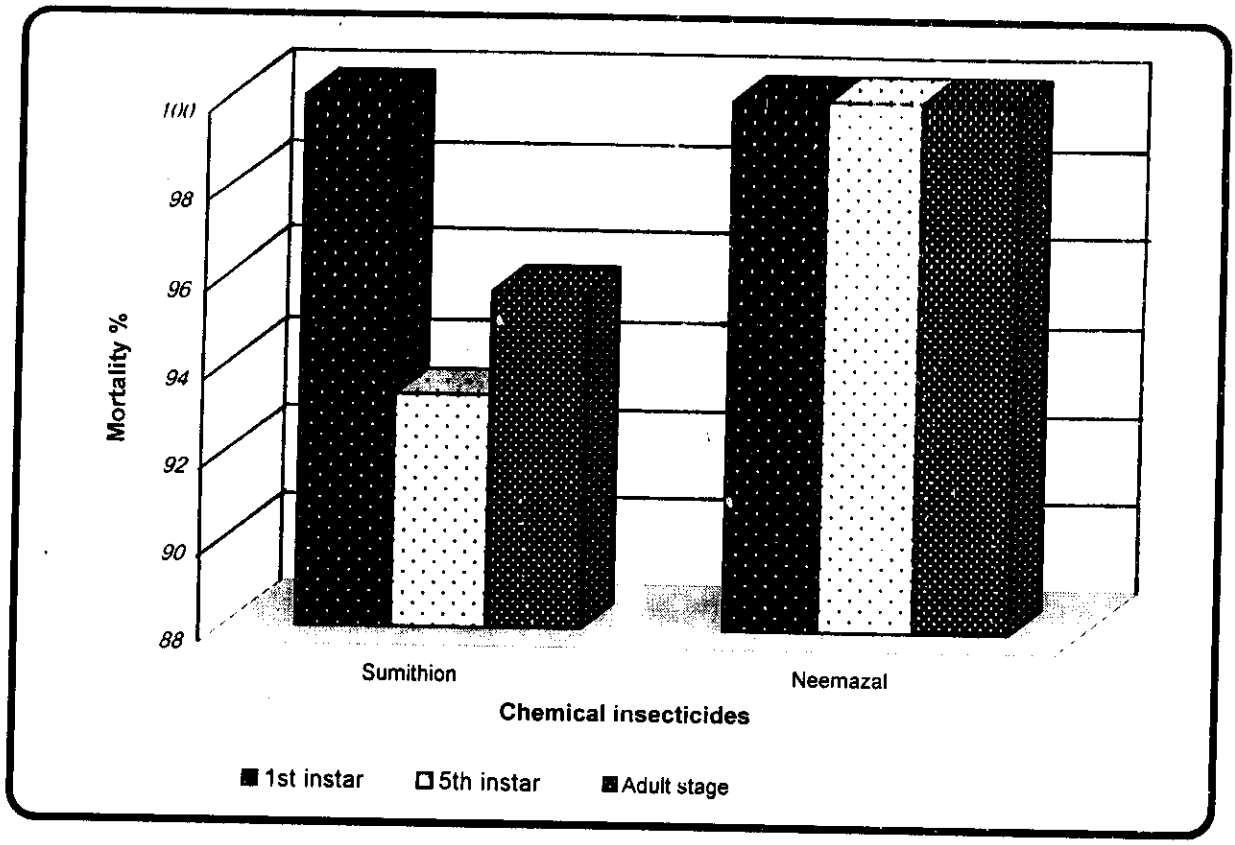
All experiments were conducted in controlled cabinets (30±1°C and photoperiod 16L: 8D) and examined for mortality after 24-hour exposure.

The results of these experiments were tabulated in table (42) and graphically illustrated in figure (42).

Table (42): Toxicity of some insecticides used as mosquito larvicides to different stages of S. urinator* under controlled conditions (temp. 30 ±1°C and photoperiod 16L:8D).

Chemical insecticide	Mortality %			Egg sterility %
	Nymph stage		Adult stage	
	1st	5th		
Sumithion (0.014 ml/L)	100	93.33	95.67	
NeemAzal (2ml/L)	100	100	100	
Dimilin (0.002 mg/L)	64.67	48.3		19.08
Sumilave (0.0003mg/L)	78.7	63.43		76.7

(*) Newly deposited eggs, hatched nymphs and emerged adults were used.



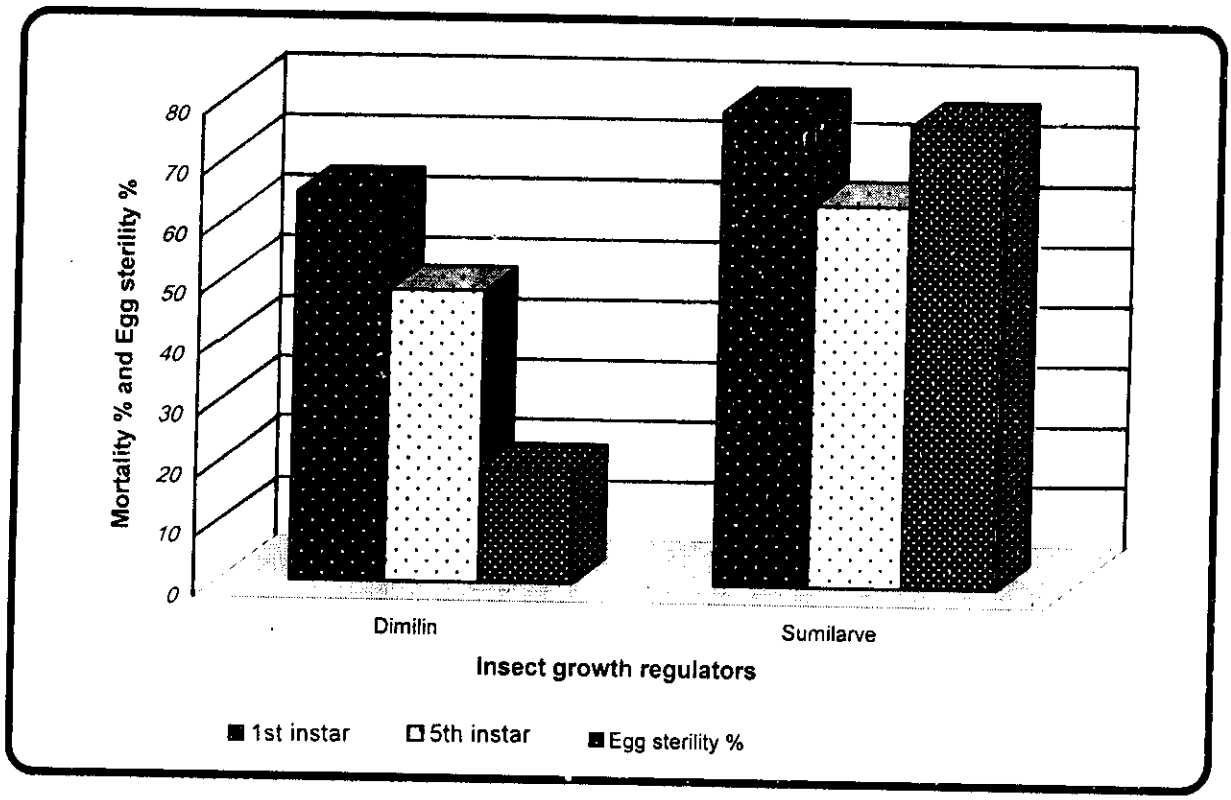


Fig. (42) : **Toxicity of some insecticides used as mosquito larvicides to differet stages of S. urinator.**

The data in table (42) indicated that the different stages of S. urinator were markedly affected by the doses of Sumithion and NeemAzal which induce LC_{50} to mosquito larvae, as NeemAzal induced 100% mortality among all stages treated with it. Also Sumithion induced 100% mortality among 1st instar nymphs. The decreased rate of mortality was observed among 5th instar nymphs (93.33%) followed by adult stag mortality (95.67%) after treated.

It is clear from data in the same table that Sumilarve and Dimilin reduced the rate of hatchability as compared to the check group. Dimilin was more effective on the egg stage than Sumilarve as it produce high sterility percentage (19.08%) followed Sumilarve (76.7%).

As compared to the check group, Dimilin induced mortality of 64.67 and 48.3% among 1st and 5th instars ,while Sumilarve induced 78.7 and 63.43%among the same nymphal instar, most mortality occurred during molting or after molting directly.

Metamorphosis and Abnormalities: -

It could be noticed that: various evident of abnormalities might occur as a result of treatment of egg stage and 1st ,5th nymphal instars with Dimilin and Sumilarve.

- Some deformed adults had very short fore and hind wings. fig. (10).

- Few emerged adults fail to form the chitin and died after molting with few hours fig. (11).

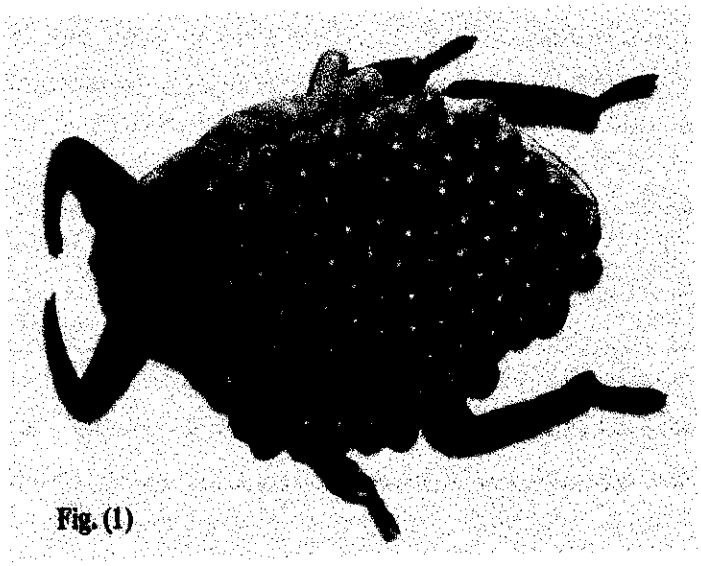


Fig. (1)

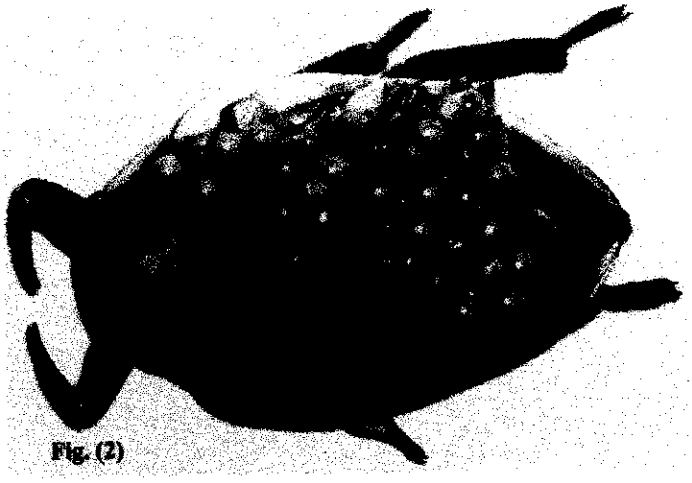


Fig. (2)

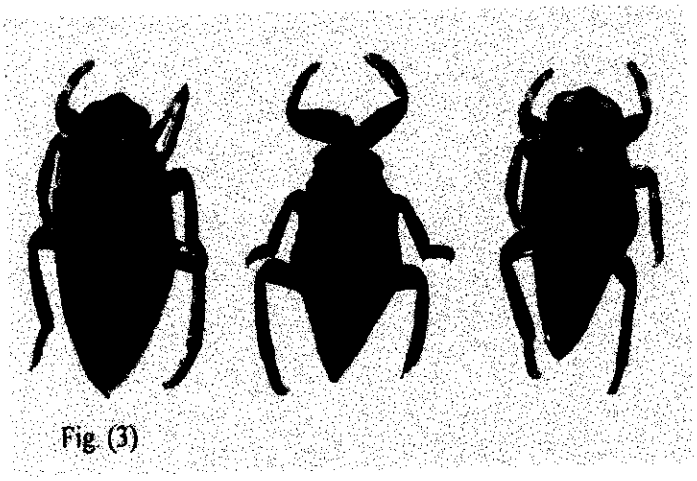


Fig. (3)

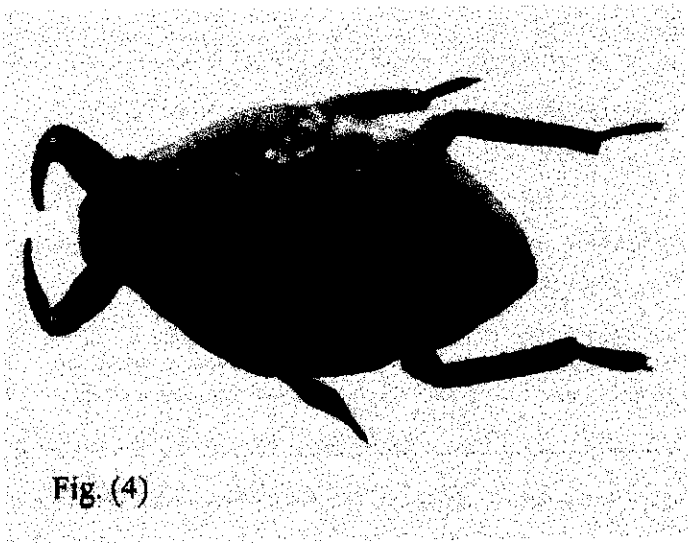


Fig. (4)

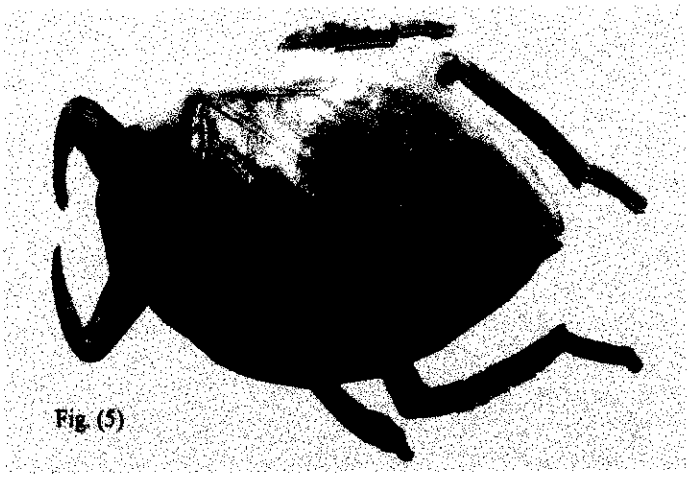


Fig. (5)

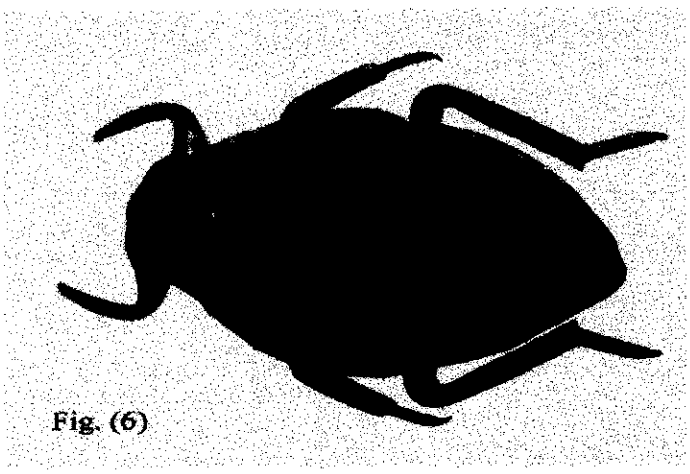


Fig. (6)

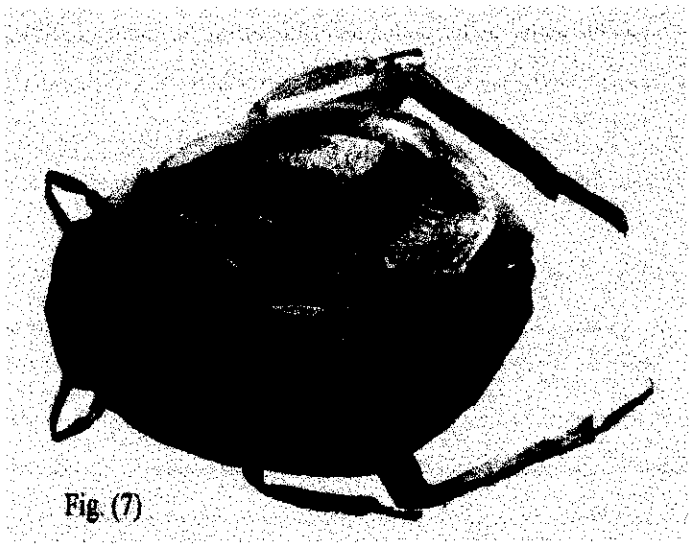


Fig. (7)

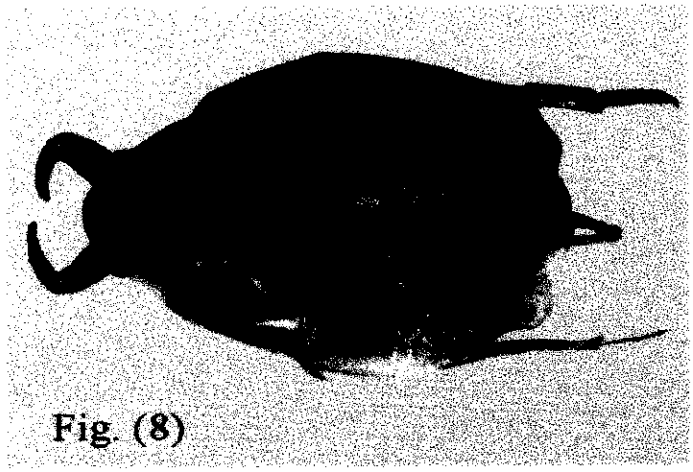


Fig. (8)

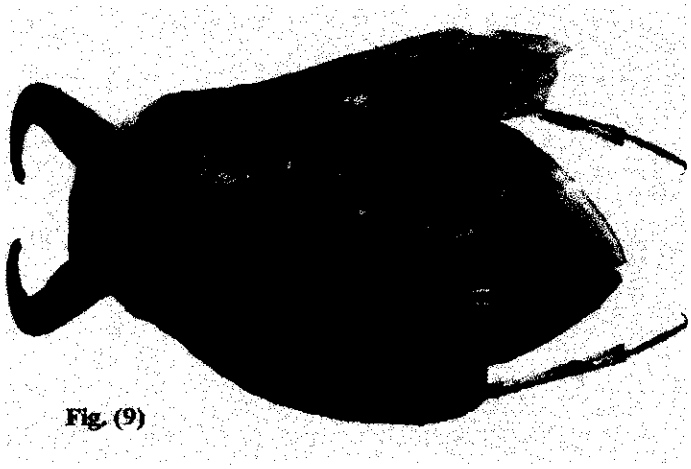


Fig. (9)

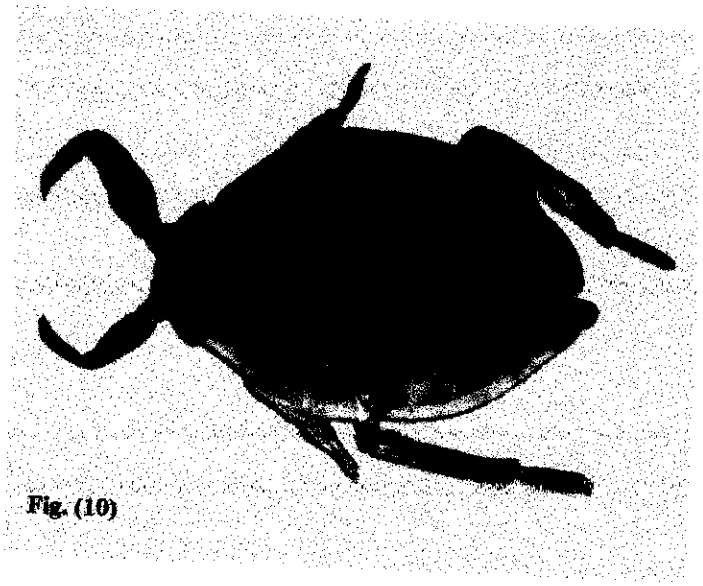


Fig. (10)

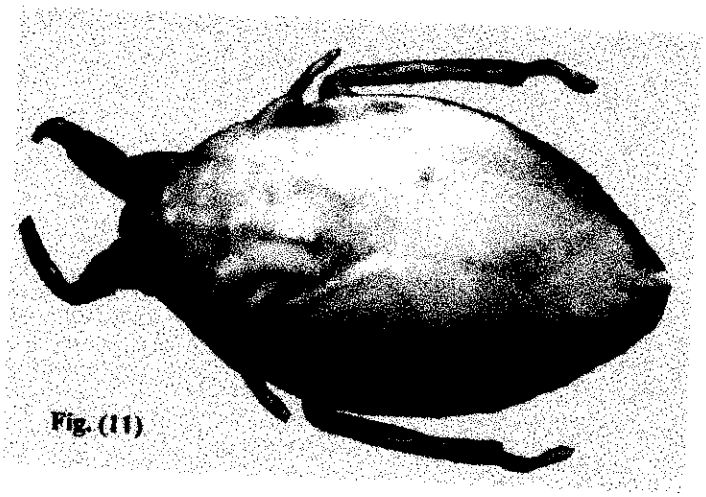


Fig. (11)

8.2. Effect of insect growth regulators on the development of the immature stage:-

Three groups of normal 2nd instar nymphs free from deformations emerged from 1st nymphs which treated in the previous experiment with Dimilin, Sumilarve and check group were used to test the effect of IGRs on the duration of each nymphal instar , mortality and total nymphal duration as well as sex ratio.

Results obtained from this experiment are presented in tables (43 and 44) and graphically illustrated in the figures (43 and 44).

Table (43): Effect of insect growth regulators on the duration of nymphal instars(*) of S. urinator under controlled conditions (temp. 30 ± 1°C and photoperiod 16L: 8D).

IGRs	Nymphal duration (in days) mean ± S.E.					Average total duration of nymph stage
	1st	2nd	3rd	4th	5th	
Control	ab 3.25±0.1	b 2.65±.11	ab 3.25±.0.12	ab 4.38±0.5	ab 4.94±0.19	18.53±0.12
Dimilin (0.002mg/L)	a 3.45±0.11	3.35±0.15	a 3.82±0.3	a 4.27±0.33	a 5.36±0.15	20.42±0.71
Sumilarve (0.0003mg/L)	b 3.20±0.13	b 2.85±0.18	b 2.95±0.13	b 5.2±0.17	b 5.4±0.25	19.38±0.18

Means in each column followed by the same letter are not significantly different.

(*) Newly hatched nymphs were used.

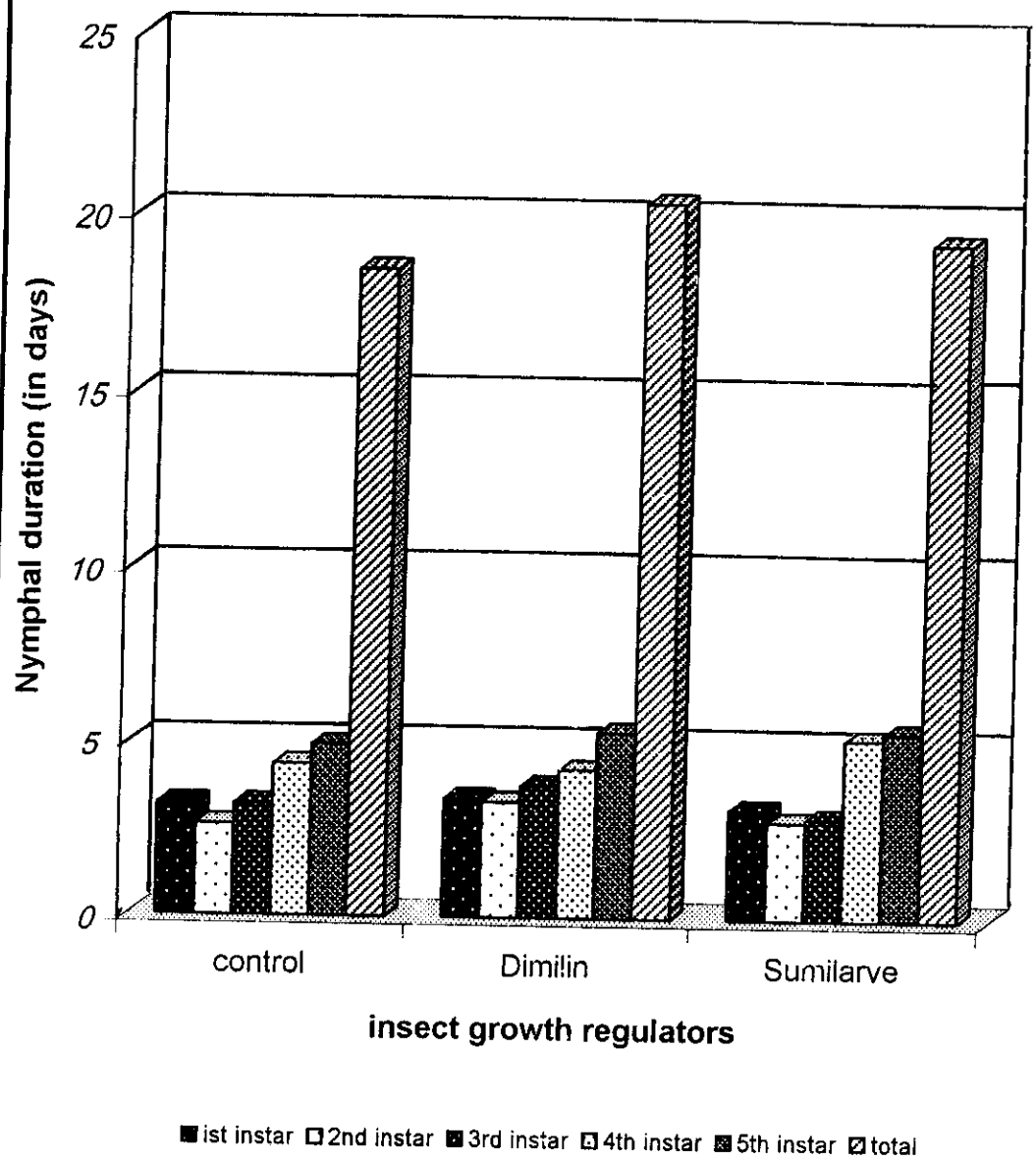


Fig.(43):Effect of insect growth regulators on the duration of nymphal instars of S. urinator

The statistical analyses of data in table (43) show that when 1st instar nymphs of S. urinator were treated with Dimilin (0.002mg/L) and Sumilarve (0.0003mg/L) the total nymphal duration of these treated insects was increased than those untreated (check group).

A non-significant difference was observed in the duration of 1st nymphal instar treated with Dimilin or Sumilarve than those untreated.

The duration of 2nd nymphal instar treated with Dimilin was significantly longer ($p<0.01$) than those untreated, whereas the duration of nymphs treated with Sumilarve was not significantly different.

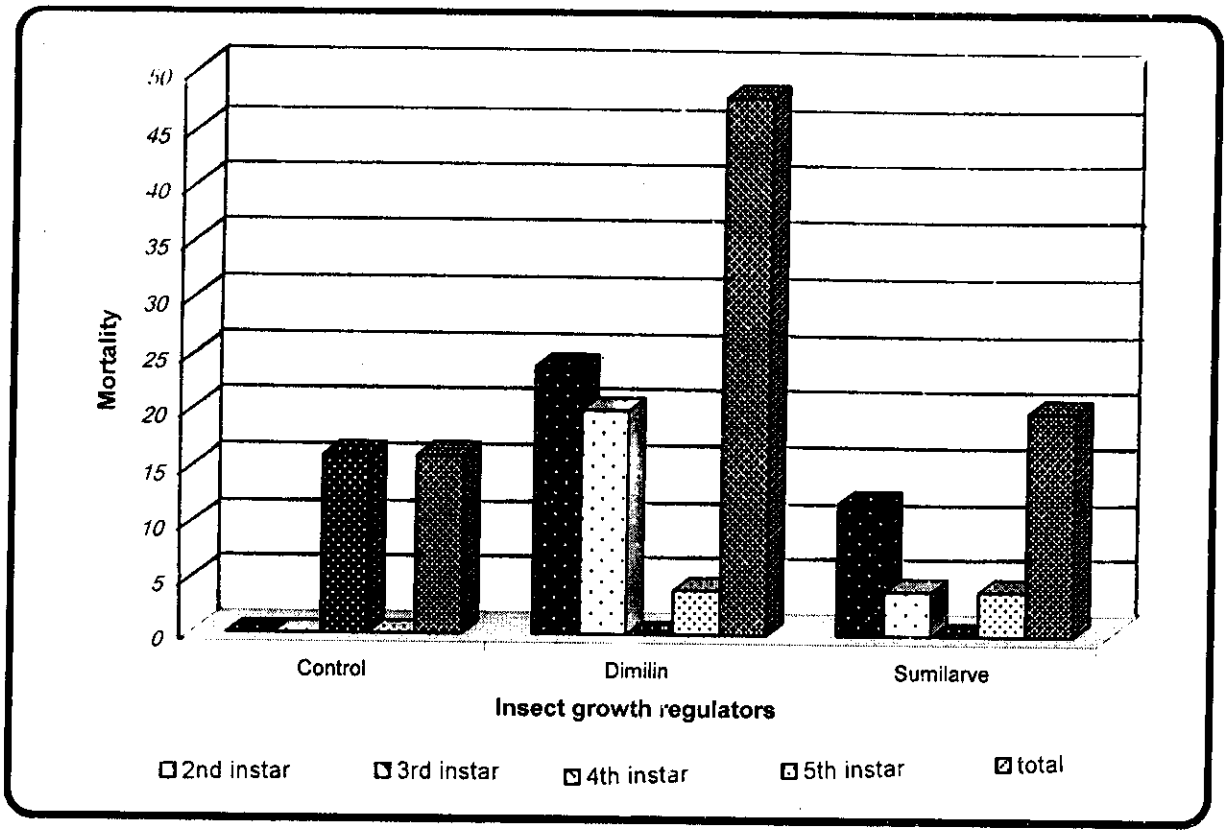
A slight non-significant increase in most instar nymphs of 3rd, 4th and 5th instar nymphs treated with Dimilin and Sumilarve was observed than the check group.

The average total duration of the nymphal stage treated with Dimilin (20.42 days) and Sumilarve (19.08 days) were significantly longer ($P<0.05$) than those of untreated (18.53 days).

Table (44) : Effect of insect growth regulators on the percentage mortality of nymphal instars (*) of S. urinator under controlled condition (temp.30±1°C and photoperiod16L: 8D).

IGRs	Mortality%					Sex ratio Female : male
	2nd	3rd	4th	5h	total	
Control	0	0	16	0	16	1: 1.1
Dimilin (0.002mg/L)	24	20	0	4	48	1.83 : 1
Sumilarve (0.0003mg/L)	12	4	0	4	20	1.4 : 1

(*) Newly emerged nymphs were used.



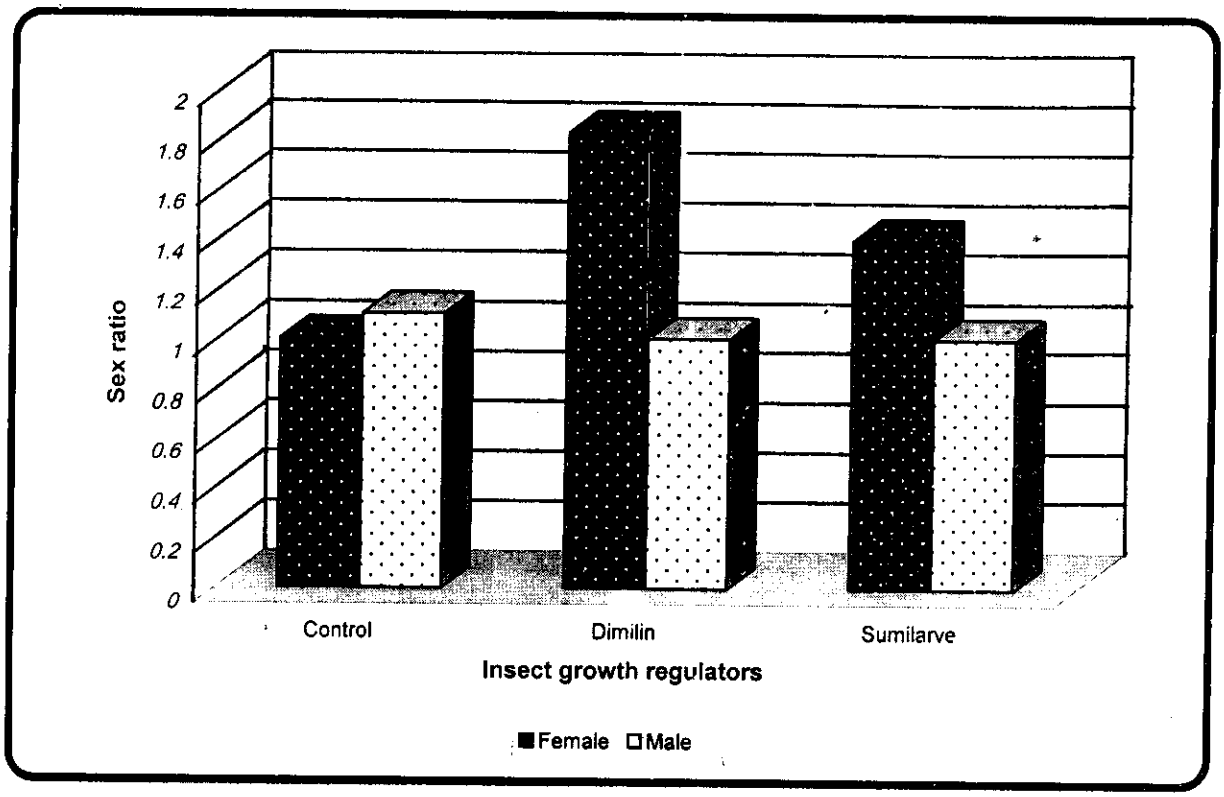


Fig. (44) : Effect of insect growth regulators on the percentage mortality of nymphal instar of S. urinator

Data in table (44) show that when early 1st instar nymphs was treated with Dimilin or Sumilarve, most mortality occurred during molting or directly after molting, also the rate of mortality decreased with the increase of the age. The highest mortality % was recorded during the 2nd instar nymphs (24 and 12 % for nymphs treated with Dimilin and Sumilarve respectively), followed by 3rd instar nymphs(20 and 4 % for nymphs treated with Dimilin and Sumilarve respectively).

No mortalities were recorded during the 4th nymphal instar in both experiments, the mortality % of 5th nymphal instars in both experiment was 4%.

Data also show that the total rate of mortality of nymphs were treated with Dimilin (48%) and Sumilarve (20%) were more higher than that untreated check group (16%).

The data in the same table show that the sex ratio of adults emerged from nymphs were treated with Dimilin and Sumilarve skewed towards females as compared to the sex ratio of adults emerged from untreated nymphs.

8 .3.Effect of insect growth regulators on some biological aspects of the adult stage:-

In order to study the influence of the recommended dosage which induce 90% mortality to the mosquito larvae in the laboratory on the sexual maturation, fecundity, and adult longevity as well as fertility and incubation period of eggs deposited by the water bugs treated by IGRs, groups of adults free from deformations emerged from 5^{th} instar nymphs which treated in the previous experiment with Dimiline, Sumilarve and check group were used. The experiment was maintained in the same conditions as described in 8.1.

The results obtained are given in tables (45,46and 47) and graphically illustrated in figures (45, 46 and 47).

Table (45): Effect of insect growth regulators on the sexual maturation of S. urinator adults under controlled conditions of temperature (30±1°C) and photoperiod (16L: 8D).

IGRs	Sexual maturation (in days) mean+S.E.		
	Preoviposion period	Ovipostion period	Postoviposion period
Control	9.9 ±1.02 ab	99.6 ±10.56	9.7 ±1.13 b
Dimilin (0.002mg/L)	10.3 ±0.92 a	27.8 ±6.99	6.2 ±1.33
Sumilarve (0.0003mg/L)	8.5 ±0.97 b	74.8 ±14.65	9.4 ±3.15 b

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

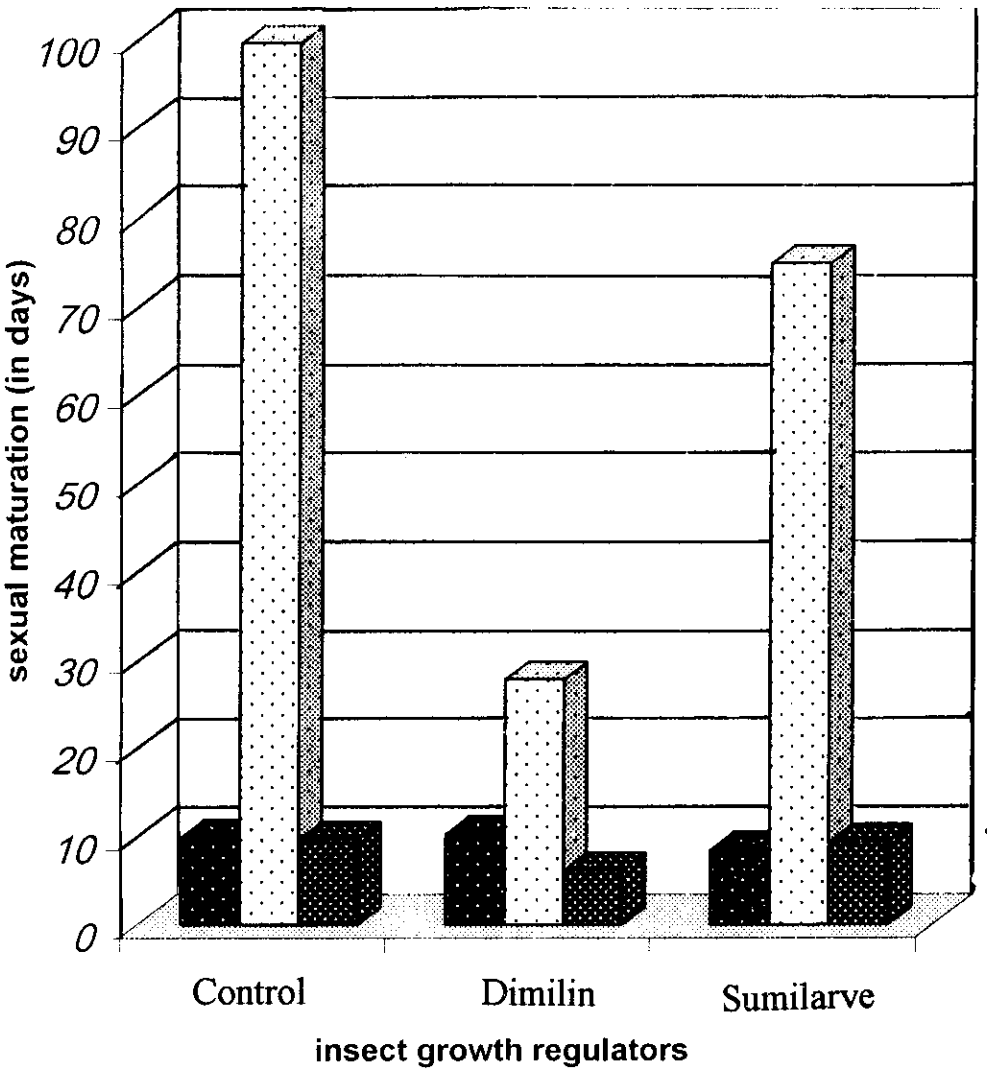


Fig. (45)Effect of insect growth regulators on the sexual maturation of S. urinator adult

The statistical analyses of data in table (45) reveal that Dimilin is more effective in the reducing oviposition period of the adult than Sumilarve. But in all cases the preovipostion period of females treated with Dimilin and Sumilarve was not significantly different than those untreated.

Females treated with Dimilin had very high significant ($P<0.001$) shorter ovipostion period than the females of the check group, while females treated with Sumilarve had significant ($P<0.05$) shorter duration.

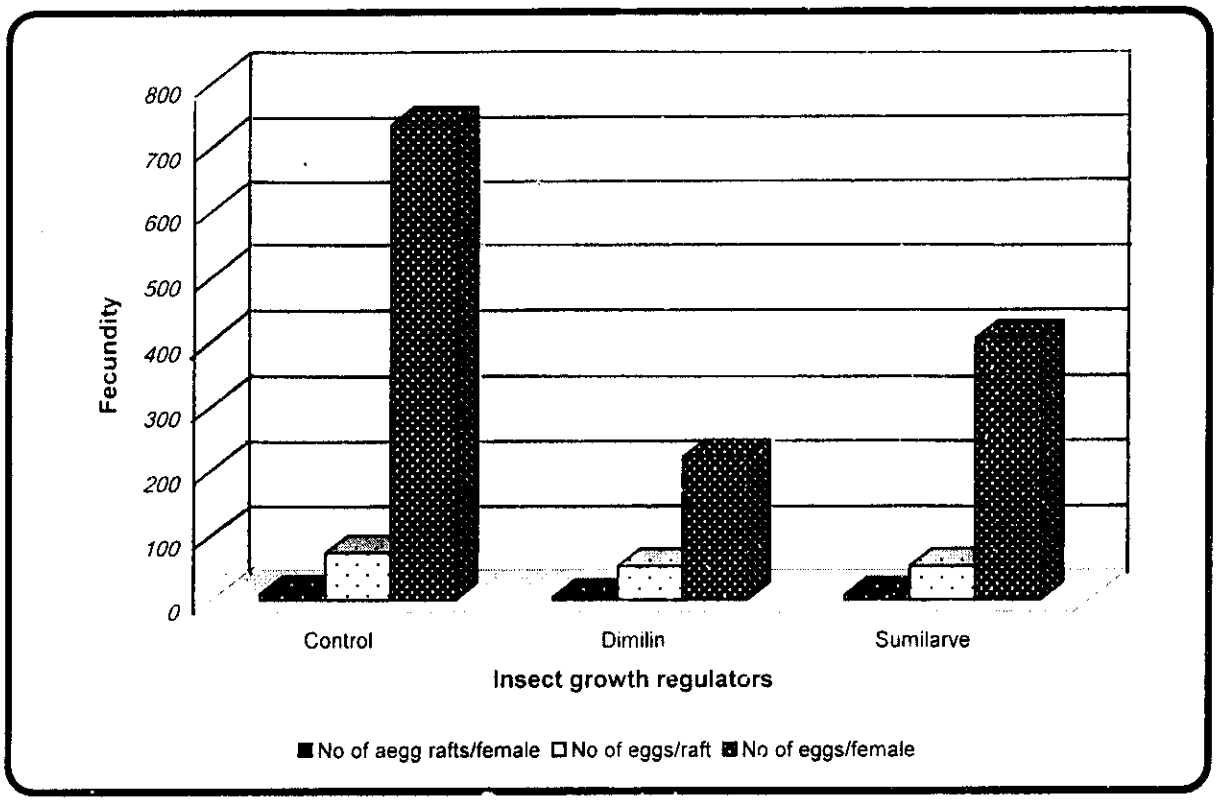
The postovipostion period of females treated with Dimilin was significantly shorter ($P<0.05$) than the check group, in the same time no significant difference was observed in this period in case of females treated with Sumilarve.

Table (46): Effect of insect growth regulators on the fecundity as well as incubation period and fertility of eggs of S. urinator adults* under controlled temperature(30±1°C) and photoperiod (16L: 8D).

IGRs**	Fecundity mean ± S.E			Incubation period (in days)	Fertility %
	no of egg rafts/female	no of eggs/raft	no of eggs/female		
Control	10.1±0.88	73.65±2.59	734.9±64.38	7.2±0.17	92.92
Dimilin (0.002mg/L)	4.00±0.63	52.39±4.8	222±50.29	7.67±0.63	93.34
Sumilarve (0.0003mg/L)	7.6±1.10	52.35±5.62	403.7±75.61	7.86±o.51	87.66

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.



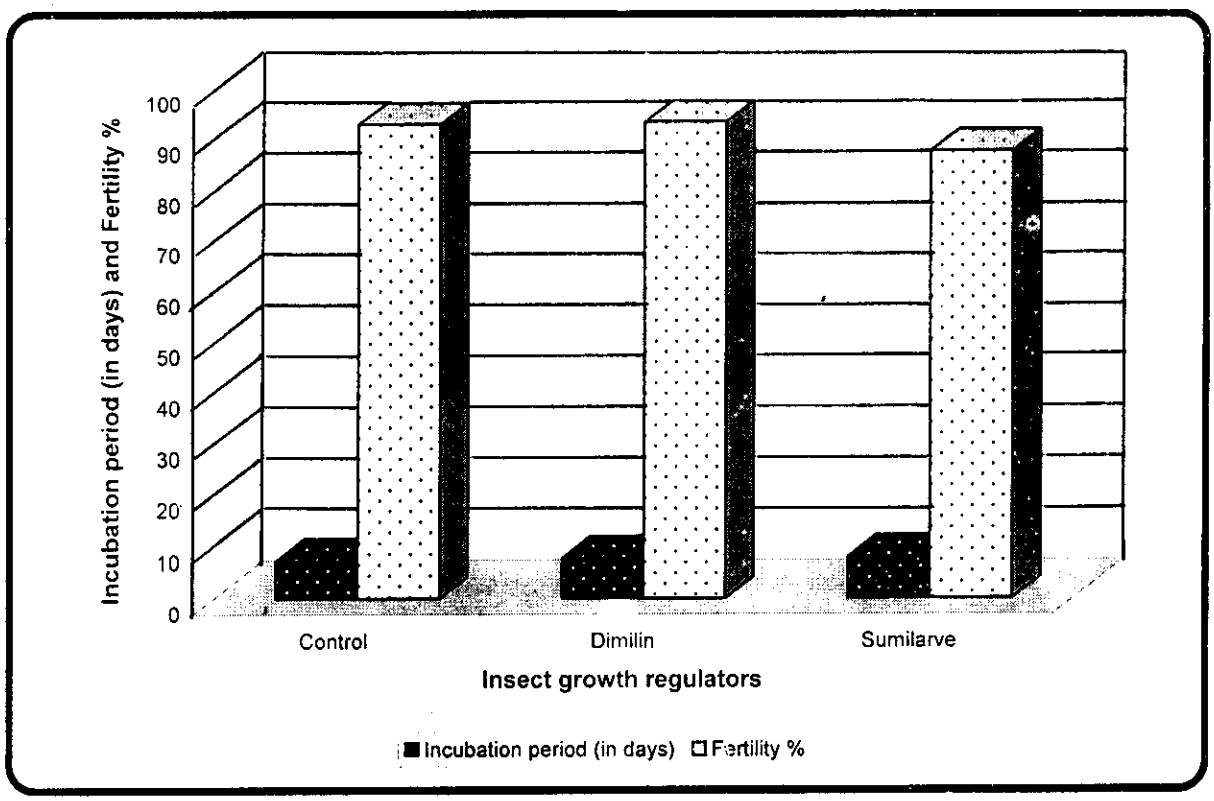


Fig. (46) : Effect of insect growth regulators on the fecundity as well as incubation period and fertility of eggs of S. urinator adults

From the statistical analysis of data in table (4'6) it is clear that:

A very high significant reduction in the number of rafts /female treated with Dimilin than the check group ($P<0.001$), while a non significant reduction was observed in case of females treated with Sumilarve.

Females treated with Dimilin or Sumilarve produced significantly lower number of eggs/raft ($P<0.05$) than the females of the check group.

Number of eggs produced by females treated with Dimilin (222egg/female) or females treated with Sumilarve (403.7egg/female) was very high significantly decreased than those produced by the check group ($P<0.001$).

A non-significant difference was observed in the incubation period among all treatments of the experiment.

The data also indicate that their was no marked effect on the hatchability of eggs laid by females which resulted from treated 5^{th} instar nymphs with Dimilin (93.34%). But the percentage hachability of eggs produced by insects treated with Sumilarve was slightly affected (87.66%).

Table (47): Effect of insect growth regulators on the adult (*) longevity of S. urinator under controlled conditions of temperature (30±1°C) and photoperiod (16L: 8D).

IGRs**	Longevity (in days) mean ±S.E.	
	female	male
Control	116.7 ±20.14	121.5 ±8.69 b
Dimilin (0.002mg/L)	40 ±3.7	64.9 ±5.49
Sumilarve (0.0003mg/L)	92.9 ±4.70	138.2 ±13.94 b

Means in each column followed by the same letter are not significantly different.

(*) Newly emerged adults were used.

From the statistical analysis of data in table (47) it is clear that: Males and females treated with Dimilin had significantly shorter duration than those of the check group ($P<0.001$), whereas the longevity of females treated with Sumilarve show significant reduction than the check females ($P<0.05$) but a non significant reduction in longevity of males in the same experiment was observed.

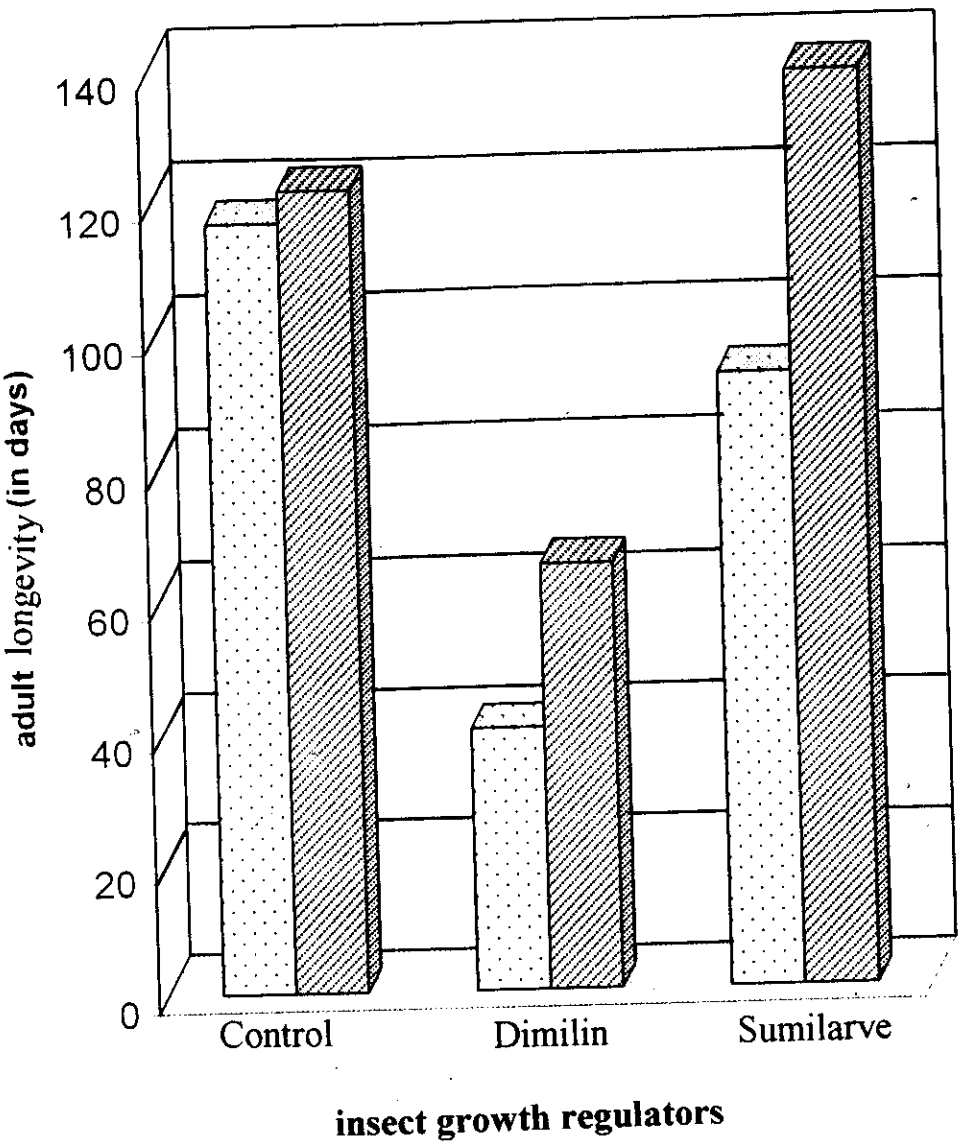


Fig.(47)Effect of insect growth regulators on the longevity of S. urinator adults