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Life table parameters *Tyrophagus putrescentiae* (Schank), *Caloglyphus manure* (Eraky & Osman), and *Sancassania berlesei* (Michael), fed on baker's yeast

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Abstract
The biology and life table of three acarid mites, *Tyrophagus putrescentiae* (Schank), *Sancassania (Caloglyphus) berlesei* (Michael), and *Caloglyphus manure* (Eraky & Osman) fed on baker's yeast at 25±2°C and R.H 70±10%. *T. putrescentiae, C. manure*, and *S. berlesei* had respective life cycles of 12.35, 7.47, and 11.1 days for females and 10.4, 5.9, and 10.2 for males. The average female life span was 39.95, 22.5, and 32.4 days, while the average male life span was 23.9, 17.2, and 26.16 days. The mean generation time (T) for the afore mentioned three mites was 16.35, 10.97, and 15.30 days, while their net reproductive rates (R0) were 174.57, 337.36 and 187.86 times, respectively. The net rate of natural increase (rm) for *T. putrescentiae, C. manure* and *S. berlesei* was 0.597, 0.950, and 0.640 individual /day, while the finite rate of growth (erm) averaged 1.82, 2.59, and 1.90 time /day, respectively.

Keywords: *Tyrophagus putrescentiae*, *Sancassania berlesei*, *Caloglyphus manure*, yeast, biology, life table parameters

Introduction
Acaridae is a huge, globally distributed family. Over 400 species of acarid mites belonging to roughly 90 genera are recognized worldwide, and many more, particularly in the tropics, remain to be identified (Zhiqiang, 2003) [15]. Acaridides are abundant in leaf litter, upper soil layers rich in organic materials, and decomposing animal droppings. Many species are connected with invertebrate and vertebrate nests or bodies (Gerson *et al.*, 2003) [11]. The biological characteristics of *Caloglyphus manure* Eraky Osman fed on dry cheese, baker's yeast, and egg masses of the root-knot nematode *Meloidogyen sp*. in the laboratory at 25±1°C were described by Eraky and Osman (2008) [10]. Abou El-Atta *et al.*, (2017) [1] analyzed different biological properties of *T. putrescentiae, S. berlesei*, and *C. manure*, when fed on egg masses of *Meloidogyne incognita* in vitro at 25±1°C. The effect of three different diets (wheat flour, maize flour, and wheat bran) as a type of food on biological characteristics, fertility of the Astigmatid Mite, *Caloglyphus berlesei* (Michael) was investigated by (Kassem, 2020) [12]. Consequently, the purpose of this study is to investigate some biological characteristics of three acarid mites, *Tyrophagus putrescentiae* (Schank), *Caloglyphus manure* (Eraky & Osman), and *Sancassania* (*Caloglyphus*) *berlesei* (Michael), fed on baker's yeast under laboratory conditions of 25±2°C. The effect of the life table factors of various species was also investigated.

Materials and methods
Mites' cultures
Using Tullgren funnels, the three mites *T. Putrescentiae, C. manure* and *S. berlesei* were collected from chicken manure and cultivated in the laboratory. Two different types of plastic cells were used each with a floor made from a mixture of plaster of Paris & charcoal (1:1). First one was large rearing cell measuring (2.5cm) diameter and (2cm) depth, were used for mite cultures. The second smaller ones (1cm in diameter and 0.8cm in depth) were used for biological investigations in which a strong cover of glass was employed to keep mites from escaping. The floor of plaster of Paris was maintained damp to a modest degree. According to kind of mite, three primary groups of Acaridid cultures are maintained in large rearing cells. All groups were given baker's yeast daily and incubated at 25±2°C. Mites' eggs of tested species were individually implanted in the small cells. Cells were checked twice daily throughout the whole of one's life. Each experiment began with twenty newly-hatched larvae. One-way analysis of variance (ANOVA) was used to assess the data, and Duncan's multiple range tests were used to separate the means (Cohort Software, 2004) [7]. Life table analysis utilizing Birch's approach (1948) [3] and a BASIC computer application to generate Life table parameters (Abou-Setta *et al.*1986) [2] were used. The mean generation time (T), gross reproductive rate (GRR), net reproductive increase (R0), intrinsic rate of increase (rm), finite rate of increase (erm), and doubling time were determined (DT) conformed to (Carey, 1993) [4]. Survival the life tables were established based on daily recorded data on development time (from egg to first egg laid), sex ratio, number of eggs laid, number of eggs reaching maturity, and females survived. The age range for making the survival tables was chosen with an interval of one day.

Results and Discussion
Immature stages
Table (1) showed that *S. berlesei* female and male larvae hatched after 3.09 and 2.92 days; while for *T. Putrescentiae* 2.5 and 2.2 days and for *C. manure* 0.94 and 0.98 day respectively. On the other hand, life cycle averaged 12.35, 11.1 and 7.47 days for female and 10.4, 10.2 and 5.92 days for male to *T. putrescentiae, S. berlesei* and *C. manure* respectively. Immature males generally have a shorter life cycle than females. Abou El-Atta *et al.* (2017) [1] obtained

similar results, they recorded that *C. manure, S. berlesei*, and *T. putrescentiae* life cycles lasted 13.52, 7.92, and 12.6 days for females and 13.17, 7.31, and 11.29 days for males, respectively. *Caloglyphus berlesi* (Michael) male life cycle was studied at 20°C, as it were 13.14, 16.47, and 17.92 days for wheat flour, maize flour, and wheat bran, respectively. Female life cycle was recorded as 14.6, 18.8 and 22.0 days, with wheat flour, maize flour, and wheat bran, respectively, (Kassem, 2020) [12]. (Eraky and Osman, 2008) [10] reared *C.manuri* on egg masses *Meloidogyne spp*. and discovered that the female and male life cycles lasted 10.4 and 8.1 days, respectively.

Table 1: Duration (in days) of *S. berlisie, C.manuri* and *T. Putrescntiae* evelopmental stages fed on baker's yeast and kept at25 °C ±2 and R.H 70±10%.

Mite	Sex	Egg	Larva	Q	protonymph	Q	Tirtoymph	Q	Immature	Life cycle
Tyrophagus putrescentiae	♀	2.5b±0.166	2.7a±0.152	1.05a±0.05	1.9a±0.17	1.1a±0.06	2.0a±0.21	1.1a±0.1	9.85a±0.387	12.35b±0.357
	♂	2.2b±0.13	2.3a±0.15	1.1a±0.1	1.4a±0.163	1.1a±0.1	1.2b±0.133	1.1a±0.1	8.2a±0.359	10.4a±0.4
Caloglyphus manuri	♀	0.948c±0.068	1.75c±0.118	0.75b±0.064	1.52b±0.096	0.72c±0.072	1.35b±0.186	0.65b±0.129	6.52c±0.224	7.47c±0.237
	♂	0.98c±0.065	1.04c±0.051	0.79b±0.065	0.89b±0.052	0.67b±0.098	0.9b±0.113	0.64b±0.134	4.94c±0.29	5.9b±0.279
Sancassania berlesie	♀	3.09a±0.108	2.02b±0.032	1.04±0.052	1.07c±0.036	0.91c±0.019	1.98a ±0.01	0.99a ±0.037	8.017b±0.094	11.1b ±0.140
	♂	2.92a ±0.154	1.97b ±0.03	0.93ab ±0.047	0.94b±0.049	0.84b±0.052	1.76a ±0.127	0.907ab ±0.026	7.34b ±0.184	10.2a ±0.255
LSD	♀	0.352	0.328	0.162	0.347	0.179	0.471	0.281	0.766	0.756
	♂	0.355	0.274	0.215	0.299	0.250	0.362	0.270	0.318	0.922

Means followed by the same letter in the same column are not significantly different at the 0.05 level.

Adult stage

Table (2) shows that males are shorter-lived than females. Females began to deposit eggs after 1.13, 0.9 and 0.4 days and laid an average of 530.9, 296.3 and 268.6 eggs for *C. manure, S. berlesei* and *T. putrescentiae* respectively (Tables 2, Fig1). The adult female lived for 27.6, 21.3 and 15.03 days and life span averaged 39.95, 32.4 and 22.5 days for females of *T. putrescentiae, C. manure* and *S. berlesei*, respectively. However the adult male lived for and 13.5, 11.28 and 15.9 days and life span 23.9, 17.2, and 26.16 days for *T. putrescentiae, C. manure* and *S. berlesei* respectively. *C. berlesei* laid an average of 755.7 eggs, according to (Eraky, 1987) [8]. (Walia and Mather, 1998) [14] found that female *T. putrescentiae* lays an average of 171.40 eggs when reared on juvenile *M. javanica*. Furthermore, (Chmielewski, 2000) [5] observed that the average number of eggs laid per female of *C. berlesi* was 221.7 when reared on bee bread.

In (2003) [6], Chmielewski also discovered that *C. berlesi* fertility averaged 237.4 eggs when reared on buckwheat sprouts. Also in (2008) [10] Eraky and Osman observed that female *C. manuri* laid 601.4, 535.0 and 159.1 eggs and lived for 15.7, 11.6 and 17.8 days when fed on dry yeast, cheese and *Meloidogyn sp*. egg masses, respectively.

Table 2: Duration (in days) of *T. Putrescntiae, C. manuri* and *S. berlisie* adult stages fed on baker's yeast kept at 25 °C ±2 and R.H70±5%.

Mite	Sex	Preovi.	Ovip.	Postovi.	Longevity	Lifespan
Tyrophagus putrescentiae	♀	1.4b±0.163	20.5a±3.012	6.8a±2.259	27.6a±4.019	39.95a±3.9
	♂	---------	--------	-------	13.5ab±2.578	23.9a±2.478
Caloglyphus manure	♀	1.13a±0.118	11.95b±0.417	1.95b±0.163	15.03b±0.422	22.5c±0.305
	♂	-------	--------	--------	11.28b±0.421	17.2b±0.612
Sancassania berlesie	♀	0.9b0.066	13.46b±0.371	7a±0.471	21.3ab±0.628	32.4b±0.666
	♂	--------	---------	--------	15.9a±0.433	26.16a±0.472
LSD	♀	0.355	5.132	3.877	6.853	6.664
	♂	---------	------	--------	4.437	4.349

Means followed by the same letter in the same column are not significantly different at the 0.05 level.

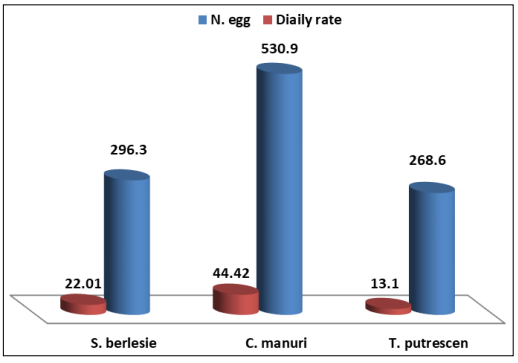

Fig 1: Total and daily rate of deposited egg/female of *S. berlesei, C. manure* and *T. putrescentiae* when fed on baker's yeast and kept at 25°C ±2 and R.H 70±10%.

Life table parameters

The following life table parameters were considered: mean generation time (T), net reproductive increase (R0), doubling time (DT), intrinsic rate of increase (rm), and finite rate of increase (erm)., gross reproductive rate (GRR). Apropos life table parameters of *T. putrescentiae, C. manure* and *S. berlesei* as shown in Table (3) mean generation time (T) was significantly influenced by type of mites as (T) averaging 16.35, 10.97 and 15.30 days for *T. putrescentiae, C. manure* and *S. berlesei*, respectively. The population of *T. putrescentiae, C. manure* and *S. berlesei* duplicate every 2.368, 1.488 and 2.209 days. So the net reproductive rat (R0) was significantly affected by kind of mite as (R0) values averaged 174.57, 337.36 and 187.86 for the same mites mentioned before, respectively.

Moreover, (Birch, 1948) [3] recorded that the intrinsic rat of natural increase (rm) is helpful for forecasting the probable population expansion of an animal under specific environmental conditions, towards (rm) depicts an overall impact on growth, survival, and reproduction. Table (3) construes (rm) values as it was 0.597, 0.950 and 0.640 individuals per female / day for tested mites *T. putrescentiae*, *C. manure* and *S. berlesei*, respectively. The finite rate of increase was 1.82, 2.59 and 1.90 the same mites, respectively. (Eraky, 1995) [9] observed that intrinsic rate of increase (rm) and the reproductive rat (R0) were 0.09 and 80.24 however, doubling time (DT) and mean generation time (T) were7.70 and 49.29 when *T. putrescentiae* (schrank) reared on the bird-cherry aphid *Rhopalosiphum padi* L. at 18 C; while, (Eraky and Osman, 2008) [10] found that mean generation time (T) averaged 11.82, 9.32 and 15.85 days, net reproductive rate (R0) values were 298.53, 346.40 and 83.08 times, net rate of natural increase (rm) was 0.482, 0.627 and 0.278 individual per female /day and the finite rate of and gross reproductive rate (GRR) were 1.43, 1.1 & 2.49; and 368.17, 447.28 &127.45 when fed on the dry cheese, baker's yeast, and egg masses of rot knot nematode.

Baker yeast was the most favorable for rearing *C. manure*. According to (Taha *et al.*, 2019) [13], the grain mite *C. lactis*' biological characteristics, fecundity, and life table parameters were studied in relation to the effects of dry yeast granules, crushed wheat, and crushed rice as a type of food. The information obtained demonstrated the ability of *C. lactis* to feed and grow using only the diets mentioned above.

Table 3: Life table parameters of *S. berlisie, C.manuri* and *T. putrescntiae* when fed on baker's yeast and kept at 25℃ ±2 and R.H 70±10%.

Mite	Mean Total Fecundity	R0	T	rm	erm	DT
Tyrophagus putrescentiae	268.6	174.57	16.35	0.597	1.82	2.368
Caloglyphus manuri	530.9	337.36	10.97	0.950	2.59	1.488
Sancassania berlesie	296.3	187.86	15.30	0.640	1.90	2.209

Conclusion

The present result showed that feeding the three tested acarid mites *T. putrescentiae*, *C. manure* and *S. berlesei* on Bakers' yeast obtain the highest rates offspring.

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