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Biological Aspects of Four Mite Species under Laboratory Conditions

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ABSTRACT

This work was conducted to determine the effect of yeast food on biology of the acarid mites, *Caloglyphus berlesi* (Michael), *Caloglyphus mycophagous (Megnin), Rhizoglyphus robini* Clapared and *Tyrophagous longior* (Gervais) under the laboratory condition at 26 ± 2°C and 70 % R.H. The generation time significantly differed among different female species ($F_{3,76}$ = 159.83; $P < 0.05$). *Tyrophagous longior* had significantly the longest generation time with average 19.05 days, followed by *Caloglyphus berlesi* 14.83 days and *Rhizoglyphus robini* 14.64 days; while *Caloglyphus mycophagous* showed significantly the shortest generation time with average 9.81 days. Likewise, there were significant differences among different species in daily rate of eggs per female ($F_{3,76}$ = 21.697; $P < 0.05$). *Caloglyphus mycophagous* exhibited the highest average daily rate 25.51 eggs, followed by *Caloglyphus berlesi* with 19.80 eggs, then *Tyrophagous longior* with average 15.82 eggs. The last species was *Rhizoglyphus robini*, with the lowest average daily rate 8.38 eggs. Therefore, *Caloglyphus mycophagous* is considered the most dangerous species as its generation time was the shortest and with highest daily rate. So it, gave very large of population.

Key words: Biology; *Caloglyphus berlesi*; *Caloglyphus mycophagous*; *Rhizoglyphus robini*; *Tyrophagous longior*; Generation time; Daily rate.

INTRODUCTION

Mites of the sub-order Acaridida are common pests in grain storage and mostly found in damp or moist grains, residues, oilseeds and animal feeds. They generally cause qualitative and quantitative losses to several stored products (Hubert, 2011). Mites cause direct consumption of human food, animal feed or other products the infested products. They can penetrate the hard grains and feed directly on the grain kernels; therefore they destroy germination power, changing the moisture contents and initiating growth and spread mould (Sinha and Wallace, 1977; Taha, 1985; Gulati and Mathur, 1995; Zeinab-Mostafa, 2015). Mites also produce hazardous compounds among them the allergens are of the highest importance. Kato *et al.* (1994) studied the population dynamics of two species of bulb mites; *Rhizoglyphus robini* Clapared and *Caloglyphus* sp. of which the latter showed a higher rate of population growth than *R. robini* on potted Rakkayo bulbs.

The objective of this study was to determine the effect of yeast food on the biology of the four acarid mite species namely, *Caloglyphus berlesi* (Micael), *Caloglyphus mycophagous* (Megnin), *Rhizoglyphus robini* Clapared and *Tyrophagous longior* (Gervais) under the laboratory condition.

MATERIALS AND METHODS

Mite species were collected from rice, wheat and animal feed. For obtaining pure culture female and male adults were placed in rearing plastic blocks (2 cm long x 2 cm diameter wide) filled with a mixture of (Cement: Charcoal in ratio of 9: 1) as a substrate. The rearing plastic cells for the biology of each mite species contained yeast and a drop of water as source of food and humidity. The cell was covered to prevent mite from escaping. Thirty blocks were used for each species. Each replicate contained a singly newly deposited egg by using a fine camel brush (00). The cells were investigated twice daily in the morning and just before sunset by binocular microscope. Drops of water were added to the blocks. The biological aspects (incubation period, hatching, active and quiescent larvae, protonymph, tritonymph, adult female and male, mating, oviposition and adult longevity were investigated and recorded. Couples of single females and males placed together were observed for behavior. Life cycle, generation time, fecundity and life span were calculated. Mite species were reared on yeast under laboratory condition at 26 ± 2°C and 70% R.H. Statistical analysis of obtained data was conducted using Proc ANOVA and GLM in SAS (SAS Institute 1998). Duncan Multiple Range Test was conducting in the same program.

RESULTS AND DISCUSSION

The present study was conducted to determine the effect of food on the duration of various life stages of the acarid mites *Caloglyphus berlesi, Caloglyphus mycophagous, Rhizoglyphus robini* and *Tyrophagous longior*.

Developmental duration:

There are four immature developmental stages characteristic of acarids: egg, larva, protonymph and tritonymph. The larvae are active, slightly larger than the eggs, and have three pairs of legs. The nymphs (protonymph and tritonymp) are larger and with four pairs of legs. They look similar to adults, which in turn are larger than the nymphs. No

mortality of immatures was recorded when fed on yeast.

Incubation period:

Table 1 shows the duration of each immature stage. There were significant differences among the four different species in female incubation period ($F_{3,76}$ = 69.14; $P < 0.05$) and for the males ($F_{3,76}$ = 34.19; $P < 0.05$). *Tyrophagous longior* female had the longest incubation period with average 3.36 days, next were both species *Rhizoglyphus robini* with average 2.88 days and *Caloglyphus berlesi* with average 2.86 days; while, *Caloglyphus mycophagous* exhibited the shortest incubation period with average 1.50 days. However the males of *Tyrophagous longior*, *Caloglyphus berlesi* and *Rhizoglyphus robini* were not significantly different in the incubation period with averages 2.66, 2.66 and 2.60 days, respectively. In contrary, the male of *Caloglyphus mycophagous* had the shortest incubation period with average 1.33 days.

Larval stage:

Female larval stage duration differed significantly among the four species ($F_{3,76}$ = 88.61; $P < 0.05$; Table 1). *Tyrophagous longior* female had the longest larval period with average 3.94 days, followed by *Rhizoglyphus robini* with average 3.31 days and *Caloglyphus berlesi* with average 3.20 days, then *Caloglyphus mycophagous*, which had the shortest larval period with average 2.11 days. Likewise, the male larval stage duration was also significantly different among the four different species ($F_{3,76}$ =35.02; $P < 0.05$). *Caloglyphus berlesi* male had the longest larval period with average 3.04 days, followed by *Tyrophagous longior* with average 2.95 days and *Rhizoglyphus robini* with average 2.89 days, then *Caloglyphus mycophagous*, which exhibited the shortest larval period with average 1.78 days.

Protonymphal stage:

Significant differences occurred among the four female species protonymphal stage ($F_{3,76}$ = 24.37; $P < 0.05$) and for the males ($F_{3,76}$ = 42.60; $P < 0.05$). *Tyrophagous longior* female had the longest protonymphal period with average 3.98 days, next was *Caloglyphus berlesi* with average 3.59 days and *Rhizoglyphus robini* with average 3.24 days, then *Caloglyphus mycophagous,* which represented the shortest larval period with average 1.94 days. Also, the male of *Caloglyphus berlesi* existed the longest protonymphal period with average 3.62 days, followed by *Tyrophagous longior* with average 3.54 days, after that was *Rhizoglyphus robini* with average 2.53 days, then *Caloglyphus mycophagous*, which had the shortest protonymphal period with average 1.74 days.

Table (1): Developmental time of the four acarids different stages on yeast

Species	Male	Female
	Mean ± SD	Mean ± SD
Incubation		
Tyrophagous longior	2.66 ± 0.31[a]	3.36±0.28[a]
Rizoglyphus robini	2.60 ± 0.34[a]	2.88 ± 0.61[b]
Caloglyphus berlesi	2.66 ± 0.31[a]	2.86 ± 0.35[b]
Caloglyphus mycophagous	1.33 ± 0.31[b]	1.50 ± 0.41[c]
Larvae		
Tyrophagous longior	2.95 ±0.38[a]	3.94 ±0.43[a]
Rizoglyphus robini	2.89 ± 0.22[a]	3.31 ± 0.33[b]
Caloglyphus berlesi	3.04 ± 0.28[a]	3.20 ± 0.30[b]
Caloglyphus mycophagous	1.78 ± 0.25[b]	2.11 ± 0.38[c]
Protonymph		
Tyrophagous longior	3.54 ±0.47[a]	3.98 ±1.09[a]
Rizoglyphus robini	2.53 ± 0.39[b]	3.24 ± 0.32[a]
Caloglyphus berlesi	3.62 ± 0.42[a]	3.59 ± 0.97[a]
Caloglyphus mycophagous	1.74 ± 0.23[c]	1.94 ± 0.57[b]
Tritonymph		
Tyrophagous longior	3.29 ±0.28[a]	4.81 ±0.31[a]
Rizoglyphus robini	2.86 ± 0.32[b]	3.26 ± 0.37[c]
Caloglyphus berlesi	3.45 ± 0.43[a]	3.68 ± 0.23[b]
Caloglyphus mycophagous	1.99 ± 0.39[c]	2.01 ± 0.27[d]
Total immature stages		
Tyrophagous longior	12.44 ±1.01[a]	16.10 ± 1.44[a]
Rizoglyphus robini	10.87 ± 0.91[b]	12.69 ± 0.74[b]
Caloglyphus berlesi	12.77 ± 0.80[a]	13.33 ± 0.99b
Caloglyphus mycophagous	6.85 ± 0.70[c]	7.56 ± 0.80[c]
Adult longevity		
Tyrophagous longior	25.00 ±6.02[a]	25.25 ± 5.68[a]
Rizoglyphus robini	12.50 ± 2.80[b]	14.85 ±3.13[b]
Caloglyphus berlesi	8.63 ± 1.41[c]	13.95 ±1.05[b]
Caloglyphus mycophagous	14.63 ± 2.50[b]	15.30 ± 2.96[b]
Life span		
Tyrophagous longior	37.44 ±6.56[a]	41.35 ± 6.07[a]
Rizoglyphus robini	23.37 ± 2.92[b]	27.54 ± 3.22[b]
Caloglyphus berlesi	21.40 ± 2.11[b]	27.28 ±1.52[b]
Caloglyphus mycophagous	21.47 ± 2.58[b]	22.86 ± 3.34[c]

Means followed by different superscript letters within each life stage for male or female are significantly different ($P \leq 0.05$)

Tritonymphal stage:

There were significant differences among the four different species in tritonymphal stage of the females ($F_{3,76}$ = 297.16; $P < 0.05$) and for the males ($F_{3,76}$ = 26.92; $P < 0.05$). *Tyrophagous longior* female had the longest tritonymphal period with an average 4.81 days, followed by *Caloglyphus berlesi* 3.68 days, then *Rhizoglyphus robini* 3.26 days. After that *Caloglyphus mycophagous*, showed the shortest period with an average of 2.01 days. *Caloglyphus berlesi* and *Tyrophagous longior* males exhibited the longest tritonymphal period with average 3.45 and 3.29 days, respectively, followed by *Rhizoglyphus robini* with average 2.86 days, then *Caloglyphus mycophagous*, which had the shortest period with average 1.99 days.

Total immature stages:

Female total developmental stages duration differed significantly among the four species ($F_{3,76}$ = 237.97; $P < 0.05$; Table 1). *Tyrophagous*

Table (2): Generation time and oviposition of four acarid species

Species	Generation time (days)	Oviposition period (days)			Egg/female	Egg/ day
		Pre.	Oviposition	Post.		
Tyrophagous longior	19.05± 1.83a	2.95 ± 0.89a	19.10 ±5.65a	3.20 ±0.89a	313.8±121.85a	15.82 ± 3.99b
Rizoglyphus robini	14.64 ± 0.96b	1.95 ± 0.60b	10.10 ±3.34b	2.80 ±0.41a	85.5 ± 40.24c	8.38 ± 2.81c
Caloglyphus berlesi	14.83 ± 0.96b	1.50 ± 0.51 c	10.45 ±1.05b	2.00 ±0.73b	205.75±37.66b	19.80 ± 3.67b
Caloglyphus mycophagous	9.81 ± 1.14c	2.25 ± 0.72ab	10.90 ±2.90b	2.15 ±0.81b	290.7±179.46a	25.51 ±12.40a

Means followed by a different superscript letter within each period are significantly different ($P \leq 0.05$).

longior female had the longest in total developmental time with average 16.10 days, followed by *Rhizoglyphus robini* and *Caloglyphus berlesi* with average 13.33 and 12.69 days, respectively and then *Caloglyphus mycophagous* had the shortest total developmental time with average 7.56 days. Likewise, the male total developmental stages durations were also significantly different among the four different species ($F_{3,76}$ = 78.63; $P < 0.05$). *Caloglyphus berlesi* and *Tyrophagous longior* males males exhibited the longest time with average 12.77 and 12.44 days, respectively, followed by *Rhizoglyphus robini* with average 10.87 days, then *Caloglyphus mycophagous*, having the shortest period with average 6.85 days.

Generally, in each species as would be expected the total developmental stages duration was shorter in males than in females but not significantly differed (LSD; $P > 0.05$).

Adult longevity:

Adult female longevity period had significant differences among female species ($F_{3,76}$ = 40.36; $P < 0.05$). *Tyrophagous longior* female had the longest longevity with average 25.25 days; while those of the other species: *Caloglyphus mycophagous*, *Rhizoglyphus robini* and *Caloglyphus berlesi* were significantly shorter with average 15.30, 14.85 and 13.95 days, respectively. Adult male longevity period differed significantly among different female species ($F_{3,76}$ = 31.10; $P < 0.05$). *Tyrophagous longior* male had the longest longevity period with average 25.00 days, followed by *Caloglyphus mycophagous* with average 14.63 days and *Rhizoglyphus robini* with average 12.50 days, then *Caloglyphus berlesi,* having the shortest period with average 8.63 days.

Life span:

There were significant differences among life span of different female species ($F_{3,76}$ = 80.91 ; $P < 0.05$). *Tyrophagous longior* female had the longest life span with average 41.35 days, followed by *Rhizoglyphus robini* with average 27.54 days and *Caloglyphus berlesi* with average 27.28 days, then *Caloglyphus mycophagous*, which had the shortest period with average 22.86 days. Likewise there were significant differences among different male species ($F_{3,76}$ = 31.73; $P < 0.05$). *Tyrophagous longior* male had the longest life span period with average 37.44 days, while other species: *Rhizoglyphus robini*, *Caloglyphus mycophagous* and *Caloglyphus berlesi* with averages 23.37, 21.47 and 21.40 days, respectively.

Specific female stages:

Pre-oviposition period: There were significant differences among different female species ($F_{3,76}$ = 9.06; $P < 0.05$). *Tyrophagous longior* had significantly the longest pre-oviposition period with average 2.95 days, on the other hand with no significant difference with *Caloglyphus mycophagous* with average 2.25 days (Table 2). Next was *Rhizoglyphus robini* with average 1.95 days but with no significant difference with *Caloglyphus mycophagous*, then *Caloglyphus berlesi*, which had the shortest period with average 1.50 days.

Generation time: There were significant differences among different female species ($F_{3,76}$ = 159.83; $P < 0.05$). *Tyrophagous longior* had the longest generation time with average 19.05 days, followed by *Caloglyphus berlesi* and *Rhizoglyphus robini* with average 14.83 and 14.64 days, respectively, then *Caloglyphus mycophagous*, which had the shortest generation time with average 9.81 days.

Results of the generation time for *Caloglyphus berlesi* is in agreement with that of Taha-Riham (2014). Also, *Caloglyphus mycophagous* is in agreement with that Cai (1982). Likewise, *Rhizoglyphus robini* result is in agreement with, El-Sanady (1999).

Oviposition period: There were significant differences among different female species ($F_{3,76}$ = 28.42; $P < 0.05$). *Tyrophagous longior* had significantly the longest oviposition period with average 19.10 days; while other species: *Caloglyphus mycophagous*, *Caloglyphus berlesi* and *Rhizoglyphus robini* were significantly shorter with averages 10.90, 10.45 and 10.10 days, respectively as shown in table (2).

Post-oviposition period: Significant differences occurred among different female species ($F_{3,76}$ = 11.72; P < 0.05). *Tyrophagous longior* had the longest post-oviposition period with average 3.20 days; while *Caloglyphus berlesi* had the shortest period with 2.00 days.

The survival curves of the four mite species under laboratory conditions followed type I pattern in which most eggs developed to maturity and death occurred gradually over an extended ovipositional period. The number of *Rizoglyphus robini* survival declined on day 22nd and ended on day 33rd. Females started laying eggs on the day 13th and reached the highest rate on the twentieth day; after that the eggs started to decrease until the thirty first day then the females stopped laying eggs. The survival of *Caloglyphus berlesi* declined on day 25th and ended on day 30th and the females started laying eggs on the day 14th and reached the highest rate on the twentieth day after that the eggs started to decrease until the day 29th then the females stopped laying eggs. The survival of *Caloglyphus mycophagous* declined on day 16th and ended on day 31st. Females started laying eggs on day 18th and reached to the highest rate on day 14th; after that the eggs started to decrease until the day 28th, then the females stopped laying eggs. The survival of *Tyrophagous longior* declined on the day 24th and ended on the day 50th. Females started laying eggs on the day 15th and reached to the highest rate on the day 26th after that the eggs started to decrease until the day of 48th then the females stopped laying eggs.

Total average number of eggs: There were significant differences among different female species in total average of eggs ($F_{3,76}$ = 17.051; P < 0.05) and daily rate ($F_{3,76}$ = 21.697; P < 0.05). *Tyrophagous longior* had the highest total average number of eggs; 313.8 eggs; with a daily rate 15.82 eggs/day/female, with no significant difference with *Caloglyphus mycophagous* in total average of eggs 290.7 eggs and daily rate 25.51 eggs, followed by *Caloglyphus berlesi* with average 205.75 eggs and daily rate 19.80 egg, then *Rhizoglyphus robini*, which had the lowest total average number of eggs 85.5 eggs with a daily rate 8.38 eggs/day/female.

It could be concluded that *Caloglyphus mycophagous* is considered a very dangerous species, because its generation time was the shortest 9.81 days; while its daily rate was the highest 25.51 eggs/day/female, so it resulted in a very large amount of population. On the opposite, *Rhizoglyphus robini* was less effective as it gave less population and its generation time was 14.64 days and daily rate was very low 8.38 eggs/day/female.

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