Influence of Relative Humidity on Life-History Parameters of *Mononychellus progresivus* and *Oligonychus gossypii* (Acari: Tetranychidae)

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ABSTRACT Life-history parameters of *Mononychellus progresivus* Doreste and *Oligonychus gossypii* (Zacher), 2 major mite pests of cassava in Africa, were determined in the laboratory at 3 constant relative humidities (30, 60, and 90% RH) obtained with saturated salt solutions. Experiments were carried out in airtight boxes placed in an air-conditioned room at 26 ± 1°C and a photoperiod of 12:12 (L:D) h (illuminance 3,500 lux). Low (30% RH) and high (90% RH) air humidity had a negative effect on the life-history traits of both species compared with medium air humidity (60% RH). For both species, the strongest effect was obtained at 90% RH; e.g., no *M. progresivus* eggs hatched, and 96% of the immature stages of *O. gossypii* died. Relative humidity is, thus, an important abiotic factor influencing the population dynamics of both species and may explain part of the decrease in populations observed in the middle to the end of the dry season and the virtual absence of mites during the wet season.

KEY WORDS *Mononychellus progresivus, Oligonychus gossypii,* cassava

THE CASSAVA GREEN mite, *Mononychellus progresivus* Doreste, =*tanajoa* (Bondar), and the cotton red mite *Oligonychus gossypii* (Zacher), are the

the biological and demographic parameters of *M. progresivus* and *O. gossypii* (Bonato et al. 1995). In the study reported here we examine the effects

Table 1. Duration in days of the egg, larva, protonymph, deutonymph, and quiescent stages and total mortalities of *M. progresivus* and *O. gossypii* at 3 constant relative humidities and 26 ± 1°C

Species	Stage	30% RH		60% RH		90% RH	
		♀	♂	♀	♂	♀	♂
M. progresivus	Egg	4.7	4.8	4.6	4.8	0	0
	Larva	1.3	1.4	1.1	1.1	0	0
	Quiescent stage 1	0.7	0.8	0.7	0.8	0	0
	Protonymph	1.3	1.3	0.9	0.8	0	0
	Quiescent stage 2	0.7	0.6	0.6	0.6	0	0
	Deutonymph	1.4	1.1	1.1	1.0	0	0
	Quiescent stage 3	0.9	0.9	0.9	0.9	0	0
	Total ± SEM	11.0 ± 0.2	10.9 ± 0.4	9.9 ± 0.1	10.0 ± 0.2	0	0
	Mortality (%)	17		10		100	
	No. adults	31	9	53	20	0	0
O. gossypii	Egg	5.1	5.0	4.9	5.0	0	5.0
	Larva	1.5	1.5	1.3	1.1	0	1.4
	Quiescent stage 1	0.4	0.3	0.6	0.6	0	0.8
	Protonymph	1.8	0.8	0.9	0.8	0	1.3
	Quiescent stage 2	0.3	0.5	0.6	0.5	0	0.4
	Deutonymph	1.8	1.5	1.2	1.1	0	1.4
	Quiescent stage 3	0.5	0.3	0.7	0.7	0	1.1
	Total ± SEM	11.4 ± 0.2	9.9 ± 0.0	10.2 ± 0.2	9.8 ± 0.2	0	11.4 ± 0.6
	Mortality (%)	85		9		96	
	No. adults	6	1	27	24	0	2

mohygrometer probe. Both temperature and hygrometry were checked and recorded during the experiments. The boxes, 2 per each of the 3 treatments, were placed in the same air-conditioned room at 26 ± 1°C, 60 ± 5% RH, and photoperiod of 12:12 (L:D) h at 3,500 lux. Modified Munger cells (Munger 1955) were used to minimize water supply in the boxes. Munger cells were made of 2 Plexiglas plates of the same size (112 by 75 by 3 mm), the upper 1 with 12 holes of 17-mm diameter, the lower 1 without holes. A water-saturated cotton strip was placed on the lower plate. The 2 plates were held together with adhesive rubber all per female was counted daily after female emergence. Cohorts of 30 females were used for each treatment and each species.

Statistical Analyses. Comparisons between each treatment for each species and between species in the same treatment were performed using one-way analysis of variance (ANOVA) after a $\log(x + 1)$ transformation of data. If ANOVA revealed significant differences between groups tested, means were compared using the Scheffé method (LEAS 1989). The significant level was set at $P \leq 0.05$.

Calculation of Demographic Parameters. Net

Table 2. Longevity, mean ± SD daily fecundity, and total fecundity of *M. progresivus* and *O. gossypii* at 3 constant relative humidities and 26 ± 1°C

Species		30% RH	60% RH	90% RH
M. progresivus	Longevity	10.0 ± 0.3a	12.5 ± 0.2b	8.1 ± 0.4c
	Eggs/female/day	3.0 ± 0.2a	4.0 ± 0.2b	2.2 ± 0.2c
	Total eggs/female	21.7 ± 2.1a	42.5 ± 2.5b	8.6 ± 1.3c
	No. females	30	30	30
O. gossypii	Longevity	10.8 ± 0.3a	12.7 ± 0.2b	7.6 ± 0.7c
	Eggs/female/day	3.3 ± 0.2a	3.9 ± 0.1b	2.4 ± 0.2c
	Total eggs/female	28.8 ± 0.3a	39.8 ± 2.6b	7.2 ± 1.3c
	No. females	30	30	30

Values in the same line followed by the same letter are not significantly different (ANOVA and multicomparison Scheffé F tests, $\alpha = 0.05$).

which were higher than the 9% found at 60% RH (Table 1). At 30% RH, the mean developmental time (males and females) of 11.3 d was significantly longer than the 10.0 d found at 60% RH ($F = 12.08$; df = 6, 164; $P = 0.0001$ and Scheffé F value was 3.66); the differences between males and females were only significant at 60% RH (Scheffé F value was 2.15). At 90% RH, only 2 male larvae reached the adult stage. For both sexes and within treatment, the developmental time was similar for the 2 mite species, and both showed a higher susceptibility to high (90%) than to low air humidity (30%).

Survival Rate, Longevity, and Fecundity of Females. The 50% survival rate of adult *M. progresivus* females was reached at days 8, 11, and 12

ences between treatments were significant ($F = 33.6$; df = 5, 178; $P < 0.0001$; Scheffé value was: $F_{30-60} = 11.86$; $F_{30-90} = 11.96$; $F_{60-90} = 11.96$).

The 50% survival rate for *O. gossypii* was reached at days 6, 12, and 14 for the 90, 30, and 60% RH treatments, respectively (Table 2; Fig. 1). Longevity showed a similar trend as for *M. progresivus* with the highest value of 12.7 days at 60% RH, and significant differences between all treatments ($F = 20.5$; df = 5, 178; $P < 0.0001$; Scheffé value was: $F_{30-60} = 2.5$; $F_{30-90} = 2.3$; $F_{60-90} = 2.2$) (Table 2). Likewise, the highest total fecundity of 39.8 eggs per female (3.9 eggs per day) was recorded at 60% RH. Differences in total number of eggs between each treatment were significant (Ta-

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Table 3. Life-table parameters of *M. progresivus* and *O. gossypii* at 3 constant relative humidities and 26 ± 1°C. Standard error in parentheses

Species		30% RH	60% RH
M. progresivus	R_o	12.8 ± 2.4a	26.0 ± 3.1b
	G	14.9	14.4
	r_m	0.171 ± 0.010e	0.226 ± 0.006f
	λ	1.19	1.25
O. gossypii	R_o	3.0 ± 0.6c	25.1 ± 3.2b
	G	16.8	15.1
	r_m	0.066 ± 0.010g	0.214 ± 0.008f
	λ	1.07	1.24

Values followed by the same letter are not significantly different (Dunn t-test, $\alpha = 0.05$).

half than those obtained at 60% RH in the case of *M. progresivus* and one-eighth in the case of *O. gossypii.* (Table 3) ($t_{\text{Dunn}} = 6.27$; df = 6, 122; $P < 0.05$ for *M. progresivus*; and $t_{\text{Dunn}} = 10.17$; df = 6, 122; $P < 0.05$ for *O. gossypii*). A similar trend was

relative humidity of 90%, which is unexpected for tropical species. However, even under the climatic conditions prevailing in the equatorial region, a constant relative humidity of 90% for several days is rare although the maximum relative humidity recorded is 95–100% RH (Griffiths 1984). Previous workers on *M. progresivus* in Africa have attributed the disappearance of this pest during the wet season to the mechanical effect of rainfall (Yaninek et al. 1989b). The results presented here suggest that high air humidity during the rainy season has the same effect on *O. gossypii* populations (nearly absent) as on *M. progresivus* populations (exceedingly low densities) (Nyiira 1972, Leuschner 1980, Akinlosotu and Leuschner 1981, Bonato 1993). Of the 3 relative humidities tested, 60% RH appeared to be the most favorable for population growth of both mite species. The r_m values of 0.226 for *M. progresivus* and 0.214 for *O. gossypii* at 60% RH are comparable to those found by Yaninek et al. (1989a) for *M. progresivus* and by Sabelis (1985)

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