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Effects of Leaf Age of Cassava, *Manihot esculenta* on Development and Biological Performance of *Monoychellus tanajoa* Bondar and *Oligonychus gossypii* Zacher (Acarina: Tetranychidae).

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ABSTRACT.

Oviposited eggs of *Monoychellus tanajoa* and *Oligonychus gossypii* were incubated in groups of thirty on young or mature leaves of cassava. Upon hatching, the larvae were restricted to feed on either the young or mature leaves of cassava plants. Total development (egg – adult) were 8.67 days and 9.55 days for *M. tanajoa* fed young and mature leaves respectively while it was 8.91 and 8.85 days for *O. gossypii* fed young and mature leaves respectively. Mean fecundity of female *M. tanajoa* fed young leaves was 16.85 eggs per female while those females fed mature leaves was 12.34 eggs per female. On the other hand, female *O. gossypii* fed mature leaves produced 16.68 eggs per female. The differences in these values were statistically significant at $P \geq 0.05$. Longevity of the female mites was also affected by the age of the leaves being 8.04 days and 6.16 days for *M. tanajoa* fed young and mature leaves respectively. *O. gossypii* on the other hand lived for 7.16 days and 8.64 days when fed young and mature leaves respectively.

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INTRODUCTION

The cassava spidermites, *Mononychellus tanajoa* Bondar and Oligonychus gossypii Zacher, are pests of considerable importance in tropical and subtropical areas of the world (Bellotti, 1978; Nwana, 1978, Rodriguez, 1978 and Akinlosotu & Leuschner, 1981). Field observations have shown that both species of mites occupy different levels of the canopy of cassava plants (Orakpor, 1991; Orakpor, *et al.*, 2000). Different parts of the same plants are known to vary as to their biochemical or nutritional composition (Weatherly *et al.*,1959; Kennedy and Booth, 1951).

In most phytophagous insects and mites, survivorship, faster development and fecundity rates are enhanced when fed plants containing high nitrogen levels (Auclair *et al.*, 1957; Strickland, 1960; SooHoo and Fraenkel, 1966; and Van Emden *et al.*, 1969). Similarly, Lewis and Taylor (1967), remarked that food as an environmental factor, could exert profound influence on the production, longevity, survival and distribution of individual species.

The aim of this paper was to assess the influence of leaf-age of cassava plants on the development of the immature stages and of adult females of *M. tanajoa* and *O. gossypii*.

MATERIALS AND METHODS

Cuttings of cassava plants used for this study were collected from Anambra State Agricultural Development Project *(ADP), Enugu and were of the 'so-called'* mild variety designated TMS 30572 variety (ADP, 1990). The cassava plants were raised in the Zoological Garden at the Nsukka campus of the University of Nigeria. Freshly ovposited eggs (12-24 hours old) from mated females of *M. tanajoa* and *O. gossypii* were collected from laboratory cultures raised on cassava plants. The eggs were caged in groups onto young (i.e. 3^{rd} – 4^{th} leaf from top) and mature leaves (i.e. 9^{th} – 12^{th} leaf from top) of intact cassava plants (Jones and Parrelia, 1984; Orakpor, 1991; Orakpor *et al* 2000) by means of clip-on cages of about 0.5mm in diameter. Ambient temperatures were 26.0^0C to 31.5^0C and relative humidity 65-82%. Thirty eggs of each of *M. tanajoa* and *O. gossypii* were caged on young or mature leaves of intact cassava plants.

Observations were made on the duration of development of each immature stage (egg, larval, protonymph and deutonymph) and recorded. The presence of exuviae indicated the completion of development of one stage and the beginning of the next. As soon as adults emerged, male and female mites of each set were paired and caged onto the same type of leaf on which the immatures had developed. For each set of mites, the survival rate (Lx) and fecundity rate (Mx) were determined using the method of Southwood (1978). Other population parameters, such as the net reproductive rate (Ro), cohort generation time (Tc) and capacity for increase (rc) were calculated from the following relationship given by Birch (1948):

$$Ro = \sum LxMx$$

$$Tc = \frac{\sum xLxMx}{\sum LxMx}$$

$$rc = \frac{\text{Log e Ro}}{Tc}$$

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RESULTS

Developments of immature stages: - The duration of developments of immature stages of *M. tanajoa* and *O. gossypii* are shown in Table 1. The development of immature *M. tanajoa* was shorter when fed young leaves of cassava whereas those of *O. gossypii* were similar on both types of leaves. The egg stage had the longest duration in both mite species. Total development (egg – adult) was longest in *M. tanajoa* (9.551 ± 1.74 days) when reared on mature leaves. The differences in these developmental periods were however not significant at $p \leq 0.05$.

Fecundity: The mean egg production per female *M. tanajoa* fed on young and mature leaves were 16.85 ± 1.74 eggs and 12.34 ± 4.7 eggs per female respectively (Table 2). Similarly, mean egg production for *O. gossypii* fed on young and mature leaves were 12.89 ± 4.4 eggs and 16.68 ± 6.51 eggs per female respectively. Chi-square test indicates that these differences were significant at $p \geq 0.05$.

Adult longevity: - *M. tanajoa* lived longer on young leaves (8.04 ± 2.16 days) than when fed on mature leaves (6.16 ± 1.7 days); (Table 3). On the other hand, the mean longevity of *O. gossypii* was higher when fed on mature leaves (8.64 ± 2.4 days) than when young leaves were offered (7.12 ± 2.13 days). Differences between *M. tanajoa* and *O. gossypii* were significant ($p \geq 0.05$) when fed mature or young leaves.

Age-specific fecundity rate and age-specific survival rate: Figures 1a and 1b summarise the age-specific fecundity and survival rates of females of *M. tanajoa* and *O. gossypii* fed separately on young and mature leaves of cassava. *M. tanajoa* exhibited two peaks (on 3rd and 5th days) of maximum oviposition on young leaves while *O. gossypii* showed one peak on the 4th day of adult life. *M. tanajoa* also showed two oviposition peaks when fed mature leaves whereas *O. gossypii* attained maximum fecundity on the third day. In all cases, the spidermites deposited most of their eggs before their populations were reduced to half (Table 1). Also, the survivorship curves were similar to the type 1 described by Slobodkin (1962) indicating that most of the adults died of old age.

The net reproductive rate (Ro) and the capacity for increase (rc) were significantly higher in *M. tanajoa* fed young leaves than those fed mature leaves (Table 3) at $p \geq 0.05$. In the case of *O. gossypii*, Ro and rc values, though higher in spidermites fed mature leaves, the difference was not significant at $p \geq 0.05$. However, there were significant differences between the values of Ro, rc and LT_{50} of *M. tanajoa* and *O. gossypii* when reared on either the young or mature leaves of cassava.

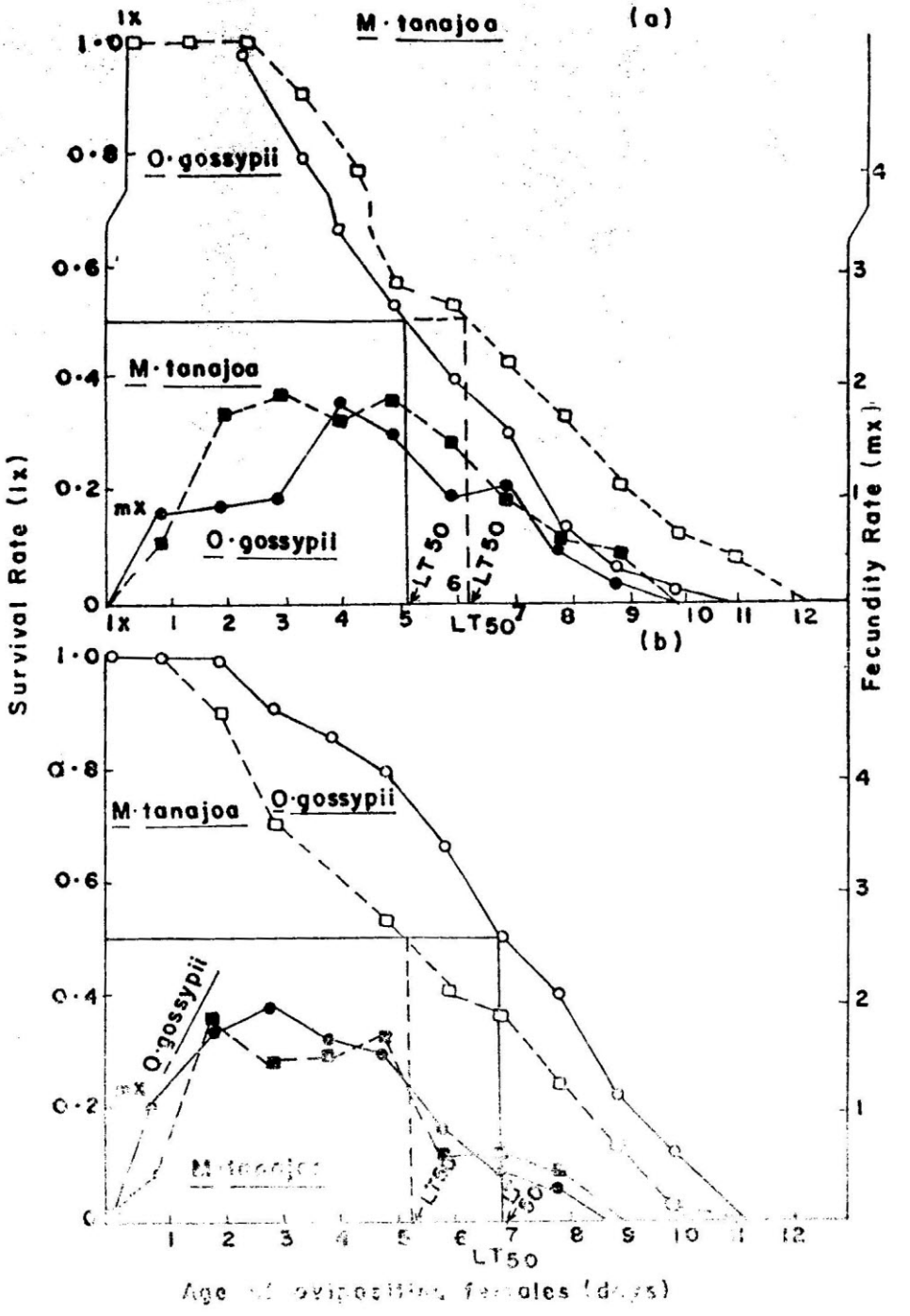

Fig. 1 [illegible] fecundity (Mx) and age specific [illegible]

Table 1: Effect of leaf-age on the duration of immature stages of *M. tanajoa* and *O. gossypii.*

Stage of development	M. tanajoa		O. gossypii	
	Young leaves	Mature leaves	Young leaves	Mature leaves
Eggs	4.07 ± 0.57	4.16 ± 0.48	4.14 ± 0.61	3.62 ± 0.78
Larval	1.08 ± 1.52	1.84 ± 0.32	1.70 ± 0.07	1.82 ± 0.63
Protonymph	1.40 ± 0.31	1.52 ± 0.47	1.37 ± 0.39	1.65 ± 0.33
Deutonymph	1.58 ± 0.19	2.03 ± 0.47	1.60 ± 0.32	1.60 ± 0.13
Larval - Adult	4.60 ± 0.78	5.39 ± 1.26	4.67 ± 0.78	5.07 ± 1.09
Egg - Adult	8.67 ± 0.75	9.55 ± 1.74	8.91 ± 1.49	8.85 ± 1.87

Table 2: Effects of leaf – age on fecundity and longevity of mated female *M. tanajoa* and *O. gossypii*

	M. tanajoa		O. gossypii	
Leaf – age	Mean Fecundity ± S.d.	Mean Longevity (in days) ± S.d.	Mean Fecundity ± S.d.	Mean Longevity (in days)± S.d.
Young leaves	16.85 ± 6.25	8.04 ± 2.16	12.89 ± 4.40	7.16 ± 2.13
Mature leaves	12.34 ± 4.70	6.16 ± 1.70	16.68 ± 6.451	8.64 ±2.40

Table 3: Effects of leaf-age on population parameters of mated females.

Population Parameter	M. tanajoa		O. gossypii		
	young leaves	mature leaves	young leaves	mature leaves	
R_o	8.68	4.87	5.39	8.17	S
T_c (in days)	13.15	13.27	13.77	12.46	NS
R_c	0.164	0.120	0.122	0.169	S
LT_{50} (in days)	7.2	4.2	5.6	7.0	S

Significant of $P \geq 0.05$

DISCUSSION

The success of an individual may be related to the number of viable offspring it produces during its lifetime. Similarly, the success of individuals contributes to the success of the species and thus, factors affecting fecundity affect in the long term, the survival of the species. Decline in fecundity with leaf-age has been reported in the cotton whitefly, *Bemisia gossypiperda* M&L (Trehan, 1944), the viburnum whitefly, *Aleurotrachelus jelineki* Fraunf (Southwood & Reader, 1976) and in the cabbage whitefly *Aleyrodes brassicae* WLK. (Iheagwam, 1980; 1981a).

In this study, feeding spidermites on cassava leaves of different ages affected their development, survival, reproduction and rate of increase. While *M. tanajoa* performed better on young leaves, *O. gossypii* was on the other hand better when fed on mature leaves of cassava. These results are in conformity with field observations (Orakpor, 1991; and Muaka *et. al.* 1996) that *M. tanajoa* and *O. gossypii* are more abundant on the young and mature leaves respectively.

Although, the intrinsic and finite rates determined under laboratory conditions are not directly applicable to field populations because, of the influences of natural enemies, limited food and space, they however suggest means of estimating the maximum attainable rates of increase, as well as the limits beyond which, the population is unlikely to persist. In this study, survival and generation time appear to have little effects on the rate of increase because, females of both spidermite species had survived for more than 50% of their life span and deposited most of their egg complement before their populations were reduced to half. Differences between the values of rc in both *M. tanajoa* and *O. gossypii* when fed on young or mature leaves therefore tended to be caused by the number of eggs per female per day and the time before peak fecundity was attained. Iheagwam (1980) had reached similar conclusions about the cabbage whitefly *Aleyrodes brassicae.*

Generally, the earlier a population reaches its maximum fecundity, the greater is its capacity for increase (Birch, 1948; Iheagwam, 1981a). In this study, *M. tanajoa* attained maximum fecundity earlier than *O. gossypii* when fed on either young or mature leaves. For a population to maintain itself, the net reproductive rate (Ro) must be at least 1.0 (Southwood, 1978). The high values of Ro recorded for both spidermite species when fed on either young or mature leaves seem to suggest their potential for rapid population build-up in the field under favourable conditions enhanced by dry weather conditions (Muaka *et. al.,* 1996, Orakpor *et. al.,* 2000).

The fact that *M. tanajoa* and *O. gossypii,* in this study, showed different responses to cassava leaves of different ages suggests that certain factors are present in the leaves which favour or inhibit their biological performance.

For example, egg production of *M. tanajoa* fed on young leaves was similar to that of *O. gossypii* reared on mature leaves, thus, suggesting that these are the preferred diets of the spidermite species in nature.

This might explain to a certain extent why these spidermites, *M. tanajoa* and *O. gossypii* are respectively more abundant on either the young or mature leaves of cassava in the field. This arrangement could in fact be beneficial to both spidermite species, as it serves to minimise interspecific competition between them and thus, enhances their ability to successfully compete against other pests of cassava especially the mealybug *Phenacoccus manihoti* Mat,-Ferr (Iheagwam, 1981b) and the spiralling whitefly *Aleurodiscus dispersus* Russel Neuenschwander, 1996). Consequently, both *M. tanajoa* and *O. gossypii* could simultaneously infest cassava stands in appreciable numbers and thus, result in severe damage to the plant.

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