Pest Management Program

Thrips	Varietal resistance	Whiteflies	Varietal resistance
Hornworm	Biological control	Shootflies	Attractants Cultural practices Varietal resistance
Mites	Varietal resistance Biological control		
Fruitflies	Cultural practices Attractants Varietal resistance	Stemborers	Cultural practices
		Mealybugs	Varietal resistance Biological control
Whitegrubs and cutworms	Microbial control Poison baits Cultural practices Soil insecticides	Scales	Biological control

Population Dynamics of the Green Cassava Mite and its Predator *Oligota*

Z. M. Nyiira[1]

The green cassava mite, *Mononychellus tanajoa* (Bondar) (Acarina: Tetranychidae), also known as the cassava leaf mite, is a fairly new pest in Africa. Its potential threat to cassava production in Africa has attracted serious investigations into its biology, ecology, and possible control. Initial infestations of this mite start in sheltered places, along the midribs and veins of cassava leaves.

Denser populations are recorded during dry spells and more are found in the lower half of the leaf. The ratio of active mites, eggs, males, and females in the apical and basal halves of the leaf are discussed. Cassava plants between 3 and 10 months old were more densely infested than the younger and older plants. Some varieties of cassava supported fewer mites than others suggesting a degree of resistance. Reduction in the number of mites was associated more with absence of leaves than weather conditions, although rain and possibly relative humidity had negative effects on population buildup of the mite.

The Staphylinidae *Oligota* was the dominant and widespread predator. It appeared in sufficient numbers and at the same time as the green cassava mite. The population fell sharply when the host population started diminishing.

The results point out the potential of varietal resistance in cassava and biological control as possible effective considerations in integrated control of *M. tanajoa*.

The green cassava mite *Mononychellus tanajoa* is a fairly new pest of cassava in Africa. Its potential threat to cassava production has attracted much attention because cassava is an important staple in Africa, where 36% of the world total is produced.

Although the green cassava mite was recorded as a major cassava pest in Brazil in 1921 (Bondar 1938), its low status did not demand serious investigation until its discovery in 1971 in Uganda (Nyiira 1972). Since then, detailed studies have been done (Bennett and Yaseen 1975; Nyiira 1975a).

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The structure of the population (dispersion) of the green cassava mite on cassava in the neotropics was described by Bennett and Yaseen (1975). They discussed the influence of age of the plant, its physiological condition, and environmental factors on levels of infestation and damage.

Nyiira (1972, 1973) showed that heavy infestations and damage to cassava in Uganda occurred during the hot dry spells. This was later accompanied by premature leaf fall and sometimes tip die-off. Major damage was suppressed by the cool rainy season. Similar observations in Brazil were reported by Bondar (1938) and by Da Costa (1973). Such seasonal fluctuations of the mite population were

Table 1. Mites recorded on 10 leaves per sample at low, medium, and heavy infestation levels.

	Fifth leaf			Seventh leaf		
	Adults	Nymphs	Eggs	Adults	Nymphs	Eggs
Apical half						
Low	41	138	959	87	274	1224
Medium	209	371	2944	107	460	1617
Heavy	1021	3994	14194	1124	5960	11279
Basal half						
Low	258	537	4074	364	978	5269
Medium	452	808	10535	376	949	6569
Heavy	1360	5642	22646	1348	9322	15882

probably due to factors such as the condition of food and availability of nutrients. The weather may have had some influence as well.

A similar population trend was observed among its predators, particularly *Oligota* species. *Oligota* is the most common and dominant predator of the green cassava mite in Uganda and Trinidad (according to Bennett and Yaseen 1975). The population of density-dependent predators tends to decline as numbers of their prey decrease and vice versa.

Therefore, the population dynamics of both *M. tanajoa* and its predator *Oligota* were studied with the practical objective of suppressing the green cassava mite in Uganda.

Materials and Methods

The effect of plant age on the population of mites was studied by counting the mites on fifth leaves of plants of different ages. Leaves were placed in jars, labelled, and placed in styrene boxes, and brought to the laboratory. The leaves were placed on ice blocks on the stage of the binocular with the dorsal side of the leaf facing the eyepiece, and the mites were counted. The mites that got stuck in the jars were washed into petri dishes using 50% alcohol, counted, and the count was added to the respective sample counts. Counts of mite eggs were carried out in the same way. The results were computed as means of total mite counts from 60 leaves per locality per age-group.

Assessment of the effect of age of foliage on mite population was done by counting mites on leaves tagged at the start of their development (i.e. from the time the leaf stalks became visible and when such stalks could conveniently be tagged). Assessment of the population fluctuation of mites was done on fifth and seventh leaves using similar collection and counting techniques.

To study interleaf distribution and abundance of mites, weekly samples of first and subsequent odd-numbered leaves up to eleventh were taken. Five leaves were sampled per variety per week for 21 weeks.

Assessment of the population of the predator was done between October and December 1972. It was done by direct counts of predators from cassava leaves in the field. The leaves were collected, labelled, and the mites counted under a binocular microscope. All leaf index expressions were counted from the apical end.

Results

Ecological Habitat

At low densities, the green cassava mite prefers to inhabit areas along the midrib and the veins of cassava leaflets. Colonies generally start in sheltered areas on the leaves either on folds or at the base of the leaves. No webs are formed. A higher density of mites per leaf results in a more uniform distribution of the egg deposition and the active mite stages. There was generally a higher number of mites and their eggs in the lower half of the leaf. The number of active mites and their eggs on the leaves is presented in Table 1. When the ratio of adult mites and their stages and males and females in the apical half was compared with similar components in the basal half during the various levels of infestations, the results revealed higher basal half ratios at low in-

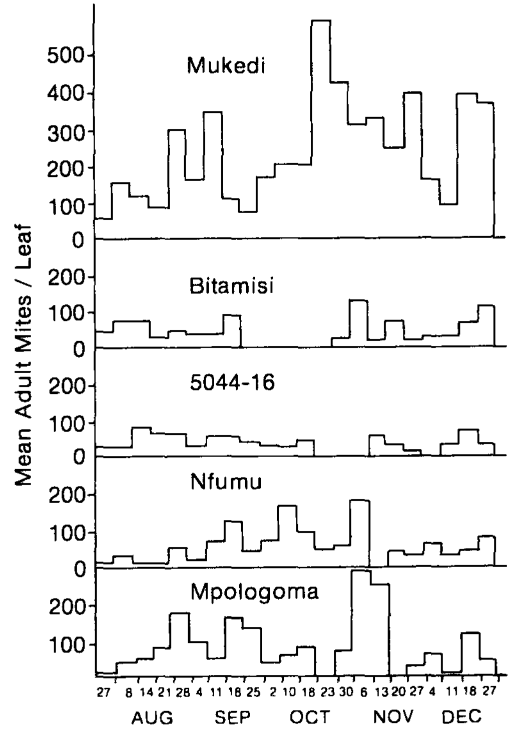

Fig. 1. Mean number of adult mites per leaf (1972).

festation and mean ratio of 1:2 during heavy infestation.

Effect of Plant Age

M. tanajoa almost exclusively feed on the undersurface of cassava leaves. However, infestation was recorded on flower stalks and young green seed. All age categories were attacked. The density of mite infestation on individual plants varied greatly. Newly germinated 10-week-old plants had insignificant numbers of mites compared to plants between 3 and 6 months. Denser infestation was recorded on plants between 6 and 9 months. Plants 9–12 and 12–15 months old had few mites.

In all age categories, a higher number of mites was recorded on either top leaves in the very young plants or leaves 5–8 in the older plants.

Effect of Foliage Condition

The results of investigations of the effect of foliage condition in three varieties of cassava on mite stages revealed that there were significantly fewer active mites and their eggs on the very young and the very old leaves ($p < 0.1\%$). The maximum density of eggs was recorded on 3-week-old leaves in Mukedi (985) and Mpologoma (459) varieties, whereas in Bitamisi, egg densities were high on leaves 10–21 days old (219–225). The population of active stages of the mite was most dense on leaves 12–21 days old in the two varieties (332 on Mukedi and 123 on Mpologoma).

Fluctuation Trends

Between August and December 1972 the weather and crop conditions were optimal for severe infestations of cassava by *M. tanajoa* in Uganda. There were more mites per leaf during September and the last half of October and first quarter of November (Fig. 1). Lower mite densities were associated more with absence of leaves on plants than with presence or absence of rain. For instance during mid August 1972 in Uganda, there was a lot of rain and low mite densities. However, heavy rain in October of the same year corresponded with high mite population on two cassava varieties (Bitamisi and Nfumu) although it reduced the mite population on Mukedi. The trend of mite egg density followed closely that of adult mites.

Nyiira (1975b) discussed the influence of physical factors on the biology and ecology of *M. tanajoa*, suggesting that factors such as relative humidity and temperature could negatively affect the reproduction rate of the mite. He further observed that migration and dispersal are partly triggered by high population density. Therefore, the reproduction rate which is influenced by the physical condition, would also partly influence the commencement and rate of dispersal. It would also influence distribution of the mite within and outside a unit. Biology of the mites as well as meteorological factors are, therefore, useful considerations in the ecological analysis of green cassava mite populations.

Rate of oviposit by *M. tanajoa* was higher at relative humidities between 50 and 70% (maximum 4.7 eggs per female per day at 60%). Most eggs were laid at 32 °C, and the rate was 3.8 eggs/female per day. Development of instars at different relative humidity levels was slightly different from that recorded

Table 2. Population of *Oligota* predators and corresponding host population on cassava during October through December 1972 at Kawanda Research Station.

Date sampled	Mites/Leaf		Predators/50 leaves		Infestation status
	Eggs	Adults and nymphs	Larvae	Adults	
13 Oct	1502	1040	0	47	Heavy
20 Oct	697	272	0	22	Heavy
27 Oct	1824	696	0	7	Heavy
3 Nov	688	238	0	24	Heavy
10 Nov	2126	601	3	20	Heavy
23 Nov	949	400	0	43	V. heavy
29 Nov	431	157	2	22	V. heavy
8 Dec	2190	422	2	21	V. heavy
14 Dec	530	349	0	4	V. heavy
22 Dec	1027	424	0	6	V. heavy
28 Dec	1162	390	0	2	V. heavy
Total	13126	4989	7	218	
Mean	1193	454	0.6	20	

in a free laboratory environment. A duration of 9 days was recorded from commencement of larval to end of deutonymphal periods at relative humidities of 50–70% compared to 10–11 days at 20–40% and 11–13 days at 80–100%. The green cassava mite was capable of multiplying 70 times in a generation lasting a mean of 17 days, at an intrinsic rate of natural increase of 0.25 mite per female per day.

Oligota Predator Population

The results of a study of the seasonal abundance and correlation with host density are presented in Table 2. During scarcity of host mites, *Oligota* disappeared. The predator was more abundant on leaves 5–8 counting from the apical end. This high density of the predator coincided with the higher concentration of host mites on these leaves. This correlation was considered favourable and sufficiently effective particularly during the dry season when the population of the host mite was high. Ninety-five percent of *Oligota* recorded were adults. No pupae were recorded on leaves, although some were found in debris and the soil surface.

Discussion

The green cassava mite probably chooses sheltered places as protection against harsh environment and excessive light. However, as the number of mites per leaf increases, they inhabit the overall area of the leaf. The ratio of the number of mites and their stages and that of the different sexes in the apical half to that of similar components in the basal half decreases from 1:4 at low infestation to 1:2 or 1:1 at high infestation. This implies that at low infestation levels there is a tendency of mites to concentrate more in the sheltered places at the base of the leaf. The mites get dispersed as the population on the unit leaf increases. The dispersion might also be induced by depletion of food and nutrient at the initial point of infestation on the leaf.

The density of the mite infestation on plants of different ages varies greatly. The initial evidence is, however, that very young plants and very old plants do not harbour a high density of mites. Plants between 12 and 40 weeks of age are densely infested with active mite stages and their eggs. This was observed in other varieties (Nyiira 1975a), where, after 36–40 weeks the population of *M. tanajoa* was reduced so low that economic control measures were not desirable.

Aging of cassava leaves has a varied effect on population density of *M. tanajoa.* The population builds up until leaves are 35 days old, when the number of mites on them falls sharply probably due to depletion of nutrients and overpopulation. The tendency is for the mites to migrate within the plant onto the younger leaves or from heavily infested plants to less infested ones to form new colonies. The foliage condition is, therefore, a critical determinant of rate of migration and dispersal.

Many factors are involved in regulating mite populations. However, the data presented in Fig. 1 suggest that different varieties of cassava support different population densities even when other conditions are similar. This variation in the intensity of infestation and, therefore damage, suggests that certain varieties are preferred. This preference would suggest breeding cassava varieties that are resistant or tolerant to the green cassava mite. We favour breeding fast-maturing varieties that are resistant/tolerant to *M. tanajoa* as the most effective control measure (Nyiira 1975c).

Oligota species in Uganda appear in synchrony with *M. tanajoa*. Table 2 shows, however, that during heavy infestation by the host mite when the population of the latter is about to start diminishing, the population of the predator falls rapidly. This allows a rapid buildup of the host mite to migrate to fresh leaves before the predator population builds up again. However, the reappearance of *Oligota*, and the combined relative effectiveness of other predators of the host mite, appear to keep down mite populations. An integrated program utilizing fast-maturing resistant/tolerant varieties backed by a viable program of biological control was suggested by Nyiira (1975a). Bennett (1975) and Bennett and Yaseen (1975) obtained useful data on correlations of *Oligota* and phytoseiid predatory mites with *M. tanajoa* populations in Trinidad. They have reported variations in the abundance of the predators. Their results probably explain the total effect of predators on the green cassava mite, an effect not otherwise explained when individual predators are considered.

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Distribution, Biology, and Population Dynamics of the Green Cassava Mite in the Neotropics

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Investigations on the biology and ecology of the green cassava mite *Mononychellus tanajoa* and its natural enemies, as well as those of other cassava mites, to evaluate the latter for trial in Africa have been conducted in the Neotropics since April 1974 by the Commonwealth Institute of Biological Control, Trinidad. In Trinidad, densities of *M. tanajoa* are closely related to rainfall; dry periods are conducive to the development of high mite populations. The age and physiological condition of the host plant also greatly influence mite densities. Mite dispersal is influenced by wind. Regular observations on several cassava varieties during 1975 did not indicate any of these to be resistant to mite attack.

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