MITES (ACARI) OF CASSAVA (*Manihot esculenta* Crantz) HABITAT IN SOUTHERN AFRICA

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Abstract

Consideration of possible side-effects of exotic biological control agents on their new environments is a necessary step in classical biological control programs. The evaluation of such effects usually requires the knowledge of the fauna present in those environments prior to introduction of control agents. This paper presents the first of a series of studies to evaluate the safety of a classical biological control program of the cassava green mite *Mononychellus tanajoa* (Bondar) in Mozambique and Malawi involving the introduction of *Typhlodromalus aripo* DeLeon, a predatory mite of the family Phytoseiidae. The objective of this study was to determine the mite fauna of cassava and of some of the visually most common plant species in or around cassava fields in those countries. The study was conducted at different occasions in the dry and rainy seasons, in 26 fields in Mozambique and 20 fields in Malawi representing a range of ecosystems. Twenty-one phytoseiid species were recorded in Mozambique and 32 in Malawi. On cassava, the dominant phytoseiids were *Euseius baetae* (Meyer & Rodrigues), *Euseius bwende* (Pritchard & Baker) and *Typhlodromalus saltus* (Denmark & Muma) in Mozambique, and *Euseius fustis* (Pritchard & Baker), *Iphiseius degenerans* (Berlese) and *T. saltus* in Malawi. On other plants, the dominant phytoseiids were *Euseius baetae*, *Amblyseius sundi* Pritchard & Baker and *Parphytoseius horrifer* (Pritchard & Baker) in Mozambique, and *I. degenerans*, *Euseius magucii* (Meyer & Rodrigues) and *Euseius orygmus* (Ueckermann & Loots) in Malawi. Several of the most common plants associated with cassava were observed to harbor phytoseiid species that were also found on the latter. Those plants may be important as reservoirs of such predators when conditions are not appropriate for them to live on cassava. This seemed to be particularly true for 6 phytoseiids in Mozambique (*A. sundi*, *E. magucii*, *P. horrifer*, *Typhlodromalus spinosus* (Meyer & Rodrigues), *Typhlodromips shi* (Pritchar & Baker) and *Neoseiulus teke* (Pritchard & Baker)), and 6 phytoseiids in Malawi (*E. orygmus*, *Phytoseius amba* Pritchard & Baker, *T. shi*, *Typhlodromus (Anthoseius) kikuyuensis* Swirski & Ragusa, *Typhlodromus (Anthoseius) malawiensis* Annou, Moraes & Hanna and *N. teke*), that were found on cassava at the end of the rainy season, but only on other plants in the dry season. *M. tanajoa* was the dominant mite species on cassava in both countries in addition to the phytoseiids; few other species were found on that plant in either country. A larger diversity of mites in addition to phytoseiids was found on other plants, but always at low numbers. Phytoseiids diversity and abundance varied between savannah and forest zones. These variations are likely due differences in biotic and abiotic factors between the two zones.

Key words: Biological control, Phytoseiidae, predators, biodiversity, Malawi, Mozambique.

Introduction

Classical biological control is a strategy involving the introduction of exotic biological control agents for permanent establishment and consequent maintenance of a target pest below its economically damaging level (Eilenberg et al., 2001). With very few exceptions, classical biological control has been one of the safest means of pest control (van Lenteren et al., 2003). Exceptions have been discussed by Howarth (1991) and Simerloff & Stiling (1996), but some of those have been recently challenged (Follet et al., 2000).

Ill effects of classical biological control attempts may arise when alien natural enemies negatively affect non-target species occurring in the ecosystem (Ehler, 1999), for example by decreasing the densities of other natural enemies of the same or other pests (Yao & Chant, 1989; Ehler, 1999; Cory & Myers, 2000). This paper presents the first of a series of studies to evaluate the safety of classical biological control activities of the cassava green mite *Mononychellus tanajoa* (Bondar) in southern Africa. The objectives of the study here reported was an assessment of the mite fauna of cassava and associated plants in Mozambique and Malawi, prior to the introduction from South America of *Typhlodromalus aripo* DeLeon, a predator of the family Phytoseiidae. Information obtained from the present study will be compared in another paper with that of a similar study in the same habitats after the introduction of *T. aripo* to determine the effect of the introduction of *T. aripo* on the native phytoseiid species in those two countries.

Mononychellus tanajoa, a neotropical tetranychid mite pest of cassava was accidentally introduced into Uganda (East Africa) in the early 1970s (Nyiira, 1972) and has since become a serious pest of cassava in all cassava growing areas in sub-Saharan Africa (Nyiira, 1972; Lyon, 1973; Lyon, 1974). A classical biological control program for *M. tanajoa* control was initiated in the early 1980s by the International Institute of Tropical Agriculture. During that campaign, several species of predatory phytoseiids were introduced to different countries in Africa (Yaninek et al., 1993), resulting in the establishment of 3 of them (Yaninek et al., 1998). Among those species, *T. aripo* quickly spread on a continental scale (Hanna & Toko, 2003; Yaninek & Hanna, 2003). This generalist predator (class III according to McMurtry & Croft, 1997) is thought to inhabit preferably the growing tips of cassava (Onzo et al., 2003; Yaninek & Hanna, 2003). It is now present in 20 countries in sub-Saharan Africa (Hanna & Toko, 2003; Yaninek & Hanna, 2003), where it shares the cassava habitat with other native phytoseiid species.

Evaluation of possible effects of that predator on the latter would be facilitated by the adequate knowledge of mite fauna in cassava habitat before its introduction. Detailed data of this sort are scarce in Mozambique and Malawi. Except for the study of Munthali (1987) on the distribution of *Iphiseius degenerans* (Berlese) in cassava strata in Malawi and the description of a few species from Mozambique (Meyer & Rodrigues, 1965; Rodrigues, 1968) and Malawi (Ueckermann & Loots, 1988), no data are available on phytoseiid mites in those countries.

Comparison of the results of the present study with those of studies to be undertaken after *T. aripo* spreads over those countries will provide insights on the safety of this predator in relation to conceivable side effects.

Materials and methods

Site selection and survey periods

Survey sites were selected across the main cassava growing areas in both countries. For logistical reasons, sites were selected along main roads in Mozambique and along main and secondary roads in Malawi (Fig. 1).

In Mozambique, surveys were conducted in the following localities: Xai-Xai (24^{o}30’ to 25^{o}20’S., and 33^{o}00’ to 34^{o}00’E.), Gaza Province; Unguana (23^{o}00’ to 23^{o}30’S., and 33^{o}00’ to 34^{o}20’E.) and Vilanculo (21^{o}00’ to 22^{o}00’S. and 35^{o}00’ to 36^{o}00’E.), Inhambane Province; Mitilili (15^{o}25’ to 15^{o}40’S., 38^{o}10' to 38^{o}20’E.), Zambezia Province; Muecate (14^{o}50’ to 15^{o}10’S., 39^{o}00’ to 40^{o}00’E.) and Nacala-Velha (14^{o}00’ to 16^{o}00’S. and 40^{o}00’ to 41^{o}00’E.). Nampula Province. Xai-Xai, Unguana, Vilanculo and Nacala-Velha all are located in coastal (Indian Ocean) savannah agroecology, while Muecate and Mitilili are located in interior transition and forest agroecologies, respectively.

In Malawi, surveys were conducted in the following localities: Salima (13^{o}40’ to 13^{o}45’S. and 34^{o}34’ to 34^{o}36’E.), Central Province; Nkhta-Bay-Mzuzu (11^{o}28’ to 11^{o}51’S. and 34^{o}00’ to 34^{o}12’E.) and Chiweta-Mlowe (10^{o}42’ to 10^{o}47’S. and 34^{o}10 and 34^{o}13’E.), Northern Province. Salima and Chiweta-Mlowe areas are located in coastal (Lake Malawi) savannah while Nkhata-Bay-Mzuzu is located in humid forest agroecology.

Twenty-six fields were evaluated in the 6 survey sites in Mozambique and 20 fields in the 3 survey sites in Malawi (Fig. 1). In each country, 3 to 10 fields were sampled in each visit. Visits were conducted in June 1999 (dry season) and in April 2000, 2001 and 2002 (end of the rainy season) in Mozambique, and in July 1999 (dry season) and May 2000 (end of the rainy season) in Malawi (Table 1). Because of flooding problems in Mozambique, surveys were not conducted in Xai-Xai and Unguana in 2000. Distances between two consecutive survey fields varied from 0.2 to 15 km, according to the availability of cassava fields in the targeted areas. The same fields were monitored in 2 consecutive surveys, except when they were harvested and not replanted; in that case, a neighboring field was selected to replace the lost one.

Sample collection and processing

The apex, one top leaf (i.e, the fourth to sixth leaf from the apex), one middle leaf (i.e., the twelfth to fifteenth leaf from the apex) and one bottom leaf (i.e., one of the last three leaves from the apex) of each of 30 cassava plants were picked from each field in each visit. All apices of each field were put in 70% alcohol and carried to a laboratory for examination under dissecting microscope, whereas leaves were checked directly in the field, also under dissecting microscope. Mites were counted and, except for *M. tanajoa*, collected in 70% alcohol.

Mites were also evaluated from the 5 most common plant species in or around each field. In the remaining of this paper, those plants are referred to either as “other plants” or as “associated plants”. At least 3 plants of each of those species, distant at least 5 m from each other, were uprooted and examined in the field under dissecting microscope for 15 minutes, collecting in 70% alcohol all mites encountered. Thirty apices (growing points) of each of those plant species were also collected in 70% alcohol and carried to a laboratory for examination under dissecting microscope. All mites collected were mounted for identification. Voucher specimens were deposited at IITA-BCCA in Cotonou, Benin. Plant species on which arthropods were collected were identified directly in the field, using reference books (Palgrave 1983; Vernon 1983; Terry & Michieka, 1987). For plants that could not be identified in the field, plant parts were collected and pressed for later identification by a weed specialist.

Results

More than 46 mite species were recorded from cassava and other plants in Mozambique, 46% of which belonging to the Phytoseiidae (Tables 2, 3, 6and 7). In Malawi, more than 52 species were recorded from cassava and other plants, 62% of which also belonging to the Phytoseiidae (Tables 2, 3, 6 and 7). Mites of that family were the most abundant predators in both countries.

Phytoseiids on cassava

Phytoseiids were found on top, middle and lower leaves in both countries. They were more abundant on middle and lower leaves than on top leaves. The species recorded in Mozambique and Malawi and the respective proportions of occurrence are shown in Table 2. A single species, *Euseius baetae* (Meyer & Rodrigues) was found in Mozambique in the dry season (Table 2), whereas ten species were found in this country at the end of the rainy season. *Euseius baetae*, *Euseius bwende* (Pritchard & Baker) and *Typhlodromalus saltus* (Denmark & Muma), were the most abundant at the end of the rainy season representing more than 97% of the total number of phytoseiid specimens collected. *Euseius baetae* represented about 77% of the phytoseiids collected in this country in that season, followed by *E. bwende* and *T. saltus*, each with about 10% of the total number collected.

Nine and 16 species were found in Malawi in the dry season and at the end of the rainy season, respectively (Table 2). *Iphiseius degenerans*, *Euseius fustis* (Pritchard & Baker) and *T. saltus* were the most abundant in all surveys, representing more than 97% of all phytoseiids collected. *Iphiseius degenerens* was the most abundant, (51%), followed by *E. fustis* (33%) and *T. saltus* (13%) in the dry season, while *E. fustis* was the most abundant at the end of the rainy season (64%), followed by *I. degenerans* (21%) and *T. saltus* (12%).

Other mites on cassava

In Mozambique, *M. tanajoa* was the main tetranychid species on cassava. It was absent in 3 fields in the dry season but it was present in every field at the end of the rainy season. This species was present in every stratum of the cassava plants, occurring at the highest densities on top leaves. It was very rare (less than 2 mites/leaf) in Xai-Xai in the dry season, whereas it was most abundant (293.0 mites/leaf) in Nacala at the end of the rainy season. Other tetranychids recorded were *Oligonychus* sp. and *Tetranychus* sp., always at low densities (Table 3). They were mainly found on middle and lower leaves. *Oligonychus* sp. was found only at the end of the rainy season in Muecate, whereas *Tetranychus* sp. was found only in the dry season in Unguana and Xai-Xai. Mites of the families Cunaxidae, Erythraeidae, Oribatulidae and Tydeidae were also found on cassava in Mozambique, but at very low numbers. They were mainly recorded on middle and lower leaves (Table 3).

In Malawi, *M. tanajoa* and *Tetranychus* sp. were the only tetranychids found on cassava in all fields, with *M. tanajoa* being by far the most common. *Mononychellus tanajoa* was found in all strata and was more abundant on top leaves than on the other strata. This species was absent from only one field in Mzuzu in the dry season; the highest density (135.3 mites/leaf) of that species was observed in Salima, at the end of the rainy season. In contrast, *Tetranychus* sp. was rare in both seasons, but less so at the end of the rainy season (Table 3) and was mainly concentrated on middle and lower leaves. *Tetranychus* sp. was recorded in Chiweta-Mlowe and Nkhata-Bay in the dry season, and in Mzuzu and Chiweta-Mlowe at the end of the rainy season. Mites of the families Erythraeidae, Macronyssidae and Oribatulidae were also found on cassava, but at low numbers (Table 3). They were mainly found on middle and lower leaves.

Association of phytoseiids with other plants

In Mozambique, 48 and 21 species of other plants were sampled in the dry season and at the end of the rainy season, respectively. Each of those plants corresponded to one of the 5 dominant species in each field at different sampling events. Plant species dominant in at least

20% of the survey fields were considered “common plants”. Among these, 3 groups of association levels with phytoseiids were defined: low level, plants on which phytoseiids were found in less than 50% of the fields; intermediate level, plants on which phytoseiids were found in 50 to 70% of the fields; and high level, including plants on which phytoseiids were found in over 70% of the fields (Table 4). Five plant species sampled in the dry season were considered common (Table 4). They harbored 68% of all phytoseiids collected on associated plants in that season (excluding cassava). Four of those plant species had high and one had low level of association with phytoseiids. Eight plant species sampled at the end of the rainy season were considered common (Table 4). They harbored more than 70% of all phytoseiids collected on associated plants in that season. Seven of those plant species had high and one had intermediate level of association with phytoseiids. *Anacardium occidentale* L. *Trichilia emetica* Vahl, *Carica papaya* L., *Tridax procumbens* L. and *Vigna unguiculata* (L.) were the most common plant species sampled in the 2 seasons in Mozambique. In the dry season, *C. papaya* harbored the highest number of phytoseiid species (6), followed by *Alchornea laxiflora* (Benth.) (4) and *A. occidentale* (4) (Table 4). At the end of the rainy season, the highest number of phytoseiid species was found on *T. procumbens* (9 species), followed by *A. occidentale* (8 species) and *Mucuna* spp. (8 species) (Table 4). The highest number of phytoseiids was recorded on *A. occidentale*, which accounted for 35% and 29% of the specimens collected on plants other than cassava in the dry season and at the end of the rainy season, respectively. In the dry season, this plant was followed by *C. papaya* and *T. emetica*, each accounting for 13% of the specimens collected on plants other than cassava. At the end of the rainy season, it was followed by *Mucuna* sp., accounting for 17% and *V. unguiculata* representing 7% of the phytoseiids collected on plants other than cassava (Table 4).

In Malawi, 27 and 32 species of other plants were sampled in dry season and at the end of the rainy season, respectively. As in Mozambique, associated plants occurring in 20% or more of the survey fields were considered “common plants”, which were also classified in groups of association with phytoseiids (Table 5). Ten plant species sampled in the dry season were considered common (Table 5). They harbored more than 68% of all phytoseiids collected on associated plants in that season. Eight of those plants had high and 2 had intermediate level of association with phytoseiids. Seven plant species sampled at the end of the rainy season were considered common. They harbored more than 80% of phytoseiid specimens collected on associated plants in that season. Six of them had high and one had low level of association with phytoseiids (Table 5). *Ageratum conyzoides* L., *Musa* spp. and *Mangifera indica* L. were the most common plant species encountered over the 2 seasons (Table 5). In the dry season, *Psidium guajava* L. harbored the highest number of phytoseiid species (9), followed by *A. conyzoides* (8). At the end of the rainy season, the highest number of phytoseiid species (12) was found on *M. indica*, followed by *P. guajava* (11) (Table 5). Phytoseiids were not found on *A. conyzoides* at the end of the rainy season. The highest number of phytoseiids was recorded on *Musa* sp., accounting for 14% and 28% of the specimens collected on associated plants in the dry season and at the end of the rainy season, respectively. In the dry season, it was followed by *A. conyzoides*, accounting for 11% of the specimens collected, whereas at the end of the rainy season, it was followed by *M. indica*, accounting for 18% of the specimens (Table 5).

Phytoseiid species composition and relative abundance on associated plant

In Mozambique, a total of 12 species were recorded on associated plants in the dry season compared to 17 species at the end of the rainy season (Table 6). *Euseius baetae* was the most common species, followed by *Amblyseius sundi* (Pritchard & Baker) and *Paraphytoseius horrifer* (Pritchard & Baker). *E. baetae* corresponded to 26% and 53% of the phytoseiids collected on those plants in the dry season and at the end of the rainy season, respectively; it was found in all surveyed sites. *Amblyseius sundi* represented 18% of the phytoseiids collected on associated plants in the dry season and 10% at the end of the rainy season, whereas *P. horrifer* represented 13% and 9% of the phytoseiids on those plants in the dry season and at the end of the rainy season, respectively (Table 6).

In Malawi, a total of 19 phytoseiid species were recorded on associated plants in the dry season, compared with 25 species at the end of the rainy season (Table 6). *Iphiseius degenerans* and *E. magucii* were co-dominant in the dry season, each representing 24% of the phytoseiids collected on those plants, followed by *Euseius orygmus* (Ueckermann and Loots), representing 19% of the specimens collected. At the end of the rainy season, *I. degenerans* was the most common species on associated plants, representing 35% of the phytoseiids collected on them, followed by *E. orygmus* (29%). *Euseius magucii* represented only 5% of the total number of phytoseiids collected at the end of the rainy season. Except for *Typhlodromips shi* (Pritchard & Baker), *E. fustis*, *P. horrifer* and *T. saltus*, which represented between 2 and 12% of the phytoseiid species, other phytoseiids were rare (Table 6).

Composition and relative abundance of other mite groups on associated plants

In Mozambique, other mite groups were rare on associated plants (Table 7). Of the tetranychids, few specimens of *Eutetranychus* sp. and *Tetranychus* sp. were found on those plants. Other mites recorded belong to the Acaridae, Anystidae, Ascidae, Camerobiidae, Cheyletidae, Erythraeidae, Eupodidae, Mochloretidae, Oribatulidae, Stigmaeidae, Tenuipalpidae and Tydeidae (Table 7).

In Malawi, other mite groups were also rare on associated plants (Table 7). Just 2 specimens of *M. tanajoa* were found on one of those plants (*Urena lobata* L.); other few tetranychids found were *Eutetranychus* sp., *Olignychus* sp., and *Tetranychus* sp. Representative of

Anystidae, Ascidae, Cunaxidae, Eupodidae, Mochloretidae, Oribatulidae, Stigmaeidae, Tenuipalpidae and Tydeidae were also found (Table 7).

Phytoseiids found on both cassava and associated plants

In Mozambique, all of the 10-phytoseiid species recorded on cassava were also encountered on at least one of the associated plants (Table 8). Nine species were concurrently recorded on cassava and associated plants at the end of the rainy season and only one species (*E. baetae*) was concurrently recorded on both cassava and associated plants in the dry season. *Neoseiulus. teke* was found on cassava at the end of the rainy season and on *Cucurbita pepo* L. in the dry season. Apart from *Phytoseius intermedius* Evans & MacFarlane, *E. bwende* and *T. saltus* , all phytoseiid species absent on cassava in the dry season, but present on this plant at the end of the rainy season (*A. sundi*, *E. magucii, P. horrifer, Typhlodromalus spinosus* (Meyer & Rodrigues), *Typhlodromips shi* (Pritchar & Baker) and *Neoseiulus teke* (Pritchard & Baker), were found on some associated plants in the dry season (Tables 2 and 6). The 3 most common phytoseiid species found on cassava (i.e. *E. baetae*, *E. bwende* and *T. saltus*) were among the species recorded on both cassava and other plant species.

In Malawi, 15 of the 18-phytoseiid species recorded on cassava were also found on at least one associated plant species (Table 8). Six and 11 phytoseiid species were concurrently found on cassava and associated plants in the dry and rainy seasons, respectively. One species was found on cassava in the dry season and on an associated plant at the end of the rainy season, whereas 2 species were found on cassava at the end of the rainy season and on associated plants in the dry season. Similarly to what was observed in Mozambique, all phytoseiid species absent on cassava in the dry season, but present on this plant at the end of the rainy season (*E. orygmus*, *Phytoseius amba* Pritchard & Baker, *T. shi*, *Typhlodromus (Anthoseius) kikuyuensis* Swirski & Ragusa, *Typhlodromus (Anthoseius) malawiensis* Zannou, Moraes &

Hanna and *N. teke*), were found on some associated plants in the dry season. In the same way, the 3 most common species (*E. fustis*, *I. degenerans* and *T. saltus*) were among the species found on cassava and other plant species.

Phyotseiid distribution and abundance in the different ecological zones

The table 9 shows the distribution and abundance of phytoseiids in different ecological zones considering Mozambique and Malawi together. The composition and abundance of phytoseiids varied between savannah and forest zones. The genus *Amblyseius* is more common in forest than in savannah. Among the commonest species recorded on cassava or associated plants, *E. baetae, E. bwende, P. horrifer* and *T. saltus* were more abundant in forest than in savannah while *E. orygmus*, *E. magucii* and *I. degenerans* is more frequent in savannah than in forest. *Euseius fustis* was abundant in both savannah and forest zones.

Discussion

This study presents the first detailed inventory of the mite fauna in cassava habitats in southern Africa. Except for *I. degenerans* and *E. fustis* (Munthali, 1987; Markham & Robertson, 1987) as well as *E. orygmus* (Ueckermann & Loots, 1988), all phytoseiids are recorded for the first time in Malawi. This study also reports for the first time the presence of the phytoseiids *Amblyseius tamatavensis* Blommers, *E. bwende, Euseius dossei* (Pritchard & Baker), *N. lula*, *P. intermedius*, *Phytoscutus gongylus* (Pritchard and Baker), *Typhlodromalus havu* (Pritchard & Baker), *T. parcidentatus* Zannou, Moraes & Hanna, *T. saltus, T. shi, Typhlodromus (Anthoseius) apoxys* (Van der Merwe), and *Typhlodromus (Anthoseius) microbullatus* (Van der Merwe) in Mozambique. Two phytoseiid species found in Malawi, *Neoseiulus* **n.sp**. and *Typhlodromus (Anthoseius)* **n.sp**. have not yet been described (Zannou *et al*., unpublished data).

Our results showed that phytoseiids were more diverse and abundant in Malawi than in Mozambique. Two reasons may explain this situation:

1. The geographic situation of those two countries. Indeed, Mozambique has a long border with India Ocean whereas Malawi is bordered with a long lake (Lake Malawi). Since most of the sites in Mozambique were located along the coast, violent marine winds may carry the phytoseiids to the interior of the country. It is well known that wind had an important influence on mite dispersal in general, and phytoseiid dispersal in particular (Yaninek et al., 1989a; Tixier et al., 1998).
2. The oviposition rate of the dominant phytoseiid species in each country. *Iphiseius degenerans*, one of the commonest phytoseiids recorded on cassava in Malawi has a high mean oviposition, 3 eggs/day compared to *E. fustis* (Zannou *et al.*, unpublished data) and to certain phytoseiid species (Van Rijn and Tanigoshi). Then the oviposition of *E. fustis* is higher than the one of *T. saltus* (Ojo, 1997). Nothing or very little is known on the oviposition of *E. baetae* and of *E. bwende*.
3. The diversity of associated plants. Indeed in Mozambique, most of the forests were destroyed and replaced by crops and/or weeds and had a low diversity of plant species (Ministério da educação, 1986; Zannou et al., unpublished data; I. Zannou, personal observation). Whereas in Malawi most of the forests were not destroyed (Ministry of information and Broadcasting, 1972; Zannou et al., Unpublished data; I. Zannou, personal observation) and had a high diversity of plant species. On the other hand, cassava varieties grown in Mozambique (i. e. Fernando Boa, Mure-Mulhe) are different from the ones grown in Malawi (i.e. Gomani, Mwatatu) (Zannou *et al.*, unpublished data) and most of common associated plants present in Mozambique are

absent in Malawi and vice-versa. *Anacardium occidentale*, one of the commonest associated plants encountered in Mozambique, was found and sampled in only one field in Malawi; and *G. arborea*, which is among the commonest associated plants in Malawi, was never sampled in Mozambique. It is known that plant diversity plays an important role in phytoseiid diversity and abundance. Moraes et al. (1993) showed that phytoseiid species of the genus *Euseius* generally occurred on shrubs and trees in northeastern Brazil. Those three reasons may also explain why the three dominant species in Mozambique were different from those in Malawi.

In both countries phytoseiids were more numerous in rainy season than in the dry season. This situation is certainly a direct consequence of the effect of variations of temperature and relative humidity, and the availability of food on the reproduction and development of the phytoseiids. At the end of the rainy season (April in Mozambique and May in Malawi) thermic amplitudes were low (3-5^{o}C), relative humidity is high (80-90%) and heavy rains were very scarce to wash phytoseiids down (Zannou et al., unpublished data). These climatic conditions may favor the reproduction and development of phytoseiids and may contribute to the increment of their population densities. In Addition, cassava and its associated plants still having young leaves with a high nutritive value favoring the reproduction and development of prey (*M. tanajoa* and other pests). The optimal conditions of temperature and humidity may also favor the production of pollen by associated plants. Indeed, many crops (i.e. maize, cowpea, pigeon pea) were in flower at that period (I. Zannou, personal observation). This availability of food may also increase the reproduction and the development of the phytoseiids and then increase their population densities. Whereas, in the dry season (June in Mozambique and July in Malawi) thermal amplitudes are high (8-12^{o}C) and relative humidity is low (less than 60%) (Ministério da Educação, 1986; Ministry of Information and Broadcasting, 1972; Zannou et al., unpublished data). These climatic conditions may slow down the reproduction and the development of phytoseiids and then decrease their population densities, because it is known that high thermic amplitude (Ojo, 1997; Yaninek et al., 1998) and low relative humidity (Yaninek et al., 1998) influence negatively population densities of phytoseiids. Water deficit blocs young leave production by cassava plants. Then cassava leaves nutritive value is reduced and the leaves yellow and drop down. The lack of nutrients in cassava leaves provokes the death of *M. tanajoa* and the decrease of the population densities of this pest. In addition, pollen and other food are scarce on crops and associated plants. This scarcity of food may also affect negatively the population densities of the phytoseiids.

Climatic factors and phytoseiid species tolerance to these factors seemed to be responsible of the very low population density of the phytoseiids recorded on cassava in the dry season in Mozambique compared to Malawi. Indeed, Mozambique was drier than Malawi and during the surveys conducted in the dry season in Mozambique, there was no young leaf on cassava plants and most of them had lost their leaves. In addition, many studies showed that the tolerance limits for climatic factors vary from a phytoseiid species to another (Ferragut et al., 1987; Bounfour & McMurtry, 1987; Yaninek et al., 1989a). Certainly, phytoseiid species inhabiting cassava plants in Malawi tolerate broader thermic amplitude and relative humidity ranges than do those inhabiting cassava plants in Mozambique. For example, *E. baetae*, the commonest phytoseiid species recorded on cassava seems to prefer forest zone, which is characterized by low thermic amplitude and a high relative humidity (Table 9).

The composition and abundance of mite fauna in general, and phytoseiid fauna in particular, varied widely between ecological zones. These variations may reflect the variable rainfall, relative humidity, temperature and altitude (abiotic factors), cassava varieties and associated plants- diversity (biotic factors) among ecological zones (Zannou & Hanna, unpublished data). *Typhlodromalus saltus* is known to prefer high relative humidity conditions (Ojo, 1997), what could explain the relatively high number of mites of this species in the forest zone. *Euseius* spp. and *I. degenerans* seem to tolerate broader temperature and humidity ranges, as they were found in humid (McMurtry & Croft, 1997) and dry areas (Swirski & Amitai, 1961; Moraes et al., 1986; Kreiter et al., 2002). This may be the reason why *E. fustis* was abundant in savannah and forest. *E. baetae* seems to prefer high relative humidity conditions, what could explain the relatively high density of this species in forest zones.

The abundance and diversity of phytoseiids recorded on each of the plant substrates seemed to be proportional to the number of fields in which the latter were encountered (Tables 4 and 5). Moraes *et al.* (1993) observed the same result in Brazil. Indeed, these authors reported that more common is a host plant, more numerous are the phytoseiid species encountered on this plant. The number of phytoseiid species recorded on a given associated plant species seemed also to be positively correlated to the abundance of phytoseiids encountered on this plant. The abundance of associated plants and their leaves structures may explain the reason why some of them had considerably higher diversity or abundance of phytoseiids. Indeed more common is an associated plant more this plant is sampled and more phytoseiids may be abundant and diverse on this plant. In addition some phytoseiid species prefer plants with glabrous leaves others prefer plants with hairy leaves. Camporese & Duso (1996) and Duso & Vettorazzo (1999) reported the preference of *Kampimodromus aberrans* (Oudemans) and *Typhlodromus pyri* Scheuten to grape varieties with hairy leaves (i.e. Trebbiano, Garganega) and of *Amblyseius andersoni* Chant to grape varieties with glabrous to slightly hairy leaves (i.e. Merlot). It is now well established that phytoseiid mites are affected by the presence of domatia and pubescence on plant leaf surfaces (Walter, 1996; Duso & Vettorazo, 1999). Some phytoseiid species prefer plants with domatia as these structures are thought to provide the predators with favorable conditions for laying eggs and molting, as well as protection against extreme climatic conditions and hyper-predators (e.g., Dicke & Sabelis, 1988; Barret, 1994; Walter, 1996; Sabelis et al., 1991; Hanna & Toko, 2003; Kreiter et al., 2002).

During our surveys, most of the phytoseiid species recorded on cassava as well as associated plants were the commonest in cassava agro-system (i.e. *E. baetae*, *E. fustis*, *I. degenerans* and *T. saltus*). Some efforts to determine the possible role of plants commonly found in and around cassava fields as reservoirs of predators that are also found on cassava have been previously done. Moraes et al. (1993) reported several plant species on which common cassava inhabiting predators could also be found in northeast Brazil. Yaninek et al. (1991, 1998) conducted similar observations in Africa. Tuomo (1994) in Finland; Tixier et al. (1998) in France; and Rigamonti & Lozzia (2002) and Lozzia & Rigamonti (2003) in Italy indicated that the potential colonization of grape plants is directly influenced by the abundance of phytoseiids on nearby natural vegetation. Camporese & Duso (1996) also obtained similar results. The presence of phytoseiid species on cassava as well as a given associated plant seemed not to be correlated to the frequency of this plant. Therefore, both common and uncommon associated plants are important as reservoirs of phytoseiids in the biological control of cassava green mite.

The importance of some of phytoseiid species common on cassava as biological control agents of *M. tanajoa* is well known. Indeed, Akpokodje et al. (1990) and Nwilene & Nachman (1996) reported that *I. degenerans* feeds on all the stages of cassava green mite. According to Akpokodje et al. (1990), *I. degenerans* may have the same predation rate with *Neoseilus idaeus* Denmark & Muma, an exotic phytoseiid introduced from South America to Africa to control this pest mite, when fed with *M. tanajoa*. Despite the species of genus *Euseius* performs better on pollen, they can also feed on cassava green mite. Ojo (1997) reported that *Typhlodromalus saltus* can also feed on this pest mite. Since some associated plants are reservoirs of these phytoseiids, it may be good to advise farmers to maintain many of these associated plants in and around their cassava fields to increase the chance of these phytoseiids to persist in cassava habitat.

Acknowledgements

We thank E. Bernadin, B. Agboton, E. Mambo, M. Chitete and H. Mleta for their help in the field work conducted; B. Bovis and A. Domingo for their help in processing the samples in the laboratory; and A. Onzo for his valuable comments on an earlier version of this manuscript. R. A. Norton identified he oribatid mites. This research was financed with IITA core donor funds, and with special project funds provided to IITA by the Danish International Development Assistance (Danida) and the International Fund for Agricultural Development (IFAD). This is IITA publication #.....

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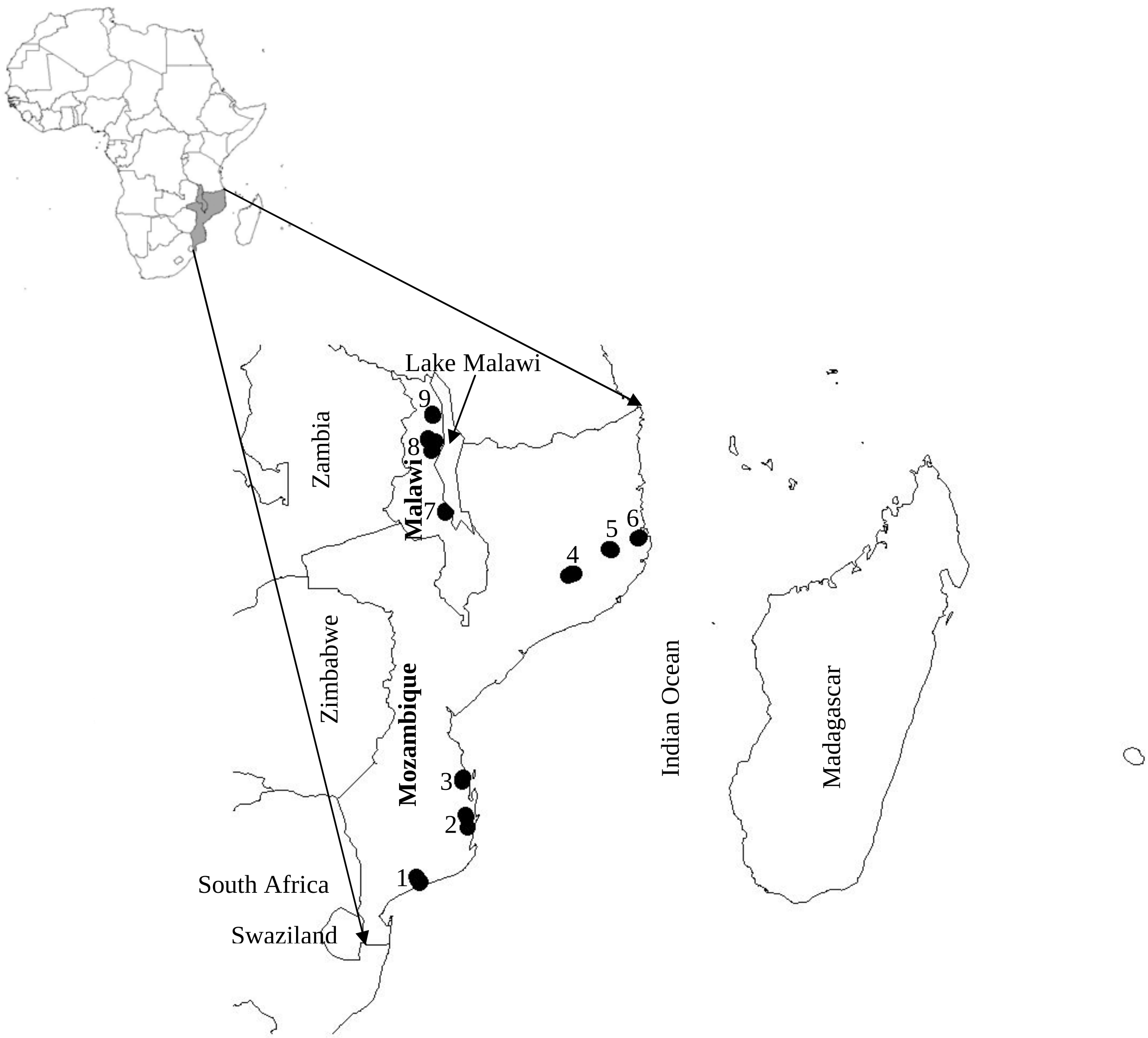
Figures Captions

Figure 1: Survey sites visited in Mozambique and Malawi before the introduction of *T. aripo*. Mozambique: 1= Xai-Xai; 2 = Unguana; 3 =Vilankulo, 4 = Mitilili; 5 = Muecate and 6 = Nacala-Velha. Malawi: 7 = Salima; 8 = Nkhata-Bay-Mzuzu; 9 = Chiweta-Mlowe.



● Survey fields

Table 1: Number of fields surveyed per site and per year in Mozambique and Malawi.

Sites	Number of survey fields 1999	2000	2001	2002
		Mozambique		
Xai-Xai†	5	0	0	0
Unguana†	5	0	0	0
Muecate	5	5	0	0
Mitilili	0	5	0	0
Nacala-Velha	0	0	3	0
Vilankulo	0	0	0	3
		Malawi		
Salima	3	5	0	0
Nkhata-Bay-Mzuzu	5	10	0	0
Chiweta-Mlowe	3	5	0	0

†Not visited again in 2000 because of flooding

Table 2: Composition of phytoseiid fauna on cassava in Mozambique and Malawi.

	Dry season		End of the rainy season	
Species	**# Specimens**	**Percentage**[†]	**# Specimens**	**Percentage**
		Mozambique		
Euseius baetae	5	100.0	751	77.4
Euseius bwende	0	0.0	98	10.1
Typhlodromalus saltus	0	0.0	94	9.7
Paraphytoseius horrifer	0	0.0	14	1.4
Typhlodromips shi	0	0.0	6	0.6
Neoseiulus teke	0	0.0	3	0.3
Amblyseius sundi	0	0.0	1	0.1
Typhlodromalus spinosus	0	0.0	1	0.1
Euseius magucii	0	0.0	1	0.1
Phytoseius intermedius	0	0.0	1	0.1
		Malawi		
Iphiseius degenerans	293	51.2	453	21.4
Euseius fustis	190	33.2	1351	63.7
Typhlodromalus saltus	75	13.1	257	12.1
Euseius talinga	6	1.1	10	0.5
Euseius magucii	3	0.5	16	0.8
Euseius baetae	2	0.4	1	0.0
Amblyseius sundi	1	0.2	0	0.0
Euseius spermahyphus	1	0.2	0	0.0
Typhlodromips rykei	1	0.2	3	0.1
Typhlodromus (A.) malawiensis	0	0.0	8	0.4
Euseius orygmus	0	0.0	6	0.3
Phytoseius amba	0	0.0	3	0.1
Neoseiulus teke	0	0.0	2	0.1
Typhlodromus (A.) kikuyuensis	0	0.0	2	0.1
Euseius neodossei	0	0.0	1	0.0
Neoseiulus lula	0	0.0	1	0.0
Phytoscutus gongylus	0	0.0	1	0.0
Typhlodromips shi	0	0.0	1	0.0

Mozambique - Dry season: # fields = 15, # phytoseiid specimens = 5; end of rainy season: # fields = 19, # phytoseiid specimens = 970. Malawi - Dry season: # fields = 11, # phytoseiid specimens = 572; end of the rainy season: # fields = 20, # phytoseiid specimens = 2116.
[†]Percentages were calculated separately for each country.

Table 3: Composition of other mite fauna (excluding *M. tanajoa*) on cassava in Mozambique and Malawi.

	Dry season		End of the rainy season	
Family/Species	**# Specimens**	**Percentage†**	**# Specimens**	**Percentage†**
		Mozambique		
Cunaxidae	0	0.0	1	5.9
Erythraeidae				
Balaustium spp.	1	0.6	2	11.8
Tetranychidae				
Oligonychus spp.	0	0.0	6	35.3
Tetranychus spp.	149	98.0	0	0.0
Oribatulidae				
Phauloppia spp.	0	0.0	5	29.3
Zygoribatula spp.	0	0.0	3	17.6
Tydeidae				
Homeopronematus spp.	2	1.3	0	0.0
		Malawi		
Erythraeidae				
Balaustium spp.	1	10.0	0	0.0
Macronyssidae	1	10.0	0	0.0
Oribatulidae				
Phauloppia spp.	1	10.0	0	0.0
Zygoribatula spp.	2	20.0	0	0.0
Tetranychidae				
Tetranychus spp.	5	50.0	42	10 0

Mozambique - Dry season: # fields = 15, # other mites = 152; end of rainy season: # fields = 19, # other mites = 17. Malawi - Dry season: # fields = 11, # other mites = 10; end of the rainy season: # fields = 20, # other mites = 42. †Percentages were calculated separately for each country.

Table 4: Plant species commonly found in cassava (*Manihot esculenta* Crantz) habitats in Mozambique and associated phytoseiid species[1].

Plant species	Number of fields recorded	Number of fields with phytoseiids	No of species	% of specimens[†]
4a. Dry season				
	Highest level of association			
Alchornea laxiflora	3	3	4	3.2
Anacardium occidentale	10	10	3	34.6
Carica papaya	4	4	6	13.0
Trichilia emetica	4	3	4	13.0
	Lowest level of association			
Ipomoea batatas	3	1	2	4.5
4b. End of rainy season				
	Highest level of association			
Anacardium occidenale	13	13	8	28.9
Cajanus cajan	7	7	4	4.1
Mangifera indica	4	4	5	5.2
Mucuna spp.	7	7	8	16.5
Tridax procumbens	9	7	9	4.1
Vigna unguiculata	11	8	3	7.2
Zea mays	4	3	5	2.1
	Intermediate level of association			
Sorghum spp.	5	3	5	2.1

[1]Plant species are separated into levels of association based on the frequency of encountering phytoseiids on them. For each species, compare the 2nd and 3rd columns of the table. [†]Percentage of phytoseiid specimens collected on each plant species over the total number of phytoseiid specimens collected on all associated plants. Dry season: # fields = 15, # plants = 48, # phytoseiid specimens = 133; end of the rainy season: # fields = 19, # plants = 21, # phytoseiid specimens = 603.

Table 5: Plant species commonly found in cassava (*Manihot esculenta* Crantz) habitats in Malawi and associated phytoseiid species [1].

Plant species	Number of fields: Recorded	Number of fields: With phytoseiids	No of species	Percentage of Specimens[†]
5a. Dry season				
	Highest level of association			
Ageratum conyzoides	7	7	8	10.8
Conyza sumatrensis	2	2	6	6.7
Euphorbia heterophylla	2	2	2	2.6
Ficus exasperata	4	4	4	8.2
Mangifera indica	5	5	3	10.6
Musa spp.	6	6	7	13.9
Panicum sp.	2	2	5	3.6
Psidium guajava	3	3	9	5.6
	Intermediate level of association			
Gmelina arborea	3	2	2	5.2
Urena lobata	2	1	2	1.0
5b. End of rainy season				
	Highest level of association			
Euphorbia heterophylla	4	4	4	4.1
Gmelina arborea	7	7	7	11.9
Mangifera indica	16	15	12	17.7
Musa spp.	12	12	10	25.6
Psidium guajava	7	6	11	10.8
Zea mays	7	6	7	10.0
	Lowest level of association			
Eucalyptus spp.	4	1	1	0.1

[1]Plant species are separated into levels of association based on the frequency of encountering phytoseiids on them. For each species, compare the 2nd and 3rd columns of the table. [†]Percentage of phytoseiid specimens collected on each plant species over the total number of phytoseiid specimens collected on all associated plants. Dry season: # fields = 11, # plants = 27, # phytoseiid specimens = 417; end of the rainy season: # fields = 20, # plants = 32, # phytoseiid specimens = 719.

Table 6: Composition of phytoseiid fauna on plants associated with cassava in Mozambique and Malawi.

	Dry season		End of the rainy season	
Species	**# Specimens**	**Percentage†**	**# Specimens**	**Percentage†**
		Mozambique		
Euseius baetae	34	25.6	320	53.1
Amblyseius sundi	24	18.0	62	10.3
Typhlodromips shi	18	13.5	36	6.0
Phytoseius horrifer	17	12.8	51	8.5
Typhlodromus (A.) microbullatus	11	8.3	28	4.6
Phytoseius amba	8	6.0	0	0.0
Typhlodromus (A.) apoxys	6	4.5	0	0.0
Euseius magucii	6	4.5	3	0.5
Amblyseius tamatavensis	3	2.3	7	1.2
Neoseiulus teke	3	2.3	0	0.0
Typhlodromalus spinosus	2	1.5	16	2.7
Phytoscutus gongylus	1	0.8	0	0.0
Typhlodromalus saltus	0	0.0	30	5.0
Euseius dossei	0	0.0	19	3.2
Typhlodromalus parcidentatus	0	0.0	14	2.3
Euseius bwende	0	0.0	11	1.8
Neoseiulus lula	0	0.0	2	0.3
Neoseiulus baraki	0	0.0	1	0.2
Neoseiulus esculentus	0	0.0	1	0.2
Typhlodromalus havu	0	0.0	1	0.2
Phytoseius intermedius	0	0.0	1	0.2
		Malawi		
Iphiseius degenerans	101	24.2	248	34.5
Euseius magucii	99	23.7	32	4.5
Euseius orygmus	78	18.7	210	29.2
Typhlodromips shi	49	11.8	54	7.5
Euseius fustis	21	5.0	35	4.9
Paraphytoseius horrifer	18	4.3	11	1.5
Typhlodromalus saltus	12	2.9	14	2.0
Phytoseius amba	8	1.9	9	1.3
Neoseiulus **n.sp.**	8	1.9	0	0.0
Typhlodromus (A.) kikuyuensis	4	1.0	0	0.0
Amblyseius tamatavensis	4	1.0	7	1.0
Typhlodromus (A.) malawiensis	4	1.0	18	2.5
Typhlodromalu havu	2	0.5	0	0.0
Proprioseiopsis cannaensis	2	0.5	0	0.0
Phytoseius ferox	2	0.5	5	0.7
Amblyseius sundi	2	0.5	7	1.0
Typhlodromus (A.) praecutus	1	0.2	3	0.4
Typhlodromips rykei	1	0.2	2	0.3
Neoseiulus teke	1	0.2	0	0.0
Typhlodromus (A.) **n.sp.**	0	0.0	1	0.1
Typhlodromus (T.) magdalenae	0	0.0	5	0.7
Typhlodromips spp.	0	0.0	1	0.1

Phytoseius intermedius	0	0.0	8	1.1
Neoseiulus barkeri	0	0.0	2	0.3
Euseius talinga	0	0.0	20	2.8
Euseius spermahyphus	0	0.0	7	1.0
Euseius baetae	0	0.0	11	1.5
Euseius africanus	0	0.0	6	0.8
Amblyseius herbicolus	0	0.0	2	0.3
Typhlodromalus spinosus	0	0.0	1	0.1

Dry season: # fields = 15, # plants = 48, # phytoseiid specimens = 133; end of the rainy season: # fields = 19, # plants = 21, # phytoseiid specimens = 603. [†]Percentages were calculated separately for each country.

Table 7: Composition of other mite fauna on plants associated with cassava in Mozambique and Malawi.

	Dry season		End of the rainy season	
Family/Species	**# Specimens**	**Percentage†**	**# Specimens**	**Percentage†**
			Mozambique	
Acaridae				
Tyrophagus spp.			12	14.3
Ascidae	0	0.0		
Aceodromus convolvuli			2	2.4
Asca spp.	0	0.0	13	15.5
Anystidae	1	1.2		
Anystis sp.			1	1.2
Camerobiidae	0	0.0		
Neophyllobius sp.			0	0.0
Cheyletidae	1	1.2		
Hemicheyletia sp.			0	0.0
Eupodidae	1	1.2		
Eupodes spp.			1	1.2
Erythraeidae	3	3.7		
Balaustium sp.			0	0.0
Erythraeus sp.	1	1.2	1	1.2
Pygmephoridae	0	0.0	1	1.2
Oribatulidae	0	0.0		
Phauloppia spp.			2	2.3
Rubroscirus spp.	0	0.0	4	4.8
Zygoribatula spp.	3	3.7	4	4.8
Mochloretidae	8	9.8	13	15.5
Stigmaeidae	0	0.0		
Stigmaeus spp.			4	4.8
Tenuipalpidae	0	0.0		
Brevipalpus spp.			0	0.0
Tenuipalpus sp.	16	19.5	0	0.0
Tetranychidae	1	1.2		
Eutetranychus sp.			0	0.0
Tetranychus spp.	1	1.2	24	28.6
Tydeidae	30	36.6		
Homeopronematus sp.			0	0.0
Parapronematus sp.	1	1.2	1	1.2
Parafrotydeus sp.	1	1.2	1	1.2
Tydeus spp.	0	0.0	0	0.0
			Malawi	
Anystidae				
Anystis **sp.**	4	8.5	2	2.4
Ascidae				
Aceodromus convolvuli	2	4.3	0	0.0
Asca sp.	0	0.0	1	1.2
Cunaxidae				
Armascirus sp.	0	0.0	6	7.2
Cunaxa sp.	0	0.0	1	1.2

Rubroscirus spp.	1	2.1	2	2.4
Eupodidae				
Eupodes spp.	8	17.0	9	10.8
Linopodes sp.	1	4.3	0	0.0
Mochloretidae	0	0.0	2	2.4
Oribatulidae				
Phauloppia spp.	7	14.9	1	1.2
Zygoribatula spp.	5	10.6	0	0.0
Stigmaeidae				
Agistemus spp.	1	2.1	7	8.4
Tetranychidae				
Eutetranychus sp.	0	0.0	1	1.2
Mononychellus tanajoa	2	4.3	0	0.0
Oligonychus spp.	7	14.9	4	4.8
Tetranychus spp.	0	0.0	11	13.3
Tenuipalpidae				
Brevipalpus spp.	0	0.0	11	13.3
Tydeidae				
Paraponematus spp.	0	0.0	3	3.6
Tydeus spp.	9	19.1	22	26.5

Dry season: # fields = 15, # plants = 48, # other mites = 82; end of the rainy season: # fields = 19, # plants = 21, # other mites = 84. [†]Percentages were calculated separately for each country.

Table 8: Phytoseiid species found on both cassava and associated plants in Mozambique and Malawi.

Species	Dry season # other Plants	Dry season % specimens[1] (# specimens) Cassava	Dry season % specimens[1] (# specimens) Other plants	End of the rainy season # other plants	End of the rainy season % specimens[1] (# specimens) Cassava	End of the rainy season % specimens[1] (# specimens) Other plants
			Mozambique			
Amblyseius sundi	0	0 (0)	100 (24)	2 (1)	98 (62)	2 (1)
Euseius bwende	0	0 (0)	0 (0)	90 (98)	10 (11)	90 (98)
Euseius baetae	8	13 (5)	87 (34)	70 (751)	30 (320)	70 (751)
Euseius magucii	0	0 (0)	100 (6)	33 (1)	67 (3)	33 (1)
Neoseiulus teke		0 (0)	100 (3)	100 (3)	0 (0)	100 (3)
Paraphytoseius horrifer	0	0 (0)	100 (17)	22 (14)	78 (51)	22 (14)
Phytoseius intermedius	0	0 (0)	0 (0)	50 (1)	50 (1)	50 (1)
Typhlodromalus saltus	0	0 (0)	0 (0)	76 (94)	24 (30)	76 (94)
Typhlodromalus spinosus	0	0 (0)	100 (2)	6 (1)	94 (16)	6 (1)
Typhlodromips shi	0	0 (0)	100 (18)	14 (6)	86 (16)	14 (6)
			Malawi			
Iphiseius degenerans	11	74 (293)	26 (101)	10	65 (453)	35 (248)
Euseius fustis	6	94 (190)	6 (12)	6	97 (1351)	3 (35)
Typhlodromalus saltus	4	78 (75)	22 (21)	3	95 (257)	5 (14)
Amblyseius sundi	2	33 (1)	67 (2)	0	0 (0)	0 (0)
Euseius magucii	16	3 (3)	97 (99)	9	35 (17)	65 (32)
Typhlodromips rykei	1	50 (1)	50 (1)	2	60 (3)	40 (2)
Typhlodromus (A.) malawiensis	3	0 (0)	100 (3)	3	31 (8)	69 (18)
Euseius baetae	0	100 (2)	0 (0)	4	8 (1)	92 (11)
Euseius talinga	0	100 (6)	0 (0)	3	33 (10)	67 (20)
Euseius orygmus	5	0 (0)	100 (78)	12	3 (6)	97 (210)
Phytoseius amba	3	0 (0)	100 (8)	3	18 (2)	82 (9)
Typhlodromips shi	11	74 (293)	26 (101)	10	65 (453)	35 (248)

[1]Percentage of specimens of each phytoseiid species collected on cassava or associated plants over the total number of specimens of concerned species.

Table 9: Phytoseiids diversity and abundance in different ecological zones considering the total of Mozambique and Malawi survey sites.

	Savannah zone		Forest zone	
	# Specimens	Percentage†	# Specimens	Percentage†
Amblyseius herbicolus	0	0.0	2	0.1
Amblyseius sundi	34	1.4	62	1.9
Amblyseius tamatavensis	5	0.2	16	0.5
Euseius africanus	3	0.1	3	0.1
Euseius baetae	124	5.3	1067	33.1
Euseius bwende	24	1.0	65	2.0
Euseius fustis	796	33.9	801	24.9
Euseius magucii	85	3.6	61	1.9
Euseius neodossei	1	0.0	0	0.0
Euseius orygmus	232	9.9	81	2.5
Euseius spermahyphus	1	0.0	8	0.2
Euseius talinga	1	0.0	35	1.1
Iphiseius degenerans	762	32.4	333	10.3
Neoseiulus n. sp.	0	0.0	8	0.2
Neoseiulus baraki	1	0.0	0	0.0
Neoseiulus barkeri	2	0.1	0	0.0
Neoseiulus esculentus	0	0.0	1	0.0
Neoseiulus lula	3	0.1	0	0.0
Neoseiulus teke	5	0.2	4	0.1
Paraphytoseius horrifer	30	1.3	82	2.5
Phytoscutus gongylus	1	0.0	0	0.0
Phytoseius amba	14	0.6	14	0.4
Phytoseius ferox	0	0.0	7	0.2
Phytoseius intermedius	6	0.3	4	0.1
Proprioseiopsis cannaensis	0	0.0	2	0.1
Typhlodromalus havu	1	0.0	2	0.1
Typhlodromalus parcidentatus	0	0.0	14	0.4
Typhlodromalus saltus	116	4.9	372	11.5
Typhlodromalus spinosus	18	0.8	2	0.1
Typhlodromips rykei	7	0.3	0	0.0
Typhlodromips shi	34	1.4	130	4.0
Typhlodromus (A.) apoxys	6	0.3	0	0.0
Typhlodromus (A.) kikuyuensis	1	0.0	0	0.0
Typhlodromus (A.) malawiensis	27	1.1	6	0.2
Typhlodromus (A.) microbullatus	5	0.2	34	1.1
Typhlodromus (A.) new sp.	1	0.0	0	0.0
Typhlodromus (A.) praecutus	3	0.1	0	0.0
Typhlodromus (T.) magdalenae	0	0.0	5	0.2

Savannah zone: # fields = 35; # phytoseiid specimen = 2349; Forest zone: # fields = 30, # phytoseiid specimens = 3221. †Percentage of each species was calculated considering each ecological zone.