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Research Paper

Population dynamics of *Trioza messii* Dzokou (Hemiptera: Psylloidea: Triozidae), insect pest of *Caloncoba welwitschii* (Flacourtiaceae), medicinal plant in Cameroon

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Abstract. In the tropical regions of Africa, the factors which assure the population regulation of pests are less known. The objective of this work was to study the population dynamics of *Trioza messii* (Dzokou *et al*., 2009) and to search for the climatic factors which assure their regulation. Between January 2006 and December 2007, monthly collections of larvae, males and females of *Trioza messii* were carried out in 4 localities of the Menoua Division, Western Highlands of Cameroon. Meteorological data of the same period permitted to trace ombrothermic diagram and the curves of wind speed and insolation of Dschang. As for maturity phases, with the larvae we obtained 4 periods of 6 peaks with 4 peaks in 2006 and 2 peaks in 2007. For males, 4 periods of 9 peaks with 5 peaks in 2006 and 4 peaks in 2007. As for the females, 3 periods of 6 peaks with 3 peaks in 2006 and 3 peaks in 2007. The SPSS software was used to analyse the data. The correlation test of Spearman between the effectives of *T. messii* and the precipitations and the wind speed registered in Dschang is significant ($r = 0.616$, $p < 0.001$). The precipitations have a positive influence on the numerical variations on the effectives of *T. messii*. The wind speed has a negative influence on the numerical variations of the effectives of *T. messii* Dzokou in Dschang ($r = -0.431$, $p < 0.035$).

Keywords: *Trioza messii,* host plant, population dynamics, means of fight, Cameroon.

INTRODUCTION

Psylloids are small plant sap-sucking insect with great economic importance (Soufo *et al*., 2018; Dzokou *et al*., 2017; Yana *et al*., 2017; Malenovsky *et al*., 2007). The first instar larvae of *Trioza messii* Dzokou, Tamesse & Burckhardt (Hemiptera-Triozidae) dig small lodges on the upper surface of the leaves, their growth generates an aureole, first discoloured then brownish. This discoloured zone undergoes necrosis and drying up after the final moult of the insects.

Commelina welwitschii is a species of secondary formations. Even though man does not cultivate it, it is used in the traditional pharmacopoeia. In the Central African Republic, according to Ake-Assi *et al.* (1978), this plant is used to heal crisis of madness, abortions and sterility of both sexes. The leaves are also used to send away bees; you just need to deposit place close to a swarm of bees an important quantity of rumpled leaves (Ake-Assi *et al*., 1978). In the Republic of Congo and according to Bouquet (1985), the leaves and the bark are used to heal bronchi infections and rheumatism. The juice of the bark is a drink which heals intestinal infections.

The preliminary condition for the development of an integrated pest management relies on understanding of population dynamics of the pests (Tamesse and Messi, 2004). Riba and Silvy (1989) noted that generally, the population dynamic of pests of crops vary depending on the ecological and climatic conditions of each region. According to Milaire (1987), the interventions as they are, inspired by the studies of population dynamics permit to maintain the pest population below the economic damage threshold through reasonable chemical fight. Hence, in order to efficiently manage any pest, it is important to have information on the pullulation dynamic of the pest, its dispersion and the number of annual generations in orchards and plantations.

The population dynamics of *T. erytreae* was carried out in the regions of Transvaal (South African Republic), the Malkerns in Swaziland (Catling, 1969a, 1972), and in Burgerszhall in the West of Transvaal (Van Den Berg *et al.,* 1991b). The population dynamics of *T. erytreae* is influenced by the rhythm of foliar emissions (Catling, 1969a), maximal temperature variations, minimal relative humidity and deficiency of maximal humidity saturation in the air (Catling, 1969c) and by the natural enemies (Catling, 1969b, 1970). For the putting in place of any biological or integrated pest management, the population dynamics and the development cycle are unavoidable for its success. The works of Tamesse and Messi (2004) studied the factors influencing the population dynamics of African psylla on citrus plants *T. erytreae* in the locality of Yaounde; Noubissi *et al*. (2016) in studying the influence of climatic factors on the population dynamics of *Phytolyma fusca*, pest of *Milicia excelsa* (Rosales: Moraceae) in Cameroon, found 3 periods of proliferation made of 7 generations of pests in 2009 (February-April, August-October, November-December). In 2010, they obtained 3 periods of pullulation made up of 6 generations of pests (January-February, May-September and November-December).

For many other important pests, this work is still to be done in the main eco climatic zones of Cameroon. The present work carried out in one of the localities of the Western Highlands is our contribution for all strategies of biological or integrated pest control in Cameroon.

MATERIALS AND METHODS

In 2006 and 2007, larvae, males and females of *T. Messii* were collected from 20 wild stems of *Caloncoba welwitschii* in 4 localities in the Menoua Departement in Dschang (10°04'N, 5°26'E, 1385 m) (Fongo-Tongo, Foréké, Dschang-Ville and Foto). Regular visits of at least once a month were done. *T. messii* was captured with the aid of an entomological net and a mouth aspirator and introduced in tubes containing 70% ethanol. As many *T. messii* as possible were collected on individual stems of *C. welwitschii*. In the laboratory, they are sorted into larvae, adult males and females and counted under a binocular lens. The insects are preserved in 70% ethanol at the Laboratory of Zoology of the University of Yaounde I (LZUY) and the Research Unit of Phytopathology and Agricultural Zoology (UR_PHYZA), laboratory of Agricultural Zoology of the University of Dschang. Data was collected on the population dynamics by recording the number of each stage, the number of generations and their peak periods. Based on earlier studies carried out in Austral Africa, population peaks are clearly separated by about 28 days, which corresponds to separate generations. Meteorological data of the years 2006 and 2007 were obtained from the Institute of Agricultural Research for Development (IRAD), Dschang. The software SPSS was used to analyse the results. The correlation test of Spearman was used to appreciate the numeric variations of maturity stages of the pest.

RESULTS

Ombrothermic diagram of Dschang (2006 and 2007)

The data obtained in Figure 1 show 6 months of dryness during the two years of the study. The month of September is the rainiest with respectively 305.9 mm during 26 days in 2006 and 319 mm during 25 days in 2007. It is accepted that dryness declared when precipitations are inferior to 50 mm for a given month. They are the months of November, December and January for the year 2006 and December, January and February for the year 2007. January and February 2006 are the warmest with respectively 29.2 and 29°C and the less warm months those of July (25.6°C) and August (25°C). As for the year 2007, the months of February (30.4°C) and March (30.3°C). The months of July and August 2007 are less warm with 25.1°C each.

Wind speed curves and insolation in the locality of Dschang (2006 and 2007)

The wind speed curve (Figure 2) shows that the maximal speed was 1890.1 m/s in December 2007 and the minimal speed 531.5 m/s in August 2006. The maximal insolation (Figure 2) was observed in January 2007 with a value of 224.7 H1/10 for 31 days. The months of February 2006 and August 2007 were the less sunny with

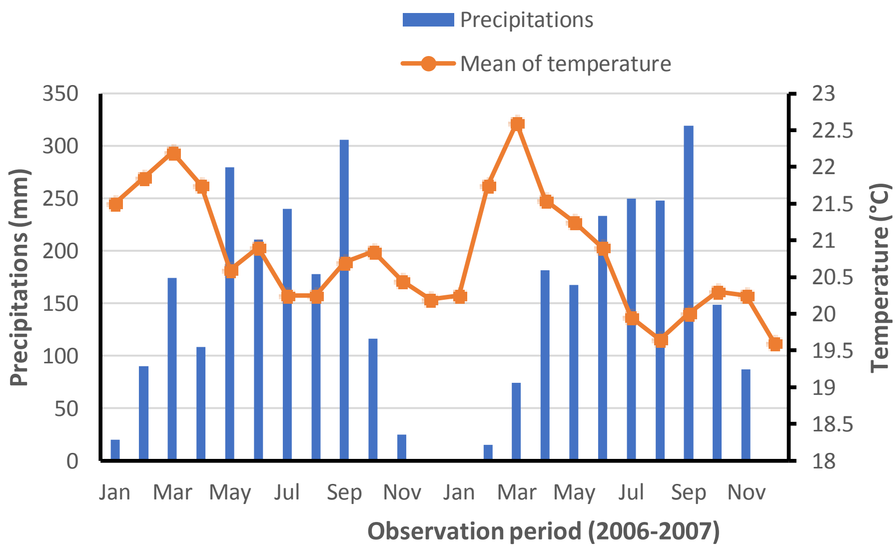

Figure 1. Ombrothermic diagram of the locality of Dschang (years 2006 and 2007).

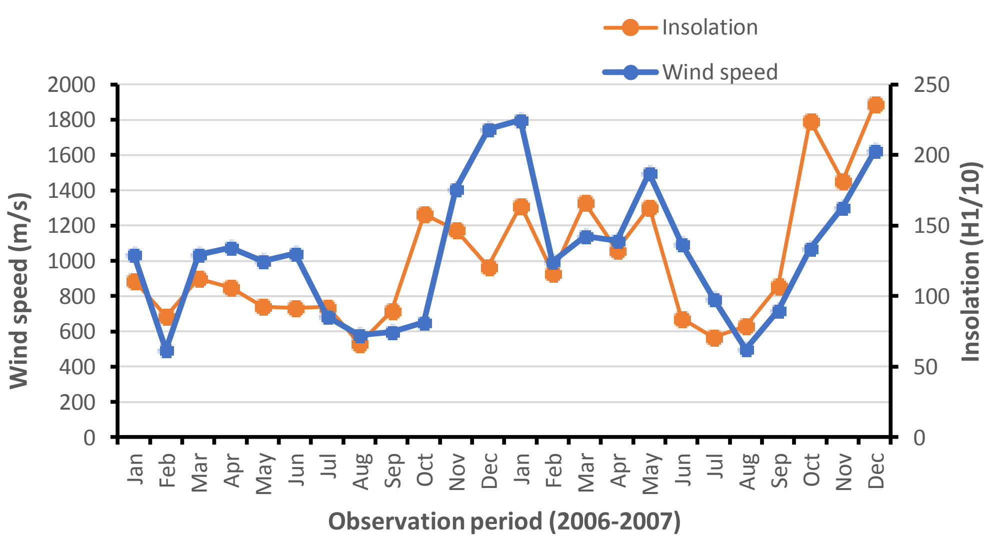

Figure 2. Curves of the wind speed and the insolation in the locality of Dschang (years 2006 and 2007).

respectively 61.9 H1/10 for 24 days and 62.5 H1/10 for 26 days.

Faunistic and population dynamics of *Trioza messii*

Between January 2006 and December 2007, 458 individuals (188 males, 190 females, 80 larvae) were collected in 4 localities of Menoua. Psyllids were present 23 times on 24 visits carried out at least once every month, hence a frequency of 95.83%. *T. messii* is common in the Menoua, Noun, High Plateaus and Bamboutos. Its host plant has a broad distribution. The shoots observed on the cut trunks could also justify the frequency of psyllids.

T. messii, psyllid of *C. welwitschii* (Flacourtiaceae). **Fongo-Tongo:** 23 i 2006, 5 males, 7 females, 3 larvae; 21 iii 2006, 6 males, 5 females, 5 larvae; 23 iv 2006, 4 females; 2 x 2006, 3 males, 5 females, 3 larvae; 4 i 2007, 1 males, 3 females, 3 larvae; 20 iv 2007, 10 males, 12 females, 8 larvae; 8 xi 2007, 1 male, 4 females, 4 larvae. **Foreke:** 4 ii 2006, 10 males, 6 females, 4 larvae; 3 v 2006, 39 males, 41 females; 16 xi 2006, 7 males, 5 females, 3 larvae; 27 xii 2006, 7 males, 6 females, 5 larvae; 8 ii 2007, 4 males, 3 females, 1 larva; 9 vi 2007, 9 males, 5 females, 7 larvae; 15 viii 2007, 6 males, 8 females, 5 larvae. **Dschang-Ville:** 23 iv 2006, 7 males, 9 females ; 21 vii 2006, 11males, 12

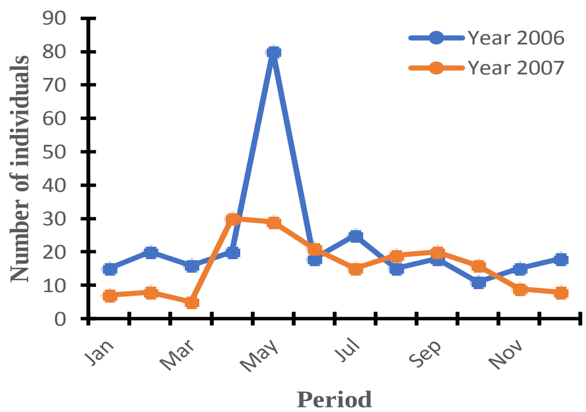

Figure 3. Population dynamics of *Trioza messii* on *C. welwitschii* in the zone of Dschang from January 2006 to December 2007.

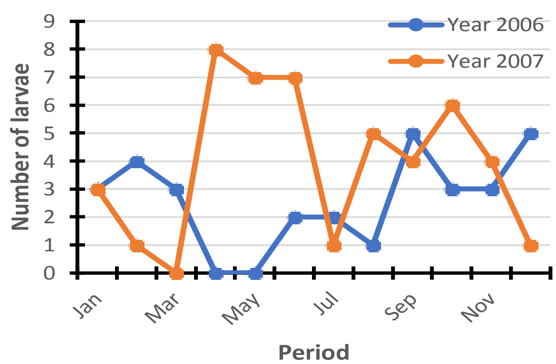

Figure 4. Abundance of *Trioza messii* larvae on *C. welwitschii* in the zone of Dschang from January 2006 to December 2007.

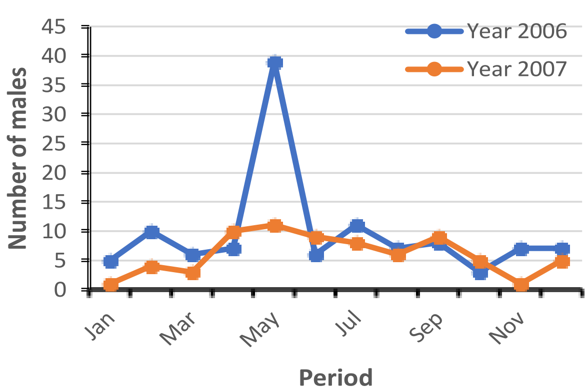

Figure 5. Abundance of males of *Trioza messii* on *C. welwitschii* in the zone of Dschang from January 2006 to December 2007.

females, 2 larvae; 2 viii 2006, 7 males, 7 females, 1 larva; 17 v 2007, 11 males, 11 females, 7 larvae; 21ix 2007, 9 males, 7 females, 4 larvae. **Foto:** 22 vi 2006, 6 males, 10 females, 2 larvae; 17 ix 2006, 8 males, 5 females, 5 larvae; 15 iii 2007, 3 males, 2 females ; 10 vii 2007, 8 males, 6 females, 1 larva ; 10 x 2007, 5 males, 5 females, 6 larvae ; 16 xii 2007, 5 males, 2 females, 1 larva.

Effects of temperature on the numerical variations of *T. messii*

The Spearman correlation test between the numerical variations of individuals of different stages of development of *T. messii* (figures 3, 4, 5 and 6) and the temperature was: r = -0.009, p = 0.9 for larvae; r = -0.007, p = 0.9 for males; r = 0.016, p = 0.9 for females; r = 0.08, p = 0.7 for all the individuals. According to the Spearman correlation test (Table 1), the correlation coefficient (r) is negative and non-significant with the larvae and the males of *T. messii*; it is positive and non-significant with the females and all the individuals in the present study.

Effects of rainfall on the numerical variations of *T. messii*

Spearman correlation between the numerical variations of individuals of different stages of development of *T. messii* (figures 3, 4, 5 and 6) and the rains were: r = 0.25, p = 0.2 for larvae; r = 0.62, p= 0.001 for males; r = 0.54, p = 0.006 for females; r = 0.62, p = 0.001 for all the individuals. According to the Spearman correlation test (Table 1), we noted that the correlation coefficient (r) was positive and non-significant with the larvae; the correlation is positive and significant with the males, the females and all the individuals. The numerical variations of males, females and the total individuals are correlated with rainfall. The rains should have a positive effect on the development of these maturity stages of *T. messii* in Dschang.

Effects of insolation on numerical variations of *T. messii*

The Spearman correlation test between the numerical variations of the individuals of the different development stages of *T. messii* (Figures 3, 4, 5 and 6) and insolation were: r = -0.019, p = 0.9 for the larvae; r = -0.26, p = 0.2 for the males; r = -0.3, p = 0.1 for the females; r = -0.23, p = 0.2 for all the individuals. According to the Spearman correlation test (Table 1), we noted that the correlation coefficient (r) was negative and non-significant for all the development stages of *T. messii* in Dschang.

Effects of wind speed on the numerical variations of *T. messii*

The Spearman correlation between the numerical

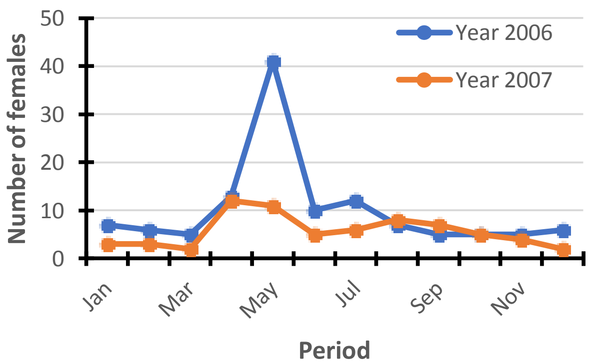

Figure 6. Abundance of females of *Trioza messii* on *C. welwitschii* in the zone of Dschang from January 2006 to December 2007.

variations of the individuals of the different stages of development of *T. messii* (Figures 3, 4, 5 and 6) and the wind speed was: r = -0.03, p = 0.8 for the larvae; r = -0.51, p = 0.01 for the males; r = -0.49, p = 0.01 for the females; r = -0.43, p = 0.03 for all the individuals. After the Spearman correlation test (Table 1), we noted that coefficient (r) is negative and non-significant for larvae. For the males, females and the total individuals (Figures 3, 5 and 6), the correlation coefficient (r) is negative and significant ($p < 0.05$).

Nature of damages caused on the host plant

The first instar larvae of psyllid of *C. welwitschii* move actively in search of a favourable site for its development and food capture on the upper surface of the leaves. The leaves appear turgid; the small lodges are surrounded with an aureole with the diameter increasing with the development of the larva and the volume of the foliar surface. This aureole, first discoloured becomes brownish at the end. This discoloured zone undergoes necrosis and dries off slightly after the last moult of the insects. The leaves highly attacked, carrying necrotic spots, dries off and falls.

DISCUSSION

The study of the population dynamics of *T. messii* (Figure 3) permitted to identify in 2006, 5 peaks which we could consider as 5 different generations of this pest which feeds depending on young leaves and buds of *C. welwitschii* in Dschang. In 2007, the number of peaks observed was 2, hence corresponding only to 2 generations. All the population peaks observed in 2007 have, except for the larvae, a low amplitude compared to the peaks observed in 2006. The highest peak was obtained in May 2006. The number of generations of *T. messii* varies from one year to another, 5 in 2006 and 2 in 2007. Cobbinah (1986) reports that in *Phytolyma lata* (Hemiptera: Homotomidae), the number of generations can reach 10 or more per year; this same author affirms that the number of generations varies from one year to another. This observation was done by other authors on the population dynamics of psyllids in the region of Yaounde in Cameroon: case of psyllid of citrus plants, *Trioza erytreae* (Tamesse and Messi, 2004); of *Diclidophlebia eastopi* and of *Diclidophlebia harrisoni*, psyllid of *Triplochiton scleroxylon* (Noubissi Youmbi *et al*., 2014); of *Pseudophacopteron* spp., psyllids of *Dacryodes edulis* (Mapon Nsangou and Tamesse, 2014); of *Blastopsylla occidentalis*, psyllid of Eucalyptus (Soufo and Tamesse, 2015). Noubissi Youmbi *et al*. (2016) obtained, while studying the population dynamics of *Phytolyma fusca* on *Milicia excelsa* (Moraceae), 7 generations in 2009 against 6 in 2011.

Generally for this study, the number of larvae collected is low with the highest number of larvae obtained in April and September of 2007. Six peaks were obtained for these larvae, with 4 peaks in 2006 and 2 peaks in 2007, this corresponds to 6 generations of larvae for the 2 years of study. The larval stages cause more damage as recognised by Tamesse *et al*. (2007), especially the fixed stages from the second instar (Dzokou *et al*., 2009a, b). We observed that the new shoots of *C. welwitschii* lost the great majority of their leaves attacked. Noubissi *et al*. (2016) observed that the host plant of *P. fusca* of 3 to 4 years of age did not die after the attacks of psyllid, but remained vulnerable. Climatic factors like rainfall and wind speed greatly influence the abundance of specific developmental stages of *T. messii*. The Spearman correlation test showed a significant correlation between the males and females adults as well as all the individuals and the rains on one side, the wind speed on the other side. The correlation coefficient r is negative for the wind speed. The wind speed has a negative influence on the population dynamics of *T. messii* in Dschang. The wind, by its mechanical action, could have helped in cleaning the surface of the leaves and displaced the adult individuals from their host, *C. welwitschii*. According to Tamesse and Messi (2004), the wind constitutes a means of passive transport which favours the dispersal of adults of *T. erytreae*, from one citrus orchard to another in the locality of Yaounde. These observations on the role of wind speed are in accordance with those obtained in this present work in Dschang. As for the larvae, the correlation coefficient is negative and non-significant; we could say that the larvae in their small lodges are protected from wind. The Spearman correlation is positive between the numerical variations of the adults of *T. messii* and the rains in Dschang. In effect, the foliar emissions most of the times depend on rainfall, dry seasons corresponding to periods of vegetative rest. The works of Van Den Berg *et al*., (1991a) showed that the foliar emissions were positively correlated with the quantity of rains in South Africa. According to the values

Table 1. Spearman correlation test between the developmental stages of *T. messii* and some climatic parameters in Dschang from January 2006 to December 2007.

Parameters		Developmental stages			
		Larvae	Males	Females	Total individuals
Temperature	r	-0.009	-0.007	0.016	0.08
	P	0.9	0.9	0.9	0.7
Rains	r	0.25	0.62	0.54	0.62
	P	0.2	0.001*	0.006*	0.001*
Insolation	r	-0.019	-0.26	-0.3	-0.23
	P	0.9	0.2	0.1	0.2
Speed of the wind	r	-0.03	-0.51	-0.49	-0.43
	P	0.8	0.01*	0.01*	0.03*

*= significant

of the Spearman correlation test (Table 1), the correlation coefficient is either positive, either negative, but non-significant for the temperatures, negative and non-significant for insolation. But, it will be difficult to think that the temperature variations and of insolation do not have an influence on the population dynamics of *T. messii*.

CONCLUSION

Trioza messii Dzokou is an important pest of *C. welwitschii* in the Western Highlands of Cameroon. The females of *T. messii* lay their eggs on the young leaves and the buds of the host plant. After hatching, the first instar larvae digs small lodges on the upper part of the organs of the host plant. The size of the small lodges increases with the growth of the larvae. After the final moult to adult, the highly discoloured leaves become brownish and fall. The abundance of the individuals of the different development stages showed 5 different generations of *T. messii* in 2006 and 2 generations in 2007. Abiotic factors like rainfall, wind speed, temperature, insolation have to various degrees, influenced the population dynamics of the pest in Dschang. The host plant phenology could be one of the factors influencing the population dynamics of *T. messii*. Integrated control should take into consideration the periods of high population of the pest in its control strategy in the Western Highlands of Cameroon.

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