Population dynamics of *Cacopsylla* sp. (Hemiptera: Psylloidea: Psyllidae), pest insect of *Prunus africana* (Rosaceae), medicinal plant species in Cameroon

Dzokou Victor Joly*  
Department of Crop Protection (UR_PHYZA), Faculty of Agronomy and Agricultural Sciences, University of Dschang, P.O. Box 222 Dschang, Cameroon  
Yana Wenceslas  
Laboratory of Biological Sciences, Faculty of Sciences, University of Bamenda, P. O. Box 39 Bambili, Cameroon  
Soufo Laurentine  
Department of Biological Sciences, Faculty of Sciences, University of Maroua, P.O. Box 814 Maroua, Cameroon  
Tamesse Joseph Lebel  
Department of Biological Sciences, Higher Teachers’ Training College, University of Yaoundé I, P.O. Box 47 Yaoundé, Cameroon  
*Corresponding author. E-mail: dzovijo@yahoo.fr

**Abstract**

*Prunus africana* is threatened in Cameroon by xylophagous and sap-sucking pest as *Cacopsylla* sp. This last causes deformations of the young leaves and buds and the plant end up losing all its leaves. Effective control of phytophagous pests requires a thorough understanding of their seasonal population dynamics. The objective of this work carried out on 150 young plants of *P. africana* in the nursery in Dschang, was to study the population dynamics of *Cacopsylla* sp. and the impact of climatic factors on the population. From January 2006 to December 2007, monthly collections of larvae, males and females of *Cacopsylla* sp. were carried out. The results showed, in 2006, three peaks (March, August and December) and two peaks in 2007 (March and August) with larvae. The fluctuation of males’ population showed five peaks with two peaks in 2006 (March and December) and three peaks in 2007 (March, June and December) while in females’ population, four peaks with two peaks in 2006 (March and December) and two peaks in 2007 (March and November). The annual numerical variation of *Cacopsylla* sp. individual is statistically correlated with variation of precipitations and the insolation. The precipitations have a negative effect on the numerical variation of males (r=−0.430, p<0.0360) and females (r=−0.434, p<0.0336) of *Cacopsylla* sp. The insolation has a positive effect on the numerical variation of males (r=0.732, p<0.0000002), females (r=0.653, p<0.000523) and the total individuals (r=0.601, p<0.00197) of *Cacopsylla* sp. With the larvae, the correlation was negative and non-significant. This work showed that March and December were better indicated to engage the fight against *Cacopsylla* sp. in Dschang.

**Keywords**: *Cacopsylla* sp., climatic factors, pest population, *Prunus africana*, Cameroon

**INTRODUCTION**

*Cacopsylla* Ossiannilsson is a Central-Asian and European species of the genus *Cacopsylla* (Lauterer, 1999) with over 450 described species (Ouvrard, 2018). For 12 species recorded from Iran, 8 species are recorded on Rosaceae, 2 species on Rhamnaceae and 2 species on Salicaceae (Burckhardt and Lauterer, 1993; Zendedel et al., 2016). Certain species of the *Cacopsylla* genus are vectors of diseases. *C. pruni* is the vector of the European stone fruit yellows (ESFY) phytoplasma disease caused by pathogen ‘Ca. Phytoplasma prunorum’. This ESY induces serious damages in cherry, sour cherry, peach, and apricot orchards, mostly in Europe (Bodnár et al., 2018). According to Hodkinson (2009), plum psyllid is strictly oligophytophagous feeding on *Prunus* spp. and overwintering on conifers (*Picea abies, Pinus sylvestris*) and other evergreen plants. Plum psyllid is a serious pest because both mature and immature males and females can easily transmit phytoplasma in a persistent manner by feeding on the phloem (Carraro et al., 2004). In Cameroon, several authors undertook work on the population dynamics of the psyllid pests: *Triozoa erytreae*, African citrus psyllid (Tamesse and
Messi, 2004); *Pseudophacopteron* spp., psyllid of *Dacryodes edulis* (Mapon et al., 2014); *Dici- 
dophlebia eastopi* and *Diciophlebia harrisoni*, psyllid of *Triplochiton scleroxylon* (Noubissi et al., 2014); *Blastopsylla occidentalis*, psyllid of Euca-
lypts (Souto and Tamesse, 2015); *Phytolyma fusca*, psyllid of *Milicia excelsa* (Noubissi et al., 2016). In the cameroonian orchards, *T. erytreae* (Hemiptera; Psylloidea: Triozidae) generates pit 
galls on the upper face of the attacked leaves during its larval development (Tamesse et al., 1999). Tamesse and Messi (2002) observed that the young seedlings of Citrus were attacked by *T. erytreae* 4 months only after germination. Those plants were stunted, and their leaves greatly de-
formed. According to the same authors, in the absence of pest management in the citrus nur-
ery, citrus psylla can cause the loss of up to 91 % of young plants. In South Africa, Ethiopia, Rwan-
da, Burundi, Malawi and Cameroun, this psyllid species is a vector of "greening" or Huanglong-
bing, a disease of degeneration of citrus fruits (Aubert et al., 1988).

*Cacopsylla* sp. is a sap-sucking insect of *Prunus africana* (Rosaceae) in Dschang. It induces de-
formations of the leaves and buds, as well as necrosis. The survey carried out by Dzokou (2010) notices the presence of another species on *Pittosporum viridiflorum* (Pittosporaceae) at Lingang, Menoua division. The feeding of the adults and especially of the larvae causes the irreversible rolling up of the leaves of the host plant which lodge at the same time the larvae. The control of psyllid pests has for many years relied on the use of insecticides, but nowadays, following increasingly severe restrictions concern-
ing the application of chemicals, Integrated Pest Management (IPM) has become the most suc-
cessful alternative. This was reported by Civolani et al. (2010), Civolani and Pasqualini (2003), 
Erler (2004) concerning the control of *Cacopsylla pyri* (pear psyllid), Sanchez and Ortin-Angulo 
(2012) concluded at the end of their studies on the control of *Cacopsylla pyri* that natural ene-
mies offer a good opportunity to develop biological and IPM programmes based on conservation of the native fauna in pear orchards in southern Spain. According to Wang (1981), Tsai et al. (2002), Aubert (1987), the three main weather factors influencing the development of *Diaphori-
a citri* populations are temperature, relative hu-
midity and rainfall.

*P. africana* is an endemic species of the afro-
mountain forests of Africa and Madagascar. Its ecological milieu generally ranges between 900 
and 3000 m of altitude, in particular, the High-
lands of the West, Mount Cameroon, Adamawa, 
Bakossi mounts and some species domesticate in Centre Region of Cameroun. This species unveils an economic, social and scientist importance for

the local populations and the international commu-
nity. Its barks are used in western pharmaceutical 
industries to look after the benign hypertrophy of the prostate (Tasse, 2006). *P. africana* is classi-
ified by the International Union for the Nature Con-
servation as a rare and vulnerable species be-
cause of continues degradation of its ecosystem 
related to the strong pressure exerted on the re-
source and the application of the nondurable methods of harvest. Awono et al. (2015) underline 
the threats weighing on *P. africana* in the North-
west and South-west regions of Cameroon be-
cause of its overexploitation. But the threats due 
to the pest insects are not signalled by those au-
thors. *P. africana* is in domestication in Cameroun 
outwards its natural distribution area. But this fact 
facing threats of the various pests among which one is *Cacopsylla* sp. It is thus a question of hav-
ing an idea about the evolution of this pest over different years. The objective of this study was to 
search the strong pullulating periods of the pest populations and the climatic factors which regulate 
them over the years for a better control strategy.

**MATERIALS AND METHODS**

From 2006 to 2007, larvae, males and females of *Cacopsylla* sp. were collected from 150 young 
plants of *P. africana* in the nursery in Dschang 
(10° 04’N, 5° 26’E, 1385 m). Regular visits of at 
least once a month were done. *Cacopsylla* sp. 
was captured with the aid of an entomological net 
and a mouth aspirator and introduced in tubes 
containing 70% ethanol. The maximum possible of 
*Cacopsylla* sp. individuals were collected on the 
whole young *P. africana*. In the laboratory, they 
were sorted into larvae, adult males and females 
and counted under a binocular lens. Insects are 
preserved in 70% ethanol at the Laboratory of Zoology of the University of Yaounde 1 (LZUY) 
and the Research Unit of Phytopathology and Ag-

cultural Zoology (UR_PHYZA), Laboratory of 
Agricultural Zoology of the University of Dschang 
(LAZUDs). Two males, 2 females and 2 larvae 
from the same collection were deposited in the Naturhistorisches Museum Basel, Switzerland 
(NHMB). Data was collected on the population dyn-
amics by recording the number of each stage, 
the number of generations and their peak periods. 
Based on earlier studies carried out in Austral Afri-
ca, population peaks were clearly separated by 
about 28 days, which corresponds to separate 
generations. Meteorological data (Table 1) of the 
years 2006 and 2007 of the study site were ob-
tained from the Institute of Agricultural Research 
for Development (IRAD), Dschang. The software 
SPSS version 16.0 was used to analyse the re-

dults. The correlation test of Spearman was used 
to appreciate the numeric variations of different 
pest stages. Excel program was used to produce 
diagrams.
RESULTS

Faunistic and population dynamics of Cacopsylla sp.: The 24 monthly visits at Dschang, the psyllids were regularly met, corresponding to a frequency of 100%, with 426 individuals (145 males, 139 females, 142 larvae). Cacopsylla sp. (Fig. 1) was a very frequent species known in Menoua Division. Cacopsylla sp., psyllid of Prunus africana (Rosaceae). Dschang: 13 January 2006, 4 ♂, 8 ♀, 2 larvae; 4 February 2006, 2 ♂, 4 ♀, 2 larvae; 9 March 2006, 16 ♂, 25 ♀, 18 larvae; 23 April 2006, 9 ♂, 7 ♀, 3 larvae; 3 May 2006, 7 ♂, 5 ♀, 4 larvae; 22 June 2006, 7 ♂, 7 ♀, 1 larva; 9 July 2006, 3 ♂, 2 ♀, 4 larvae; 2 August 2006, 4 ♂, 1 ♀, 7 larvae; 27 September 2006, 2 ♂, 6 larvae; 23 October 2006, 1 ♂, 1 ♀, 2 larvae; 25 November 2006, 8 ♂, 5 ♀, 1 larva; 3 December 2006, 23 ♂, 16 ♀, 58 larvae; 8 January 2007, 5 ♂, 6 ♀, 2 larvae; 8 February 2007, 3 ♂, 2 ♀; 17 March 2007, 9 ♂, 7 ♀, 6 larvae; 10 April 2007, 6 ♂, 5 ♀, 2 larvae; 17 May 2007, 5 ♂, 5 ♀, 2 larvae; 27 June 2007, 6 ♂, 4 ♀, 1 larva; 10 July 2007, 3 ♂, 5 ♀, 5 larvae; 15 August 2007, 2 ♂, 2 ♀, 6 larvae; 21 September 2007, 3 ♂, 4 ♀, 2 larvae; 11 October 2007, 3 ♂, 3 ♀, 1 larva; 8 November 2007, 7 ♂, 7 ♀, 2 larvae; 21 December 2007, 9 ♂, 6 ♀, 5 larvae.

The first peaks were observed in March 2006, two months only after the beginning of the rains. In March, the rains were average, whereas in December, the rains were null and the insolation maximal. Also, the largest peak of females was located in March 2006. The lifting of dormancy of the buds began with the arrival of rains. The second peak of the adults was observed in December 2006, in the high dry season. Indeed, there were no rains in December 2006 and January 2007 in Dschang (Fig. 2).

Ombrothermic diagram of Dschang (2006 and 2007): From the diagram (Fig. 3), we had 6

| Factors & Years | Temperature (°C) | Precipitations (mm) | Insolation (H 1/10) | Wind speed (m/s) |
|-----------------|-----------------|----------------------|---------------------|-----------------|
|                 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Months          |      |      | Qt   | ND   | Qt   | ND   | Qt   | ND   |
| January         | 21.5 | 20.25| 19.9 | 02   | 0    | 0    | 129.2| 28   |
| February        | 21.85| 21.75| 90.2 | 08   | 15.2 | 02   | 61.9 | 24   |
| March           | 22.2 | 22.6 | 174.2| 14   | 74.4 | 08   | 129.2| 24   |
| April           | 21.75| 21.55| 108.3| 13   | 181.7| 22   | 134.4| 28   |
| May             | 20.6 | 21.25| 279.8| 25   | 167.7| 16   | 124.8| 28   |
| June            | 20.9 | 20.9 | 210.5| 14   | 233.3| 20   | 130.4| 27   |
| July            | 20.25| 19.95| 240.2| 24   | 249.6| 22   | 85.5 | 29   |
| August          | 20.25| 19.65| 177.6| 22   | 248.2| 24   | 72.5 | 24   |
| September       | 20.7 | 20   | 305.9| 26   | 319.0| 25   | 74.6 | 26   |
| October         | 20.85| 20.3 | 116.2| 22   | 148.6| 25   | 81.2 | 27   |
| November        | 20.45| 20.25| 24.6 | 07   | 86.7 | 12   | 175.8| 30   |
| December        | 20.2 | 19.6 | 0.0  | 0    | 0.8  | 01   | 218.5| 30   |

Qt: Quantity, ND: Number of Days

Table 1. Meteorological data of Dschang years 2006-2007 obtained from the Institute of Agricultural Research for Development (IRAD).

Fig. 1: Cacopsylla sp., A: male; B: female; C: first instar larva.
months of dryness than 3 months per year. It is noticed that dryness is signalled when precipitations are inferior to 50 mm for a given month. Dryness occurred the months of November, December and January for the year 2006 and December, January and February for the year 2007. The month of September is considered as the month with most precipitations with 305.9 mm during 26 days in 2006 and 319 mm during 25 days in 2007. The months of January and February 2006 were the warmest with respectively 29.2°C and 29°C while the less warm months were 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) while the less warm months were July and August with 25.1°C each.

Wind speed and insolation variation in the locality of Dschang (2006 and 2007): The wind speed data showed that the maximal speed is 1890.1 m/s in the month of December 2007 and the minimal speed of 531.5 m/s in the month of August 2006. The maximal insolation was observed in the month of January 2007 with a value of 224.7 H1/10 during 31 days. The months of February 2006 and August 2007 were the less sunny with respectively 61.9 H1/10 during 24 days and 62.5 H1/10 during 26 days.

Effects of rainfall on the numerical variations of Cacopsylla sp.: The correlation of Spearman between the numerical individuals variation of different developmental stages of Cacopsylla sp. and the rainfall (Fig. 4) was: $r = -0.430$, $p = 0.0360$ for males; $r = -0.434$, $p = 0.0336$ for females; $r = 0.412$, $p = 0.847$ for larvae; $r = -0.369$, $p = 0.0746$ for the total. According to the correlation test (Table 2), correlation coefficient (r) was negative and significant with the variation of males and females individuals with the variation of rainfall. The numerical variations of males and females Cacopsylla sp. were correlated with rainfall. This means less abundance precipitation induced the increase of adults individuals of Cacopsylla sp. The correlation coefficient (r) was positive and non-significant for the larvae and the whole individuals, respectively.

Effects of insolation on numerical variations of Cacopsylla sp.: The Spearman correlation test between the numerical variations of the individuals of the different developmental stages of Cacopsylla sp. and insolation (Fig. 5) were: $r = -0.171$, $p = 0.421$ for the larvae; $r = 0.732$, ddl= 24, $p = 0.0000002$ for the males; $r = 0.653$, $p = 0.000523$ for the females; $r = 0.601$, $p = 0.00197$ for the whole individuals. According to the correlation test (Table 2), the correlation coefficient (r) was negative and non-significant with larvae; positive and very highly significant with males and females; positive and highly significant with the whole individuals of Cacopsylla sp.

Effects of temperature on the numerical variations of Cacopsylla sp.: The Spearman correla-

Fig. 2: Abundance of males, females and larvae of Cacopsylla sp. on P. africana and the temperature variation in Dschang from January 2006 to December 2007.

Fig. 3: Ombrothermic diagram of the locality of Dschang (years 2006 and 2007).

Fig. 4: Abundance of males and females of Cacopsylla sp. on P. africana and the precipitations variation in Dschang from January 2006 to December 2007.
tion test between the numerical variations of individuals of different developmental stages of *Cacopsylla* sp. and the temperature was: \( r = -0.104, p = 0.626 \) for larvae (Fig. 6); \( r = 0.239, p = 0.257 \) for males; \( r = 0.324, p = 0.121 \) for females; \( r = 0.138, p = 0.515 \) for total individuals. According to the correlation test (Table 2), the correlation coefficient (\( r \)) was negative and non-significant with the larvae; it was positive and non-significant with the males, females and the whole individuals in our area of study. This meant annual numerical variation of *Cacopsylla* sp. was not directly linked with the annual variation of temperature.

**Effects of wind speed on the numerical variations of *Cacopsylla* sp.:** The Spearman correlation between the numerical variation of individuals of different stages of development of *Cacopsylla* sp. and the wind speed was: \( r = -0.253, p = 0.230 \) for the larvae; \( r = 0.171, p = 0.419 \) for the males; \( r = 0.0721, p = 0.734 \) for the females; \( r = 0.0514, p = 0.809 \) for the total individuals. According to the correlation test (Table 2), the correlation coefficient (\( r \)) was negative and non-significant for larvae. For the males, the females and the total individuals, the correlation coefficient (\( r \)) was positive and non-significant. This meant annual numerical variation of *Cacopsylla* sp. individuals was not directly linked with the annual variation of wind speed.

**Impact of damages caused by *P. africana* (Rosaceae):** The psyllids attacked the young leaves and buds in the nursery. The leaves lodging the young larvae became deformed while being folded upon their lower faces. These deformations were followed by the drying of the bodies attacked after the last moult of the insects. The larvae produced a white wax which appeared at the end of the anal pore. The damage in the nursery was remarkable since young plants of 3 month-old lodged the adults and the larvae of psyllids.

**DISCUSSION**

The numerical fluctuations of the populations of *Cacopsylla* sp. enabled us to identify in Dschang
in 2006, 2 annual generations and 2 others in 2007. The presence of young buds and young leaves on *P. africana* would at least partly explain the abundance of the adult stages in March. We noticed that the number of annual generations of psyllid did not vary from one year to another. However, the 2 generations of 2006 had more significant peaks. The results were contrary to the findings of Noubissi et al. (2016) who had indicated that the numbers of the generation of *Phytolyma fusca* varied from one year to another in Yaounde. The same statement was made by various authors studying the population dynamic of psyllids in the same region (*Diclidophlebia eastopi* and *D. harrisoni* (Noubissi et al., 2014); *B. occidentalis* (Soufo and Tamesse, 2014); and *Pseudophacopteron* spp. (Mapon and Tamesse, 2014). The number of generations of psyllid species varied with the geographical location of the host plant. *Cacopsylla* sp. presented two annual generations in West region of Cameroon, while in the centre region of Cameroon, the species presented three generations; the first generation appeared in February and disappeared in June, second appeared in June and disappeared in August, while the third appeared on October and disappeared on February (Yana, 2012). The number of generations of psyllid species also can vary with the psyllid species and for a year to another. The number of generations found by Tamesse and Messi (2004) was 8 in 1992 and 3 in 1993 on the citrus psyllid in Yaounde. This can be explained by the fact that climate change affected the stability of climatic factors and the phenology of the host plant, which directly links with the fluctuation of psyllid populations. Aubert (1988) stated that *D. Citri* mortality increased with higher rainfall and relative humidity, but it was very low under hot and dry climates. The numerical variations of males, females and the total individuals were correlated with insolation. The increasing of insolation induced the increase of the number of adults of *Cacopsylla* sp. in Dschang. The correlation coefficient (r) was negative and non-significant with the larvae. This means annual numerical variation of larvae was not directly linked with the annual variation of insolation. From early April in 1999 and 2000, according to Teck et al. (2011), generations of adult and nymph of *D. citri* were increased progressively, and population density increased exponentially as the dry season (April to September) progressed in Sarawak. The greatest number of larvae was met in December 2006. For the same period, the wind speed was maximum, the temperature and the insolation were average, whereas precipitations were null. Teck et al. (2011) on the seasonal population dynamics of *Diaphorina citri* (Hemiptera-Psylilidae-Diaphoriniinae) in Sarawak showed higher population of larvae during the rainy season than during the dry season but heavy rainfall reduced population of larvae because eggs, first and second instar nymphs, were washed from October 1999-January 2000 in Sarawak. This was similar to what we observed with *Cacopsylla* sp. where heavy rainfall occurred on September 2006 and 2007 in Dschang, and the number of larvae was very low during September. Also advanced larvae stages (L4 to L5), which moved on the organs of the host plant in search of food, would be washed by heavy rainfall. According to De Queiroz et al. (2012), the decrease of *Glycapi brimblecombei* (Hemiptera-Psylilidae-Spondylaspidinae) population observed in São Paulo, Brazil at the end of spring, and beginning of summer in 2003, was attributed to the heavy rainfall. Other factors not taken into consideration in this work would control the numerical variation of *Cacopsylla* sp. larvae in Dschang. Evidently, the presence of parasitoids and predators of *Cacopsylla* sp. had an impact on its population. The correlation was negative and significant between the adult stages of *Cacopsylla* sp. and precipitations. This abundance of the adults can be explained by this absence of rains whose presence would impact negatively on the adults of *Cacopsylla* sp. This is why the adult populations of *Cacopsylla* sp. were weak between May-September 2006 and Avril-October 2007, which corresponded to the rainiest periods. Also, Tamesse and Messi (2004) showed that the populations of *T. erytreae* were higher between December and March during the dry season and lowered between September and November during the dry rainy season in Yaounde. The coefficient of correlation (r) was negative and non-significant for the wind speed. The results of the present study showed that there was a correlation between the annual variation of insolation, rainfall and *Cacopsylla* sp. population variation. This corroborated what was noticed on citrus orchards in Abohar-India for *D. citris* by Arora et al. (1997), but different than that was observed in Yaounde on *P. africana* by Yana (2012) where no climatic factor was correlated with numerical variation of *Cacopsylla* sp.

**Conclusion**

In Dschang, *Cacopsylla* sp. populations could colonise and breed on *P. africana* trees throughout the year (2006-2007). During the two years of study, generations with a higher number of individuals were obtained in March and December months. The current study showed that the beginning of the rain season in March favoured increasing adult populations of *Cacopsylla* sp. through the lifting of dormancy of the buds of *P. africana*. The correlation values from the present studies showed that the insolation and rainfall appeared to have a greater impact on *Cacopsylla* sp. population than temperature and wind speed. Any biolog-
ical or integrated pest management against this significant pest of *P. africana* in the Western Highlands of Cameroon should take into consideration these periods of strong concentrations of the pest. It is suggested that, in addition to the climatic factors, the physiological state of the trees, the edaphic conditions and the farming care, will allow a better justification of the seasonal variations of the populations of *P. africana* psyllid in Cameroon.

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