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Influence of the growing area on oil palm (*Elaeis guineensis*) inflorescences insects population

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ABSTRACT:

Oil palm tree grows naturally on low ground and on plain. Seed production varies from one area to another on the same oil palm plantation. Pollination of oil palm is essentially entomophilous; it appeared useful to assess the influence of the growing area on the fluctuation of pollinating insects' population. Samplings were performed each month on male and female inflorescences during two years on plots in lowland and plain. The insects showed no qualitative change from one area to another. Sixteen species of insects were observed on the male inflorescences against 10 species on female inflorescences. The inflorescences showed variation in the number of insects based on the growing area and the stage of flowering.

Keywords:
culture area; pollinating insects; Lamé; Côte d'Ivoire.

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INTRODUCTION

Many problems are opposed to a good production of oil palm. These include pests, pathogenic fungi and especially the continuing decline of pollinating insects. For several years many problems of fruit set were observed in some regions of cultivation of oil palm tree causing a gradual decline in seed production (Mariau *et al.,* 1991). The observation was made that the most affected areas, spread over large areas of lowland.

There are many evidences that the pollinator insects effectively contributes to the reproduction of many cultivated plant species. Regarding the oil palm tree, the discovery of the role of insects in pollination was made by Chevalier in 1910. The works of Syed (1979) and Syed *et al.* (1982) have confirmed this finding. Pollination of oil palm is essentially entomophilous (Corrado, 1985). Without pollination, fruit set by wind is extremely low (Mariau *et al.,* 1991). Pollinating insects are thus an undeniable role. In Côte d'Ivoire (West Africa), five species of *Elaeidobius* (*E. kamerunicus, E. plagiatus, E. subvitatus, E. bilineatus, E. singularis*), two species of *Microporum* (*M. congolense* and *M. dispar*), two species of *Proseostus* (*P. minor, P. sculptilis*), *Atheta burgeoni, Gabrius sp, Litargus sp, Thrips sp* and *Anthocoris sp* have been described by Desmier De Chenon, (1981) and Hala *et al.,* (2012) as pollinators of oil palm. It therefore seemed appropriate to follow the dynamics of these insects on two different ecological zones: lowland and plain. The research question that we asked is whether the growing area of oil palm has an influence on populations of pollinating insects. Many factors can explain the fluctuations of insect populations. The latest studies on this subject have established outside the bioclimatic factors which have a clear implication, that the use of insecticides in the fight against pests do not spare beneficial insects that are pollinators (Tuo *et al.,* 2011).

This preliminary study established a quantitative and qualitative comparison of oil palm inflorescences insects in two agro ecosystems: lowland and plain.

MATERIAL AND METHODS

Study site

Our study site was the experimental station of La Mé, located at 5°26, N, 3°50, W. The station is located to about thirty kilometers north-east of Abidjan (Côte d'Ivoire). This area is characterized by an ombrophilous forest (Traoré and Mangara, 2009).

The study area has an equatorial climate characterized by two distinct rainy seasons (March to July and November). These two seasons are alternated by two dry seasons: December to February and from August to October (Pene and Assa, 2003). The monthly mean temperature was about 27°C. The monthly average of the highest temperature was recorded in March and the lowest in August with respectively 28.55 and 25.5°C. The average annual rainfall was about 1500 mm. The average annual sunshine duration was about 1790 h; the average monthly relative humidity was about 81%.

Insects of male inflorescences

Three operations were performed to assess the male inflorescences of oil palm insect fauna: location, sampling and identification of insects (Fataye, 1984).

Location

Each month a location was carried out in order to count four inflorescences in the process of flowering. This location has identified 192 male inflorescences at a rate of eight per month during two years.

Sampling

As soon as the third florets of each inflorescence were listed, with pair of secateurs four spikelets per inflorescence were collected. This collection was done in the beginning of anthesis (BA). The second (full anthesis: FA) and third (end anthesis: EA) took place respectively after the first three days and two days after the second. Each batch of four spikelets collected was placed in a bag and then the insects collected were neutralized with an insecticide bomb. Before

identification, insects of each batch of spikelet were collected in pillboxes containing alcohol 70%.

Identification

Using the collection of the insect fauna of oil palm inflorescences of the National Agricultural Research Centre of La ME and a binocular microscope, insects of every month and each area were identified at the species level.

Insects of female inflorescences

This study was conducted according to the methods of N'goran (1982) and Fataye (1984).

Location

Two non-flowering inflorescences per plot were identified and followed by month. The inflorescences were cleared of husks and bulky leaves with machetes and knives three days before flowering. Each inflorescence thus revealed was covered with a muslin cage and attached to the floral stem with a rubber. The bagged inflorescences were controlled each afternoon to follow the evolution of the inflorescence.

Sampling

All the insects that were attracted are placed on the cage once flowering commences. Using a vacuum cleaner, these insects were captured every hour for ten minutes. This operation was performed at 6 AM to 6 PM during the two days of the anthesis length. The collected insects were immediately stored in pillboxes containing 70% alcohol. At the end of the day, insects collected were sent to the laboratory. At each study site, sampling was conducted on 48 inflorescences.

Identification

Insects collected were identified using the same protocol as previously.

STATISTICAL ANALYSIS

Data processing was performed using Statistica software version 7.1. An analysis of variance (ANOVA) revealed significant differences between the data. The test of Student-Newman-Keuls at 5% was used to classify the means into homogeneous groups

RESULTS AND DISCUSSION

Variation in the number of insects on male inflorescences

On male inflorescences of oil palm tree, the insects mostly belong to *Elaeidobius* (E) genus. Five species were observed: *E. kamerunicus, E. plagiatus*, *E. subvittatus, E. singularis and E. bilineatus*. *Microporum* (M) genus was represented by the species *M. dispar* and *M. congolense. Prosoestus* genus was present with two species *P. sculptilis* and *P. minor*. Species, *Atheta burgeoni*, *Lithargus sp*., *Anthocoride sp*., *Thrips sp*, *Gabrius sp*. and bees (*Nomia sp* and *Apis mellifera*) were also observed.

At the beginning of anthesis (BA)

The number of insects collected from the plot of lowland (61%) is higher than that collected on the plain (31%). At the species level, it was observed that *E. singularis*, *E. bilineatus, P. sculptilis*, *M congolense* and *Anthocoris sp* showed a significant difference depending on the growing area with a higher effective in lowland areas. The other species showed no preference for one area (Figure 1A).

At full anthesis (FA)

The total number of insects collected was 42% in the plain region and 58% in lowland areas. For the species, *E. plagiatus*, *E. kamerunicus*, *M. congolense*, *M. dispar* and *A. Burgeoni*, a significant difference was found between their respective populations based on the growing area. Only *A. burgeoni* presented a higher effective in the lowland areas. The other species were much more present in plain areas. Besides these species, no differences were recorded between the number of insects collected in lowland areas and those collected on the plain (Figure 1B).

At the end of anthesis (EA)

The total number of insects differ from one area to another. It was 75% in lowland areas against 25% on

the plain. With regard to species, only the number of *E. singularis*, *M. dispar, Lithargus sp* and *A. burgeoni* depends on the area. These species excepted *Lithargus sp* were more abundant in the lowland than on the plain (Figure 1C).

Variation in the number of insects on female inflorescences

The species observed on female inflorescences were: *E. kamerunicus, E. plagiatus, E. subvittatus, E. bilineatus, E. singularis, M. congolense, M. dispar, P. minor, P. sculptilis* and *Atheta burgeoni*.

First day of anthesis

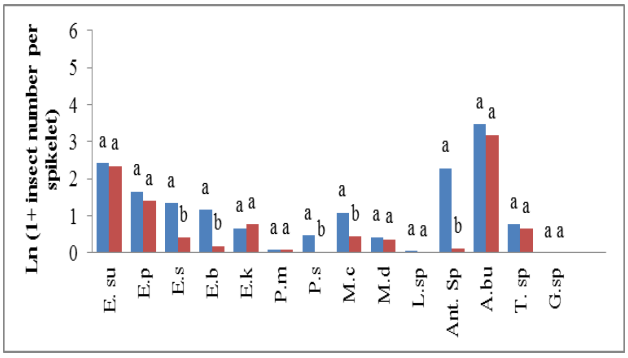
The total population of insects was significantly higher on the plain (78%) than in the lowland area (22%). At the species level, only the species *M. dispar, M. congolense, E. plagiatus, E. kamerunicus, E. subvittatus, E. singularis, A. burgeoni* and *P. minor*, were affected by the growing area. *A. burgeoni* attended more inflorescences of the lowland area. Other species were more present on the plain than in the lowlands (Figure 2A).

Second day of anthesis

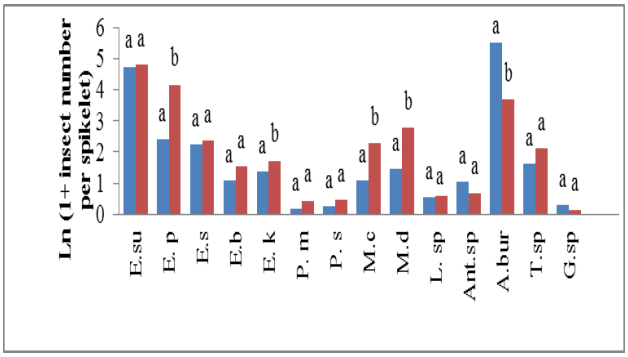
Insects were relatively influenced by the growing area. Indeed, 78% of the insects were collected on inflorescences of the plain region against 28% in the lowlands. Regarding species, *E. subvittatus, A. Burgeoni, P. minor* and *P. sculptilis*, had no preference for the growing area. The species *E. kamerunicus, E. plagiatus, E. bilineatus, E. singularis*, *M. dispar* and *M. congolense* were receptive to the area of culture (Figure 2B).

Among the species, only *E. kamerunicus*, *E. plagiatus*, *E. singularis* and *M. dispar* were affected by the growing area both the first and second day of anthesis.

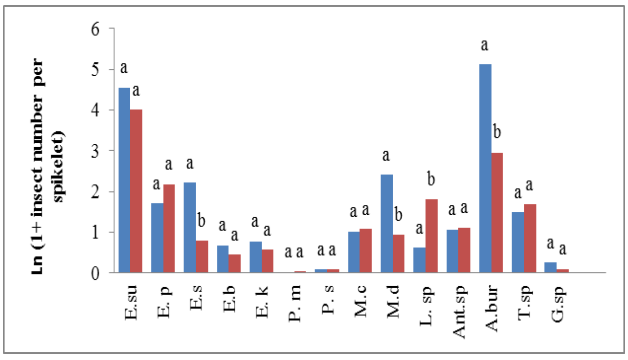
The insects of oil palm inflorescences showed no qualitative change from one area to another. These species were always present on the oil palm tree and colonize the inflorescences of this plant regardless of the study area.



A: Beginning of anthesis



B: Full anthesis



C: End of anthesis

Lowland Plain

Histograms with the same letter are not significantly different at the 5% level

Figure 1: Influence of the growing area on the number of insects present on male inflorescences
E.su: ***Elaeidobius subvittatus;*** **E.p:** ***Elaeidobius plagiatus;*** **E.s:** ***Elaeidobius singularis;*** **E.b:** ***Elaeidobius balineatus;*** **E.k:** ***Elaiedobius kamerinucus;*** **P.m:** ***Prosoestus minor;*** **P.s:** ***Prosoestus sculptilis;*** **M.c:** ***Microporum congolense*****; M.d:** ***Microporum dispar*****; L.sp: Lithargus sp.; Ant.sp.:** ***Anthocoris sp.*****; A.bur:** ***Atheta burgeoni:*** **T.sp.:** ***Thrips sp.*****; G.sp.:** ***Gabrius sp.***

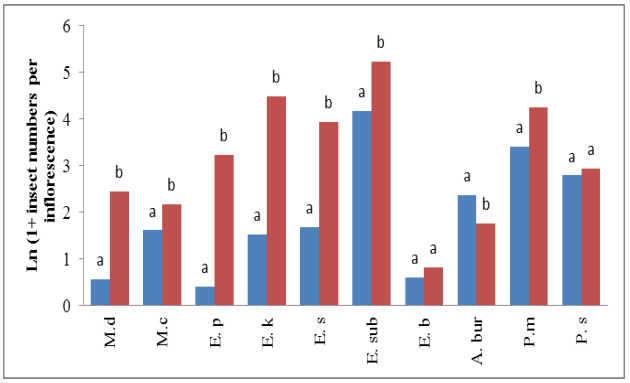
Sixteen insect species were observed on the male inflorescences against only 10 species on female inflorescences. The six species that were absent on the

female inflorescences (*Lithargus sp.*, *Anthocoride sp.*, *Thrips sp.*, *Gabrius sp.*, and bees (*Nomia sp.* and *Apis mellifera*) would not intervene mainly in oil palm pollination. According to Mariau *et al.,* 1991, four species provide the largest share of pollination of oil palm tree: *E. kamerinucus, E. plagiatus, E. subvittatus* and *E. singularis*.

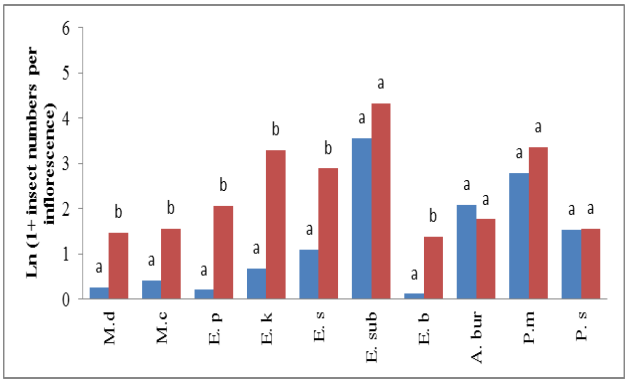
The male inflorescences showed a variation in the numbers of insects based on the growing area and the stage of flowering. In general, the lowland areas showed significantly more insects than upland areas (61% against 31% at the beginning of anthesis, 58% against 42% at full anthesis and finally 75% against 25% at the end of anthesis). Insects observed in the male inflorescences live on them usually. For example, the male flowers are the breeding sites of insects of the genus *Elaeidobius* (Beaudoin-Ollivier *et al.,* 2012). The differences could be explained by changes in environmental factors. At the beginning of anthesis, flowers began to appear on the male inflorescences that induced an attractive factor because of the strong smell of anise emitted by the male flowers. To this, were added the environmental factors including relative humidity and temperature. It was noted that the number of insects on lowland inflorescences were two times higher than those of insects collected on plain region inflorescences. At the species level, if for *E. bilineatus*, *P. sculptilis* and *M. congolense*, numbers were highest in the lowland area than on the plain region. These three species are unfortunately not effectively intervening in the pollination of oil palm tree. The other insect species showed no significant difference at the beginning of anthesis.

In full anthesis, the number of insects on male inflorescences has reached its maximum value. The attractive factor of flowers took over on bioclimatic factors. Thus, it has almost the same number of insects from one region to another. In terms of species observed in full anthesis, the number of *E. plagiatus*, *E. kamerunicus*, *A. Burgeoni*, *M. dispar* and *M. congolense* were significantly different from one area to another. Indeed, apart *A. burgeoni*, all these species were more prevalent in upland areas. This can be explained by bioclimatic factors which were more favorable to the activity of these insects.

We observed three times more insects on lowland inflorescences than on those on plain at the end of anthesis. This can be explained by the fact that on plain, the flowers were fading and dry faster than the inflorescences in lowland areas (lower temperature and



A: First day of anthesis



A: Second day of anthesis

Lowland Plain

Histograms with the same letter are not significantly different at the 5% level.

Figure 2: Influence of the growing area on the numbers of insects present on female inflorescences
E.su: *Elaeidobius subvittatus;* E.p: *Elaeidobius plagiatus;* E.s: *Elaeidobius singularis;* E.b: *Elaeidobius balineatus;* E.k: *Elaeidobius kamerinucus;* P.m: *Prosoestus minor;* P.s: *Prosoestus sculptilis;* M.c: *Microporum congolense*; M.d: *Microporum dispar*; L.sp: *Lithargus sp.*; Ant.sp.: *Anthocoris sp.*; A.bur: *Atheta burgeoni*: T.sp.: *Thrips sp.*; G.sp.: *Gabrius sp.*

higher relative humidity). Insects were removed quickly on inflorescences located in plain region. At the species level, only *E. singularis*, *M. dispar*, *A. burgeoni* and *Lithargus sp*. showed significantly different numbers from one area to another. Only bio-ecological requirements of these species can explain this distribution. According to Hussein *et al.,* 1990, the change in the population of pollinating insects in plantations of oil palm is largely due to the influence of intrinsic and extrinsic factors, in particular, biological and chemical factors.

During the anthesis, the total number of insects is higher on female inflorescences taken from the plain region than in the lowland area. At the species level, only *P. sculptilis* showed no preference zone during the two days during anthesis. The other species except *A. burgeoni* showed a preference for the plateau region. The determining factor is mainly the higher temperature which allows the presence and maximal activity of insects found on female inflorescences (Mariau *et al.,* 1991). Thus, the first day of anthesis as the second, the numbers of insects were higher in these areas.

CONCLUSION

The number of insects collected on the plain region is significantly different from that harvested the lowland area. The number of insect has been higher in male inflorescences in lowland areas than on the plain. This number was higher on the plain than in the lowland area. The numbers of insects are influenced by the culture area. This factor is to be taken into account in the implementation and the entomological monitoring of oil palm plantations.

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