Original Research Article

Insect pests and their direct damage of *Piliostigma reticulatum* (D.C.) Hochst flowers and pods in north-soudanian region of Burkina Faso

ABSTRACT

Aims: In Burkina Faso, *Piliostigma reticulatum* Hochst is one of the most important woody species for the country. It is used for food and feed and also as a plant with many medicinal properties. However, the production, market value and nutritional quality of these pods are reduced due to damage by insect pests. The objective of this work is to gain a better understanding of the insect pests, flowers, fresh and ripe pods of this plant.

Study design: Fresh flowers and pods were collected randomly.

Place and Duration of Study: Flowers, fresh pods and ripe pods of *P. reticulatum* were collected in the village of Yilou (13°01'06.8'' North Latitude and 1°32'54.6'' West Longitude) in Bam province. The observations were conducted in the laboratory. The study was carried out between December 2020 and September 2021.

Methodology: Thus 120 flowers, 200 fresh pods and 2000 ripe pods of *P. reticulatum* were collected by. Fresh flowers and pods were collected randomly from 20 trees and ripe pods from 100 trees. In the laboratory, fresh flowers and pods were dissected and insects were collected. Ripe pods were stored in the laboratory in polyethylene bags at room temperature for up to six months. When the bags were opened, all the insects observed were captured and placed in vials containing 70º alcohol. Insect damage to the pods was assessed using a score from 1 to 5. The pods were then dissected and the insects were collected again. All insects were identified under a binocular "stereomicroscope using identification keys.

Results: The results showed that Thysanoptera (Thripidae) were the most important insects in the flowers followed by Hymenoptera (Formicidae) and Coleoptera (Curculionidae). The main pests on fresh pods were Lepidoptera larvae (*Lepidochrysops quassi* Karsch). The extent of damage on mature pods in storage was high with an average score of 4.68. The pests of these pods in stock are *Caryedon serratus* (Olivier) followed by *Tribolium castaneum* (Herbst).

Conclusion: For a better protection of this plant, it is necessary to study the bioecological parameters of these pests in order to develop economically feasible control methods.

Keywords: Burkina Faso, Piliostigma reticulatum, insects, pests, pods, flowers

1. INTRODUCTION

The people of Burkina Faso have for centuries used non-timber forest products (NTFPs) such as fruits, flowers, leaves, bark and roots for subsistence, marketing, income and health [1 ; 2]. Among the forest plants whose organs are of great importance to the population is *Piliostigma reticulatum* (D. C.) Hochst. It is an evergreen shrub of the family Caesalpiniaceae (Leguminosae), naturally occurring in the Sudano-Sahelian and Sudanian regions [3]. *P. reticulatum* is a multi-purpose species for Sahelian populations. In terms of food, the young leaves are used to acidify dishes. The pods are used in the manufacture of potash. They are used in livestock feed as a nutritional supplement during the dry season. Thus the species is ranked among the preferred woody plants of animals in the Sahel [4]. These pods are known for their good palatability [5]. In areas where fodder resources are deficient, they constitute an alternative feed for ruminants. This is the case in the northern Sudanian zone of Burkina Faso, particularly in peri-urban livestock farms. Agronomically, the plant is used by farmers as an indicator of soil fertility [6]. It is also used in association with cereals in order to reduce the damage caused by insect pests of these crops [7]. Medicinally, the leaves, bark and twigs of the tree are used to treat sore throats, stomach aches and as an antiseptic [8 ;9]. Economically, products from *P. reticulum* are frequently sold on local markets [10]. The pods are collected and processed into flour by women and children before being sold on the markets [10]. Given the importance of *P. reticulum* for the population, the plant is subject to strong atrophic pressure. Protection of the plant in areas of natural stands and promotion of cultivation are recommended. In order to achieve this, it is necessary to know more about the entomofauna of this plant. Indeed*, P. reticulatum* flowers in the rainy season [9]. It is considered as a spreading flowering species [10]. Boshier and Mesen [11] pointed out that in the tropics, since many insect species are seasonal, it is likely that if the flowering period is very long, different groups of insects are interested in these flowers either as pollinators or pests. The pods of the species also undergo significant deterioration, due to the attacks of insects that preferentially consume certain parts. This has a definite impact on the nutritional value (loss of nutrients) and germination capacity of the seeds. According to [12], the seeds of woody plants are subject to insect attacks which are in some cases more intense than in agricultural monocultures. It is therefore necessary to find alternatives to help producers preserve the pods. Indeed, studies have shown that *P. reticultum* pods are attacked by bruchids of the genus Caryedon [13]. It is also possible that other insects attack *P. reticulatum* pods, whose nutrient content is very high [14]. However, in Burkina Faso, data on insects related to *P. reticulatum* are poorly documented. It is in this sense that this study was carried out. Its objective is to inventory the main insect pests of *P. reticulatum* flowers, pods and seeds. The aim of this study is to i) identify the main insect pests of flowers, ii) identify the main insect pests of fresh pods, iii) estimate the proportion of pods and seeds attacked after 6 months of storage, iv) identify the main insect pests of ripe pods and seeds of *P. reticulatum* in stock. A better knowledge of the entomofauna of *P. reticulatum* will allow the adoption of good protection methods for plantations and natural stands of this plant.

2. MATERIALS AND METHODS

2.1. Study sites

Flowers and pods of *P. reticulatum* were collected in Yilou in the rural commune of Guibaré, in the province of Bam in Burkina Faso. Yilou is crossed by the national road (RN) n°22 and is located 70 km from Ouagadougou. It lies between 13°01'06.8'' North latitude and 1°32'54.6'' West longitude. According to [15], the commune of Guibaré belongs to the north-sudanian climatic zone with an annual rainfall varying between 500 and 700 mm. The rural commune of Guibaré is characterised by soils poor in phosphorus, nitrogen and organic matter. It is made up of granitic rocks and has a relatively uneven relief. The vegetation of the rural commune of Guibaré is mainly characterised by dry Forest with few gallery forests along the Nakambe river. The most important woody species encountered are: *Vitelaria paradoxea, Parkia biglobosa, Lannea microcarpa. Faidherbia albida, Tamarindus indica, Adansonia digitata* and *P. reticulatum*. We choose the study site due to the over-exploitation of *P. reticulatum* by the local population and the potential threat on the species survival in the area. The collected pods were stored in polyethylene bags at the Natural History Laboratory of the Institute of Environment and Agricultural Research.

2.2. Methods

Open and unopened flowers were collected by hand from *P. reticulatum* trees. Flower collection took place in August during the peak flowering period of this plant. This sampling was done between 7 and 9 am. A total of 120 flowers were collected from 20 trees. The flowers were preserved in bottles containing 70^{o} alcohol. In the laboratory the flowers were dissected and observed under a binocular magnifying glass. For the pods, we collected 200 fresh pods from 20 trees in September. These pods were put in polyethylene bags and brought back to the laboratory. They were dissected and observed under a binocular loupe. Two thousand dry pods of *P. reticulatum* were also collected from 100 trees at random in December in the village of Yilou. The collected pods were stored in 3 polyethylene bags at the Natural History Laboratory at room temperature. After 6 months of storage, the bags were opened. All insects observed in these bags were captured with a mouth aspirator. Five hundred pods were randomly selected to assess insect damage on these pods. This damage was evaluated according to a score ranging from 1 to 5:

-1 when there are no holes where insects emerge from the pods,

-2 when the number of holes where insects emerge is between 1 and 5,

-3 when the number of holes is between 5 and 10,

-4 if the number of holes is between 10 and 15,

-5 if it is greater than 15.

The five hundred pods were then dissected and the seeds were collected. All the insects collected from the flowers and pods were put in vials containing 70^{o} alcohol. Seeds attacked (at least one emergence hole) by insects were separated from healthy seeds. The attacked and healthy seeds were then counted and weighed using a digital balance.

2.2.1 Identification of collected insects

The insects were sorted and classified on the basis of their external morphology. They were identified under a binocular loupe to the taxonomic level of the species. Several entomological systematics keys were used for insect identification [16 ; 17 ;18 ; 19 ;20].

2.2.2. Data processing

Estimation of the relative abundance of insects and infestation rates of *P. reticulatum* pods and seeds were done:

-The relative abundance (F) was calculated as follows: F (%) = ni*100/N ; with ni the number of individuals of a taxonomic level which is here the family or the species and N total number of individuals for all the individuals taken into account.

-Seed infestation rate: Number of seeds with at least one insect emergence hole / Total number of seeds×100

-The initial seed infestation rate for each pest species: Seed infestation rate × relative % of each pest species / 100.

The relative % of each pest species is the % of the number of each pest species out of the total pests counted. The graphs were made with R software and the Excel 2016 spreadsheet..

3. RESULTS

3.1. Insect pests of *P. reticulatum* flowers

The main orders of insects observed in the flowers of *P. reticulatum* are Thysanoptera, Hymenoptera and Coleoptera. The Thysanoptera are represented by the families Thripidae (Figure 1). The Hymenoptera are

represented by species of the Formicidae family (Figure 2). For the beetles, species of the family Curculionidae were observed in the flowers (Figure 3). The abundance of insects observed in the flowers is shown in figure 4. Thripidae were the most abundant followed by Formicidae and Curculionidae.

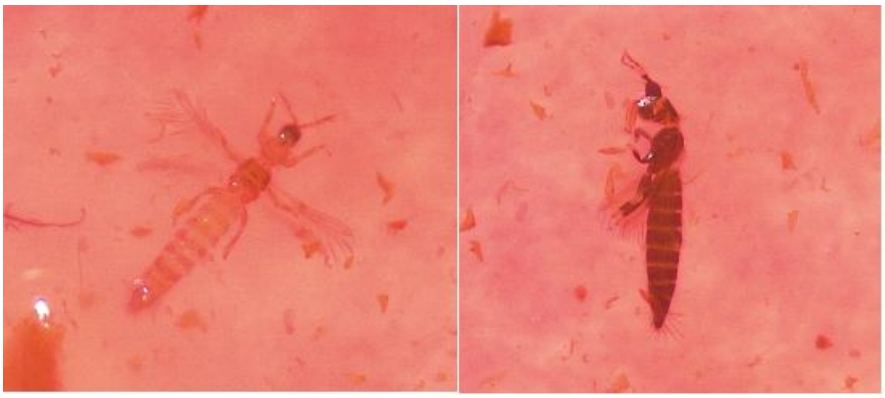

Figure 1 *:* Thripidae

Figure 2 : Formicidae

Figure 3 : Curculionidae.

Figure 4: Abundance of insects in flowers

3.2. Insect pests of fresh pods of *P. reticulatum*

The main insect pests observed in fresh pods of *P. reticulatum* were the larvae of the lepidopteran *Lepidochrysops quassi* Karsch of the family Lycaenidae (Figure 5). The infestation rate of fresh pods by *L. quassi* Karsch was 17.5%.

Figure 5 : Larvae of *Lepidochrysops quassi* Karsch

3.3. Severity of insect damage on pods in storage and percentage of attacked seeds in stock

The average score for insect damage to pods was 4.68. It should be noted that no pods scored 1. It should also be noted that about 400 pods had a score of 5 (Figure 6).

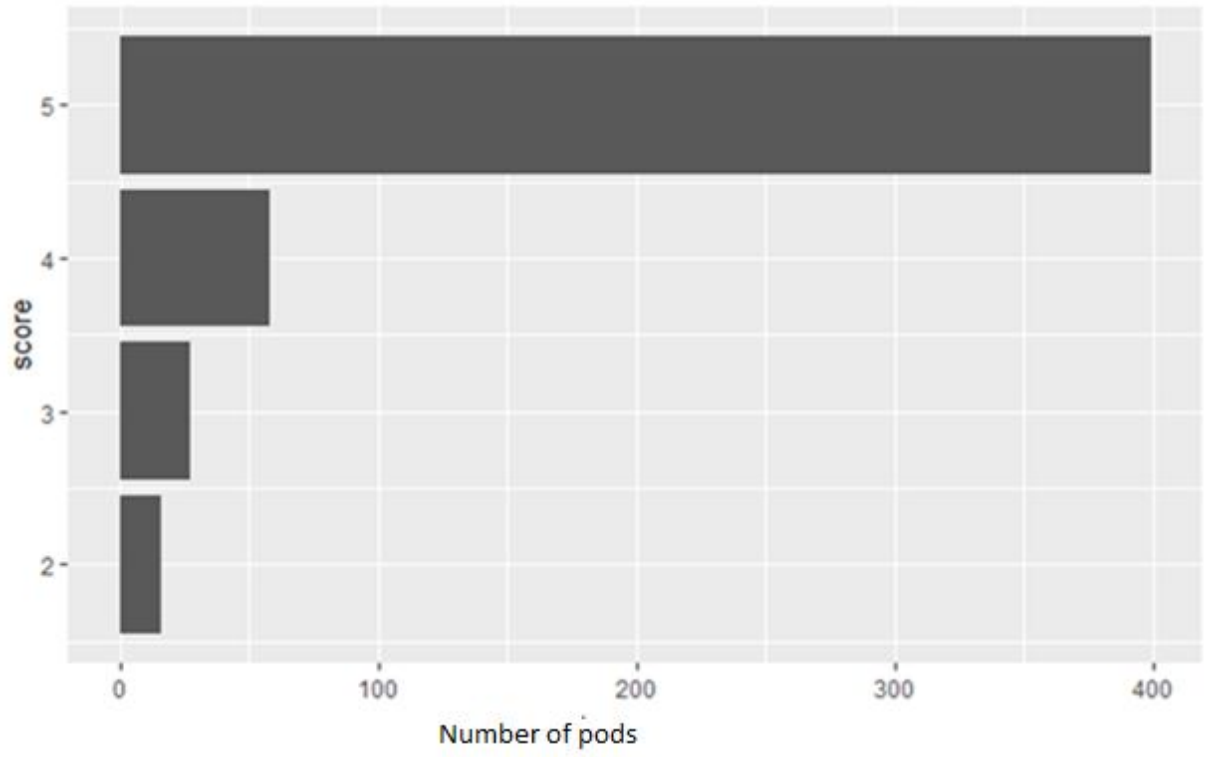

Figure 6: Severity of insect damage on pods in storage

The percentage of attacked seeds (99.77%) is higher than the percentage of healthy seeds (0.23%) (Figure 7).

Figure 7: Percentage of attacked and healthy seeds

3.4. Insect pests of *P. reticulatum* pods and seeds in storage.

Observations showed that two main pests attack pods and seeds of *P. reticulatum* in storage. These are : *Caryedon serratus* (Olivier) (Coleoptera: Bruchidae) (Figure 8) and *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) (Figure 9). *C. serratus* is the most important pest in pods in storage. The relative percentage of *C. serratus* individuals is 64.46%. The infestation rate of seeds by *C. serratus* individuals is 64.29%. *T. castaneum* was the second pest observed in pods and seeds of *P. reticulatum* in stock. The relative percentage of *C. serratus* individuals was 35.54%. The infestation rate of seeds by *C. serratus* individuals is 35.46%.

Figure 8 *: Caryedon serratus* (Olivier)

Figure 9 : *Tribolium castaneum (Herbst)*

4. DISCUSSION

Analysis of insect abundance in *P. reticulatum* flowers revealed that thrips are the most important. The high presence of these pests in *P. reticulatum* flowers is a new finding. Indeed, [10] identified 30 insect families in 10 orders in *P. reticulatum* flowers during a study in the Yilou area. Of these insects observed by [10] in *P. reticulatum* flowers, the main pests belonged to the order Coleoptera (Meloidae, Scarabeidae, Lycidae). The method used by [10] could explain the fact that there was a high diversity of insects in the flowers of *P. reticultum*. Indeed, [10] used traps on the one hand to capture the insects on the flowers of *P. reticultum* and on the other hand to use the same method as ours to observe the insects in the flowers. Thus, we can say that thrips, which are polyphagous pests [21 ; 22]), have had to adapt to *P. reticulatum* flowers in recent years. The abundance of thrips in the flowers is a major constraint for the production of this plant. Indeed, thrips cause the flowers of their host plants to drop [23]. In addition, other insects belonging to the order Hymenoptera and Coleoptera were present in the flowers. The simultaneous

presence of these numerous floral visiting insects can have a direct adverse effect on the success of fruiting and cause damage to the flowers [24]. Indeed, these phytophagous insects feed on certain parts of the plant such as nectar, pollen, fruits etc... [10].
At the level of fresh pods, Lepidoptera larvae were the most important. These results corroborate those of [10] who showed that *Lepidochrysops quassi* Karsch larvae are the main pests of fresh *P. reticulatum* pods.
For pods in storage, the average pod damage score was 4.68. This shows that the pods have been damaged by the larvae. This shows that the pods were severely attacked after 6 months of storage. This damage reduces the nutritional quality of *P. reticulatum* pods [25]. The main pest of *P. reticulatum* pods and seeds in storage is *C. serratus*. Our work corroborates that of [26 ; 27] who showed that *C. serratus* attacks *P. reticulatum* pods but also *Bauhinia rufescens* Lam, *Cassia sieberiana* DC, (DC.) Hochst, and *Tamarindus indica* L. L. on *P. reticulatum.* The population dynamics of *C. serratus* are dominated by the alternation of a relatively short period (November to February) when mature pods are abundant on the host and a long period (March to October) when these become increasingly rare and then apparently absent. When the first pods reach maturity in November, *C. serratus* populations are generally very low. Infestation rates recorded on *P. reticulatum* in November are about 2-4 eggs per 1000 pods [26]. In the absence of pods on the plants between March and October, *C. serratus* individuals could maintain themselves on pods that have fallen under the trees or on those stored by the population during the dry season. They could also migrate to other host plants such as groundnuts [26]. The high number of emergence holes observed on pods and attacked seeds indicates a rapid reproduction of *C. serratus* on *P. reticulatum.* Indeed *C. serratus* has more preference for plants of the family Ceasalpiniaceae than other host plants [28]. The damage caused by *C. serratus* on the pods of some plants such as groundnut can reach 89.78% in only five months of storage [27]. The second pest observed in pods in storage is *Tribolium castaneum* (Herbst) (Red flour beetle). It is the most ubiquitous, the most polyphagous and the most formidable of the stock insects. This pest takes advantage of the emergence holes of *C. serratus* to enter the pods. It feeds on the flour in the pods and seeds of *P. reticulatum* [29].

5. CONCLUSION AND PERSPECTIVES

At the end of our work we can say that the production of *P. reticulatum* pods is affected since the appearance of the flowers. This is due to the presence of various insects as soon as the flowers appear. Attacks, especially by thrips, from the flower buds onwards reduce flowering and thus prevent good fruiting. The extent of the attacks is accentuated on fresh and ripe pods by *L. quassi* and *C. serratus* respectively. These results explain in a general way the extent of the damage on the pods of *P. reticulatum*. In the future, we suggest studying the bio-ecology of these pests of *P. reticulatum* in order to develop sustainable management methods.

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