Entomofauna associated with cowpea *Vigna unguiculata* (L.) Walp., assessment damages caused by insect pests and predators of *Ootheca mutabilis* Sahlberg (Coleoptera : Chrysomelidae) in south of Côte d'Ivoire

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ABSTRACT

The necessity to control the insect pests of cowpea (*Vigna unguiculata*) crops has led to an inventory of insects and assessment of damage caused by pests of this plant. This study was conducted in Adzopé situated in south of Côte d'Ivoire from march to may 2014. Catches were made twice per a week, manually with pliers applying technique of mowing with sweep net and the plants have been inspected to identify damage caused by pests. In total, 44 species have been identified, distributed in 29 families and 9 orders. During the sampling period, 2316 insects were collected. The highest number (927 insects) was recorded at fruiting stage representing 40.03 % of the total catch. *Ootheca mutabilis* was the most abundant species at the stage before flowering and flowering stage with respectively relative abundances of 39.54 and 30.25 %. *Megalurothrips sjostedti* was majority at the fruiting stage with a relative abundance of 29.99 %. The analysis of the frequency of occurrence revealed that *O. mutabilis* was ubiquist species (frequency of occurrence = 100 %) on the crop. Defoliator insects caused the most serious damage at the before flowering stage and flowering stage with respectively attack rates of 78.65 and 96.35 %. At fruiting stage, the highest attack rate (45.83 %) was induced by sucking insects. Among the insects inventoried, three species (*Rhinocoris albopilosus*, *R. rapax* and *R. bicolor*. (Heteroptera : Reduviidae) have been identified as predators of *O. mutabilis* adults.

Key words : *Vigna unguiculata*, Insect pests, Predators, Phenological stages, Attack rate

1. INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) (Walp.) is a leguminous crop and one of the most important crops cultivated in the tropical and subtropical regions [1]. Its nutritional importance, its involvement in the fodder, its medicinal effects and its impact increasing of soil fertility make it a multiple utility plant [2, 3]. Despite its importance, cowpea remains a marginal plant in Côte d'Ivoire [4]. Yields rarely exceed 400 to 500 kg seeds per hectare in traditional crops [5]. However, grow of the local variety "Touba" in the climatic conditions of south of Côte d'Ivoire could provide important income for the farmers and participate to the food security of population. Unfortunately, this crop is one of the most attacked by diseases and pests that affect the production which is already insufficient. Among the insect pests of cowpea listed in the world, those who cause the most damage on the plant are: *Maruca vitrata* Fabricius (Lepidoptera: Crambidae), *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae), *Clavigralla tomentosicollis* Stal (Heteroptera : Coreidae) and *Aphis craccivora* Koch (Homoptera: Aphididae) [6]. However, very few studies have been undertaken in the forest area of Côte d'Ivoire as far as cowpea crop's is concern. Previous studies conducted in this area by [7] on the entomofauna of that variety, showed that a large number of order of insects cause damage to culture in this area. These studies have also revealed the presence of thrips to flowering and fruiting. Since this study, any other was made on the entomological constraint of cowpea in the south of Côte d'Ivoire. It was so helpful to make an inventory in order to update the list of pests and auxiliaries. This will certainly detect new pests to consider methods of struggle. It was therefore useful to make an inventory to update the list of insect pests and auxiliaries. This will certainly help detect new pests to consider control methods. The objective of this study is to update the data on the insect fauna associated with the cowpea crop in the south of Côte d'Ivoire and to assess the damage of pests according to the phenological stages in order to establish an effective control of pests.

2. MATERIAL AND METHODS

2.1. Study area

The study was conducted in Adzopé (06°10' of north latitude and 3°87' west longitude) located in the south of Côte d'Ivoire. The subequatorial climate is characterized by four seasons [8,9] : a long dry season from December to March. a long rainy season, from April to mid-July; a small dry season, from mid-July to mid-September; a small rainy season, from

mid-September to November. The study period is extended from march to may 2014 with average temperatures oscillating between 23.9 and 28.2 ° C, relative humidity ranging between 83.6 and 92 % and a rainfall of 418.3 mm.

2.2. Material

The plant material is the cowpea (*Vigna unguiculata* L. Walp) of a variety commonly called in Côte d'Ivoire "Touba". The animal material is represented by the insects caught on the experimental plot. The technical material is composed of clip, a net sweep, of gangs, small bottle, ethyl alcohol at 70 ° C and Petri dishes.

2.3. Experimental field

The size of the experimental plot was 197.76 m² with 20.6 m at length and 9.6 m at wide. It is divided into three blocks distant of two meters. Each block consisted of three subplots each measuring 4.2 m length and 1.8 m wide. Two consecutive subplots are separated by one meter. In each subplot, seedlings are arranged in four rows of 4.2 m length separated from each other by an interval of 0.6 m. The agricultural practice used is the seedling planting hole with a spacing of 0.60 m between the lines. Thinning to one plant by hole was realized 15 days after sowing. Each subplot was composed of 32 cowpea plants. The experimental plot was not treated with any pesticide during the experimentation.

2.4. Capture and identification of insects

The insects were captured using pliers and nets. They were stored in small bottle containing alcohol at 70 ° C and taken to the laboratory for identification and counting. The identification was carried out using a binocular microscope of optika brand surmounted by a camera Mikrocamlab 7 version 4.0, using family identification keys based on adult morphology [10] and others as those of [11, 12, 13, 14] to determine certain kind and species of insects. Two ecological parameters used to analyze the data are: relative abundance and frequency of occurrence. The relative abundance (Ar), was calculated according to the formula of [15], in which : Ar (%) = (Ni / N) x 100 where Ni, number of individuals of a given species and N is the total number of individuals of all species combined. According to the formula of [16], the frequency of occurrence (C) is following : C (%) = (Pi / P) x 100 where Pi is the number of occurrence of a species and P is the total number of observations.

Depending on the value of C, the classes of occurence are following : ubiquist species (C = 100 %), constant species (50 % ≤ C <100 %), commun species (25 % ≤ C <50 %) and by-catch species (C < 25 %).

2.5. Evaluation of the damage caused by insect pests

A subplot was chosen randomly per block. Assessment of the damage caused by defoliating insects, sucking insects and borer was done by counting the attacked plants at of their leaves, stems, flower buds and pods on subplot. For each group of insects, the rate of attacked plants was calculated using the formula following [17, 18] :

Rate of attacked plants (%) = (Number of attacked plants / Number of total plants) x 100

Then, the mean attack rates caused by the three groups of insects were calculated for each phenological stage.

2.6. Analysis of the data

The data collected on the damage were subjected to analysis of variance (ANOVA) using the Statistica software version 7.1. The comparison of means was performed by the test of Newman - Keuls to the 5% threshold.

3. RESULTS

3.1. Insects inventories

In total, 2316 insects were captured. They belong to 44 species distributed in 29 families and 9 orders. The number of insects according phenological stage were 698 at the stage before flowering, 691 at the flowering and 927 at the fruiting representing respectively 30.14; 29.84 and 40.03 % of the total of captured insects. The species that presented the highest total (583 individuals) was *Ootheca mutabilis*, and then comes *Megalurothrips sjostedti* and *Aphis craccivora* with respectively 421 and 148 individuals. Others 41 species each had a number of less than 100 individuals (table 1).

Table 1: Number of insects identified according to the phenological stages of the cowpea

Orders	Familes	Species	Numbers			Total
			Phenological stages			
			S.b. flow	Flow	Fruit	
Orthoptera	Gryllidae	*Brachytrupes membranaceus* Drury, 1770	12	1	0	13
	Tetigoniidae	*Ruspolia nitidula* Scopoli, 1786	7	2	0	9
		Tettigonia viridissima Limnaeus, 1758	5	0	0	5
	Acrididae	*Acrida acuminata* Stål, 1873	3	1	0	4
	Pyrgomorphidae	*Zonocerus variegatus* Linnaeus, 1758.	7	0	1	8
Dictyoptera	Mantidae	*Miomantis* sp	1	2	1	4
Coleoptera	Chrysomelidae	*Ootheca mutabilis* Sahlberg, 1829	276	209	98	583
		Medythia quarterna Fairmaire, 1880	44	22	8	74
		Aulacophora foveicolis Lucas, 1849	27	18	3	48
	Meloidae	*Mylabris* sp	0	4	1	5
	Bruchidae	*Callosobruchus maculatus* Fabricius, 1775	0	0	12	12
		Bruchiduis atrolineatus Pic, 1921	0	3	21	24
		Callosobruchus chinensis Linnaeus, 1758	0	0	6	6
		Callosobruchus rhodesianus Pic, 1902	0	0	4	4
	Lagridae	*Lagria villosa* Fabricius, 1781	4	1	0	5
	Coccinellidae	*Epilachna* sp	8	3	1	12
		Cheilomones sulphurea Olivier, 1791	8	2	9	19
	Carabidae	*Cicindela* sp	1	2	2	5
Lepidoptera	Noctuidae	*Spodoptera littoralis* Boisduval, 1833	0	2	30	32
	Pyralidae	*Maruca testulalis* Geyer, 1832	0	4	23	27
	Eucosmidae	*Cydia ptychora* Meyrick, 1907	0	5	36	41
Diptera	Agromyzidae	*Melanogromyza* sp	46	22	8	76
	Syrphidae	*Episyrphus sp*	8	3	7	18
	Asilidae	*Tolmerus cingulatus* Fabricius, 1781	8	22	29	59
Thysanoptera	Thripidae	*Megalurothrips sjostedti* Trybom, 1908	9	134	278	421
Homoptera	Aleyrodidae	*Bemicia tabaci* Gennadius, 1889	34	12	41	87
	Cicadellidae	*Empoasca dolichi* Paoli, 1930	42	21	13	76
	Aphididae	*Aphis craccivora* Koch, 1854	56	48	44	148
Heteroptera	Plataspidae	*Megacopta cribraria* Fabricius, 1798	41	11	27	79
		Coptosoma nubila	28	16	19	63
	Pentatomidae	*Aspavia armigera* Fabricius, 1781	0	8	11	19
		Nezara virudula Linnaeus, 1758	0	12	19	31
	Miridae	*Lygus* sp	0	14	16	30
	Alydidae	*Riptortus dentipes* Fabricius, 1787	8	23	54	85
		Mirperus jaculus Thunberg, 1783	1	9	17	27
	Coreidae	*Clavigralla tomentosicollis* Stal, 1855	0	0	5	5
		Anoplocnemis curvipes Fabricius, 1781	1	13	14	28
		Cletus sp	3	13	14	30
		Homoeocerus pallens Fabricius, 1781	7	0	0	7

	Reduviidae	*Rhynocoris albopilosus* Signoret, 1858	2	14	23	39
		Rhynocoris rapax Stål, 1855	0	2	4	6
		Rhinocoris bicolor Fabricius, 1781	0	7	17	24
Hymenoptera	Apidae	*Apis melifera* Linnaeus, 1758	0	2	1	3
	Vespidae	*Vespula* sp	1	4	10	15
9 orders	29 families	44 species	698	691	927	2316
			30.14 %	29.84 %	40.03%	100 %

S.b.flow : Stage before flowering ; Flow : Flowering stage ; Frui : Fruiting stage.

3.2. Relative abundance of species according to phenological stages

During the stage before flowering, the most abundant species was *O. mutabilis* with a relative abundance of 39.54 %. The others species harvested were less represented, each with a relative abundance of less than 10 %. At the flowering stage, *O. mutabilis* was also the most abundant with 30.25 % of the total number of insects caught. Next comes *Megalurothrips sjostedti* which accounted for 19.39 % of the catches. At the fruiting stage, the most abundant species was *Megalurothrips sjostedti* with a relative abundance of 29.99 %. Next comes *Ootheca mutabilis* which accounted for 10.57 % of the total number of insects caught. Others species had each a relative abundance of less than 10 % (Table 2).

Table 2 : Relative abundance of the species according to the phenological stages

			Relative abundance (%)		
			Phenological stages		
Ordre	Famille	Espèce	S. b. flow	Flow	Fruit
Orthoptera	Gryllidae	*Brachytrupes membranaceus* Drury, 1770	1.72	0.14	0
	Tetigoniidae	*Ruspolia nitidula* Scopoli, 1786	1	0.29	0
		Tettigonia viridissima Limnaeus, 1758	0.72	0	0
	Acrididae	*Acrida acuminata* Stål, 1873	0.43	0.14	0
	Pyrgomorphidae	*Zonocerus variegatus* Linnaeus, 1758.	1	0	0.11
Dictyoptera	Mantidae	*Miomantis* sp	0.14	0.29	0.11
Coleoptera	Chrysomelidae	*Ootheca mutabilis* Sahlberg, 1829	39.54	30.25	10.57
		Medythia quarterna Fairmaire, 1880	6.30	3.18	0.86
		Aulacophora foveicolis Lucas, 1849	3.87	2.60	0.32
	Meloidae	*Mylabris* sp	0	0.58	0.11
	Bruchidae	*Callosobruchus maculatus* Fabricius, 1775	0	0	1.29
		Bruchiduis atrolineatus Pic, 1921	0	0.43	2.27
		Callosobruchus chinensis Linnaeus, 1758	0	0	0.65
		Callosobruchus rhodesianus Pic, 1902	0	0	0.43
	Lagridae	*Lagria villosa* Fabricius, 1781	0.57	0.14	0
	Coccinellidae	*Epilachna* sp	1.15	0.43	0.11
		Cheilomones sulphurea Olivier, 1791	1.15	0.29	0.97
	Carabidae	*Cicindela* sp	0.14	0.29	0.22

Lepidoptera	Noctuidae	*Spodoptera littoralis* Boisduval, 1833	0	0.29	3.24
	Pyralidae	*Maruca testulalis* Geyer, 1832	0	0.58	2.48
	Eucosmidae	*Cydia ptychora* Meyrick, 1907	0	0.72	3.88
Diptera	Agromyzidae	*Melanogromyza* sp	6.59	3.18	0.86
	Syrphidae	*Episyrphus* sp	1.15	0.43	0.76
	Asilidae	*Tolmerus cingulatus* Fabricius, 1781	1.15	3.18	3.13
Thysanoptera	Thripidae	*Megalurothrips sjostedti* Trybom, 1908	1.29	19.39	29.99
Homoptera	Aleyrodidae	*Bemicia tabaci* Gennadius, 1889	4.87	1.74	4.42
	Cicadellidae	*Empoasca dolichi* Paoli, 1930	6.02	3.04	1.40
	Aphididae	*Aphis craccivora* Koch, 1854	8.02	6.95	4.75
Heteroptera	Plataspidae	*Coptosoma cribraria* Fabricius, 1798	5.87	1.59	2.91
		Coptosoma nubila	4.01	2.32	2.05
	Pentatomidae	*Aspavia armigera* Fabricius, 1781	0	1.16	1.19
		Nezara virudula Linnaeus, 1758	0	1.74	2.05
	Miridae	*Lygus* sp	0	2.03	1.73
	Alydidae	*Riptortus dentipes* Fabricius, 1787	1.15	3.33	5.83
		Mirperus jaculus Thunberg, 1783	0.14	1.30	1.83
	Coreidae	*Clavigralla tomentosicollis* Stal, 1855	0	0	0.54
		Anoplocnemis curvipes Fabricius, 1781	0.14	1.88	1.51
		Cletus sp	0.43	1.88	1.51
		Homoeocerus pallens Fabricius, 1781	1	0	0
	Reduviidae	*Rhynocoris albopilosus* Signoret, 1858	0.29	2.03	2.48
		Rhynocoris rapax Stål, 1855	0	0.29	0.43
		Rhinocoris bicolor Fabricius, 1781	0	1.01	1.83
Hymenoptera	Apidae	*Apis melifera* Linnaeus, 1758	0	0.29	0.11
	Vespidae	*Vespula* sp	0.14	0.58	1.08
9 Orders	29 Families	44 Species	100	100	100

3.3 Distribution of insects based on the frequency of occurrence

The distribution of insects based on the frequency of occurrence has revealed the presence of 1 ubiquist specie that was *Ootheca mutabilis* and 6 constant species : *Riptortus dentipes, Aphis craccivora, Megalurothrips sjostedti, Medythia quaterna, Rhynocoris albopilosus, Aulacophora foveicolis*. It has also recorded 16 common species and 22 by-catch species (Table 3).

Table 3: Frequency of occurrence of the species captured

Orders	Families	Species	C (%)	Classe
Orthoptera	Gryllidae	*Brachytrupes membranaceus* Drury, 1770	18.75	By-catch
	Tetigoniidae	*Ruspolia nitidula* Scopoli, 1786	18.75	By-catch
		Tettigonia viridissima Limnaeus, 1758	18.75	By-catch

	Acrididae	*Acrida acuminata* Stål, 1873	12.5	By-catch
	Pyrgomorphidae	*Zonocerus variegatus* Linnaeus, 1758.	25	Common
Dictyoptera	Mantidae	*Miomantis* sp	18.75	By-catch
Coleoptera	Chrysomelidae	*Ootheca mutabilis* Sahlberg, 1829	100	Ubiquist
		Medythia quarterna Fairmaire, 1880	56.25	Constant
		Aulacophora foveicolis Lucas, 1849	50	Constant
	Meloidae	*Mylabris* sp	18.75	By-catch
	Bruchidae	*Callosobruchus maculatus* Fabricius, 1775	18.75	By-catch
		Bruchiduis atrolineatus Pic, 1921	25	Common
		Callosobruchus chinensis Linnaeus, 1758	12.5	By-catch
		Callosobruchus rhodesianus Pic, 1902	12.5	By-catch
	Lagridae	*Lagria villosa* Fabricius, 1781	18.75	By-catch
	Coccinellidae	*Epilachna* sp	25	Common
		Cheilomones sulphurea Olivier, 1791	37.5	Common
	Carabidae	*Cicindela* sp	18.75	By-catch
Lepidoptera	Noctuidae	*Spodoptera littoralis* B oisduval, 1833	31.25	Common
	Pyralidae	*Maruca testulalis* Geyer, 1832	25	Common
	Eucosmidae	*Cydia ptychora* Meyrick, 1907	25	Common
Diptera	Agromyzidae	*Melanogromyza* sp	37.5	Common
	Syrphidae	*Episyrphus* sp	31.25	Common
	Asilidae	*Tolmerus cingulatus* Fabricius, 1781	43.75	Common
Thysanoptera	Thripidae	*Megalurothrips sjostedti* Trybom, 1908	50	Constant
Homoptera	Aphididae	*Aphis craccivora* Koch, 1854	31.25	Common
	Cicadellidae	*Empoasca dolichi* Paoli, 1930	25	Common
	Aleyrodidae	*Bemicia tabaci* Gennadius, 1889	56.25	Constant
Heteroptera	Plataspidae	*Coptosoma cribraria* Fabricius, 1798	37.5	Common
		Coptosoma nubila	43.75	Common
	Pentatomidae	*Aspavia armigera* Fabricius, 1781	18.75	By-catch
		Nezara virudula Linnaeus, 1758	12.5	By-catch
	Miridae	*Lygus* sp	12.5	By-catch
	Alydidae	*Riptortus dentipes* Fabricius, 1787	56.25	Constant
		Mirperus jaculus Thunberg, 1783	18.75	By-catch
	Coreidae	*Clavigralla tomentosicollis* Stal, 1855	12.5	By-catch
		Anoplocnemis curvipes Fabricius, 1781	12.5	By-catch
		Cletus sp	12.5	By-catch
		Homoeocerus pallens Fabricius, 1781	12.5	By-catch
	Reduviidae	*Rhynocoris albopilosus* Signoret, 1858	56.25	Constant
		Rhynocoris rapax Stål, 1855	18.75	By-catch
		Rhinocoris bicolor Fabricius, 1781	43.75	Common
Hymenoptera	Apidae	*Apis melifera* Linnaeus, 1758	12.5	By-catch
	Vespidae	*Vespula* sp	18.75	By-catch

3.4 Assessment of the damage caused by the insect pests following phenological stages

3.4.1. Stage before flowering

At the stage before flowering, defoliator insects (*Zonocerus variegatus, Ruspolia nitidula, Gryllus bimaculatus, Medythia quaterna, Aulacophora foveicolis, Lagria villosa, Melanogromyza* sp, *Epilachna* sp, larvae of *Maruca testulalis* and especially *Ootheca mutabilis* caused the most damage with an attack rate 78.65 ± 7.02 %. Sucking insects (*Aphis craccivora, Empoasca dolichi, Bemicia tabaci, Megacopta cribaria* and C*optosoma nubila, Hoemeocerus* sp) caused damage with an attack rate of 25.26 ± 2.96 %. Statistical analysis showed highly significant differences in attack rates between two groups of insects (df = 1; F = 49.11; P < 0.0001) (Figure 1A).

3.4.2. Flowering stage

At flowering stage, defoliator insects (*Ootheca mutabilis, Mylabris* sp, *Megalurothrips sjostedti,* the larvae of *Spodoptera littoralis* and *Maruca testulalis*) have induced the highest attack rate (96.35 ± 1.70 %), then come sucking insects (*Aphis craccivora, Bemicia tabaci*) with an attack rate of 24.48 ± 1.88 %. The lowest attack rate was occasioned by the borers with an attack rate of 7.47 ± 1.12 %. Statistical analysis revealed highly significant differences between the attack rate of the three groups of insects (df = 2; F = 871.64; P <0.0001) (Figure 1 B).

3.4.3. Fruiting stage

Sucking insects (*Aphis craccivora, Bemicia tabaci, Megacopta cribaria, Coptosoma nubila, Aspavia armigera, Nezara virudula, Lygus* sp, *Riptortus dentipes, Mirperus jaculus, Clavigralla tomentosicollis, Anoplecnemis curvipes* and *Cletus* sp) caused the most serious damage with 45.83 ± 3.76 % of plants attacked. The attack rates induced by pod and seed borers (C*allosobruchus maculatus, Bruchiduis atrolineatus, Callosobruchus chinensis, Callosobruchus rhodesianus*, the larvae of *Maruca testulalis* and *Cydia ptychora*) and defoliator insects were respectively 21.53 ± 2.43 % and 28.13 ± 3.18. Statistical analysis showed significant differences in the attack rates of the three insect groups (df = 2; F = 15.72; P = 0.004) (Figure 1C).

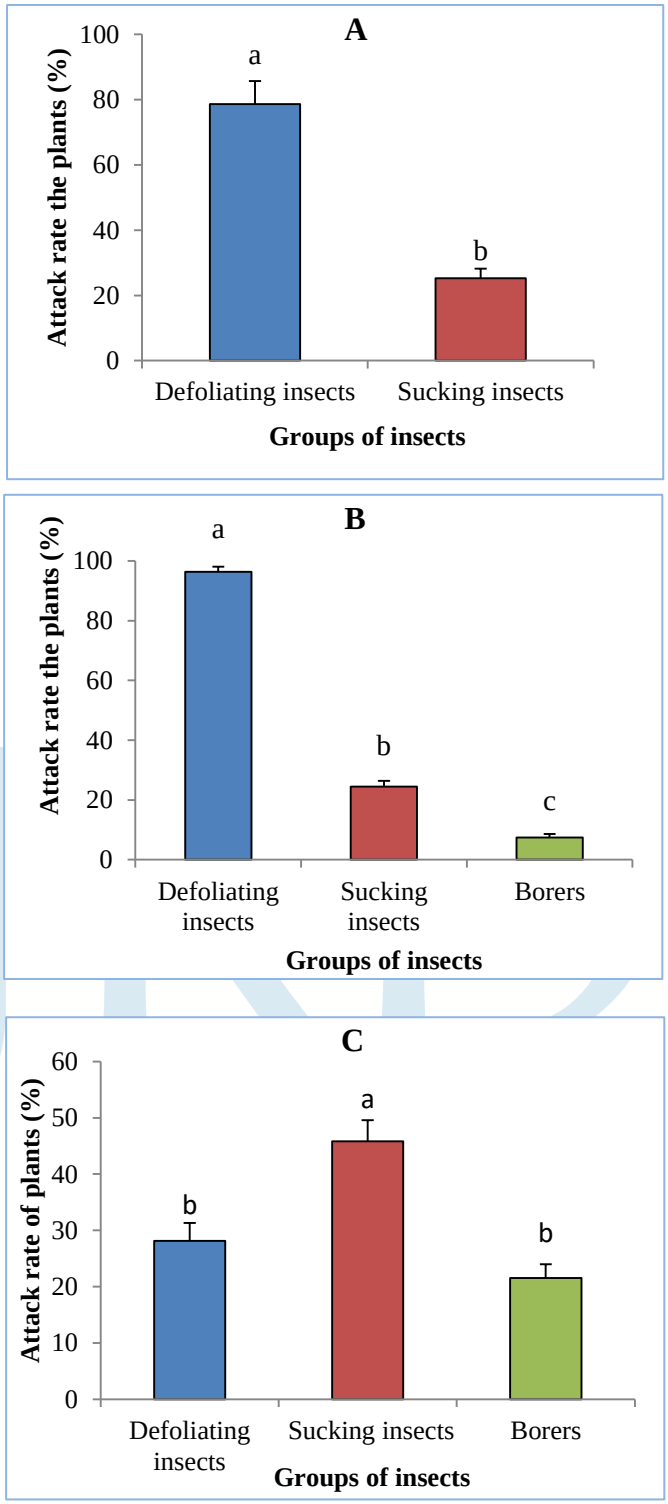

Figure 1: Attack rates of three groups of the insect pests during the phenological stages (A = Stage before flowering ; B= Flowering stage ; C = Fruiting stage)

3.5. Action of insect predators and pollinators

3.5.1. Insect predators

The predators captured belonging to five orders : The order of Dictyoptera represented by *Miomantis* sp and Hymenoptera by *Vespula* sp. The order of Coleoptera was composed of two species: *Cheilomenes sulphurea*, predators of aphids in larval and adult stage and *Cicindela* sp that captured his prey to the race. The Diptera also had two species: *Episyrphus* sp which the larvae destroyed a large number of aphids, and *Tolmerus cingulatus* which were true predators of other insects (Coleoptera, Hymenoptera and Larvae of Lepidoptera).The order of Heteroptera is represented by 3 species *Rhinocoris rapax*, *Rhinocoris albopilosus*, and *Rhinocoris bicolor*, which attacked the adults of *O. mutabilis* sucking theirs hemolymphs.

3.5.2. Insect Pollinators

Various insects visiting the flowers have been observed. Adults of the Hymenoptera (*Apis melifera*, *Vespula* sp), Diptera (*Episyrphus* sp) and Lepidoptera played a role of pollinating agents.

4. DISCUSSION

Many insects were captured at three phenological stages (stage before flowering, flowering and fruiting) of cowpea. This observation was consistent with those of [19] and [7] who reported the presence of many insects in these three phenological stages of the plant of cowpea in Côte d'Ivoire. At the end of the completed inventory, 44 species distributed in 29 families and 9 orders have been identified. Previous studies done by [7] on cowpea in south of Côte d'Ivoire revealed about sixty families belonging to 10 orders in which 7 had economic importance. Other study on the entomofauna of the cowpea done in Benin by [20] allowed the harvesting of 35 species belonging 18 families and 7 main orders. In total 2316 individuals were captured with the highest number (927 insects) recorded during the fruiting stage representing 40.03 % of total of captured insects. This high number at this phenological stage could be explained by the emission of certain attractive chemical substances elaborated during the formation of the fruits. Our results are similar to those of [7] which obtained a higher number of insects on cowpea at fruiting stage than at the stage before flowering and flowering. [21] during a study on the entomofauna associated eggplant in south of Côte d'Ivoire also reported a number of insects very high during the fruiting stage. Among the insects captured, *O. mutabilis* was highest numbers. This is due to the fact that this Chrysomelidae was caught during the stage before flowering, flowering and fruiting stage of

the crop with high numbers at each phase. This observation is similar to those of [22] who reported that the population of *O. mutabilis* increased exponentially at the stage before flowering and flowering and dropped from the period of pod formation during cowpea crop.

The relative abundance of species recorded to the different phenological stages showed that *O. mutabilis* was most abundant at the stage before flowering and flowering. This observation would be linked to the presence of tender leaves, flower buds and the flowers they gnawed. The species *M. sjostedti* was abundant at the flowering and fruiting stages. The abundance of the Thysanoptera would be related to the formation of a fairly large number of flower buds and flowers at this stage of development of cowpea. Our results are in agreement with those of [7] who reported a abundance of *M. sjostedti* on cowpea at the flowering and fructification stage compared to other insects present.

The distribution of the species based on the frequency of occurrence revealed that *O. mutabilis* was an ubiquist species during the crop cycle of cowpea. This Ubiquity would be justified by the fact that this pest attacked several organs of the host plant (leaves, flower buds, flowers and pods.) but more on leaves. These results are similar to those of [23] who noticed that the Chrysomelidae including *O. mutabilis* were observed to all phenological stages of the Curcubitaceae (*Lagenaria sicereria* and *Citrullus lanatus*) and on different organs (stems, branches, flowers and fruits). Five pests (*M. quaterna, A. foveicolis, B. tabaci, M.sjostedti, R. dentipes*), has been constant species. Pests would have been attracted by the volatiles released by the host plant. A predator (*Rhinocoris albopilosus*) was also constant species. The presence of *R. albopilosus* can be explained by the abundance of prey especially *O. mutabilis*.

The different insects harvested are divided into three groups according to the trophic status. Thus we distinguish pests, predators and pollinators. According to the contested part of the plant among the pests, there are defoliating insects, sucking insects and borers of pods and seeds. The attack rates induced by these pests varied according to the phenological groups and stage of the plant. During the stage before flowering, defoliating insects induced a higher attack rate than those caused by sucking insects. The high attack rate is justified by the ubiquity and abundance of *O. mutabilis* and other defoliating insects that have a preference for leaves because they are tender. This observation is similar to those of [24] which indicated that at this stage of the plant, these insects attack the leaves because they are tender and turgescent. Sucking insects especially *A. craccivora* attacked leaves and stems causing stunting of plants. This observation was also reported by [7] who revealed the attack of these organs by the Homoptera. The Heteroptera Plataspidae (*Megacopta cribraria* and *Coptosoma*

nubila) also attacked stems and leaves. This observation is consistent with that of [25] who reported the presence of Plataspidae on the cowpea crop in Nigeria. At flowering stage, defoliating insects caused the most damage. This would be due to the fact that in addition to the defoliating insects already mentioned, other insects have attacked floral organs such as *O. mutabilis*, *Mylabris sp* and *M. sjostedti* which ate the floral buds and flowers that withered and eventually fell. These observations are similar to those of [26] who indicated that when insects gnawed the flowers and pods, these actions can destroy flowers and fruits. During the fruiting stage, sucking insects have induced the highest attack rate. These results corroborate those of [20] and [7] who reported pod attacks by this category of pests. The decrease in attack rates induced by defoliating insects could be explained by the decline in numbers of the main defoliating insect *O. mutabilis*.

Predators caught on the site attacked various prey species. The larvae and adults of *Cheilomenes sulphurea* fed on a large number of aphids. These observations are consistent with those of [27] who reported that the species *Cheilomenes sulphurea* in the larval stage and adult is an excellent predator of aphids. The larvae of *Episyrpus* sp also attacked aphids. Three species belonging to the family of the Reduviidae (*R. albopilosus*, *R. rapax* and *R. bicolor*) were collected. This presence would be justified by the presence of many prey in particular *O. mutabilis* which they sucked hemolymph whose they sucked hemolymph. These results are close to those of [28] who identified in Cote d'Ivoire *R. albopilosus* as predator of *Dysdercus volkeri* (Heteroptera: Pyrrhocoridae) and *Podagrica decolorata* (Coleoptera; Chrysomelidae). The species *R. rapax* was also observed by [14] as a predator of adults from *Lilioceris livida* (Coleoptera; Chrysomelidae). Other predators attacking at various preys have been observed. It was Coleoptera (*Cicindela* sp.), Diptera (*Tolmerus cingulatus*) and Hymenoptera (*Vespula* sp). Similarly, [13] have identified these insects belonging to these different orders as predators of other insects.

5- CONCLUSION

The inventory of insects associated of cowpea in south of Côte d'Ivoire revealed the presence of 44 species distributed between 9 orders and 29 families. Insects were captured to all phenological stages with a higher number at the fruiting stage. Two species had the highest numbers. These are *Ootheca mutabilis* and *Megalurothrips sjostedti*. At the stage before flowering and flowering, *O. mutabilis* was most abundant whereas *M. sjostedti* was most abundant during fruiting stage. This inventory also revealed that *O. mutabilis* was ubiquist species during cowpea crop. The attack rates of plants varied according to the phenological

and groups of insects. Defoliator insects induced the highest attack rate at the stage before flowering and flowering. Sucking insects caused highly attack rate during fruiting stage. Three species have been identified as predators of adults of *O. mutabilis.* There are *Rhinocoris albopilosus*, *R. rapax* and *R. bicolor.* It would be useful to carry out studies on the bioecology of *O. mutabilis* which is the major entomological constraint of cowpea in south of Côte d'Ivoire, in order to propose an effective method of struggle against this pest.

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