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RESEARCH ARTICLE

VARIETAL SELECTION OF COWPEA (*VIGNA UNGUICULATA* L.) FROM THE PLAGUE ACTION OF INSECTS IN DALOA (CENTER-WEST, COTE D'IVOIRE)

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ABSTRACT

Cowpea (*Vigna unguiculata* L.) is a legume whose seeds and leaves are used for human consumption. However, many insects cause damage to inflorescences, fruits and / or leaves. The objective of the work was to take an inventory of insects, identify pests, describe their damage and assess the damage caused by pests in order to select resistant varieties. To carry out this study, 16 varieties were cultivated. The test was conducted using a three-block arrangement. A method was used to quantify the insects physical capture using the hay net. The visual method was used to quantify the damage by a simple count. The data collected indicate that the insects most harmful to cowpea belong to four orders: Lepidoptera, Heteroptera, Coleoptera and Orthoptera. The damage caused by insects on each variety is different. This damage is proportional to the number of pests. In conclusion the varieties N11BBoBp, N8BRcp, N18ZR, N21DR and N10BBrp would be the most resistant to pests. These results indicate a new approach to the dynamics of cowpea insect pests.

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INTRODUCTION

A large part of the world's population and particularly that of Africa suffers from protein malnutrition. Indeed, hundreds of thousands of children die each year from Kwashiorkor and Marasmus as a result of protein deficiency (Aykroyd *et al*., 1982). This protein malnutrition is due not only to the quantitative insufficiency of available animal proteins, but also to their high cost, which makes them inaccessible to low-income populations. Legumes are also an important source of protein. This is the case of cowpea (*Vigna unguiculata* L.) which is a legume of warm regions of African origin. It is cultivated for its seeds and leaves. Consuming cowpeas contributes to a healthy and balanced diet for humans. It is cultivated in many countries. Global cowpea production is over 5.7 million tons of dry seeds per year (Tengo, 2011). Its annual cultivated area in the world is more than 12.5 million hectares, including 9.8 million in West Africa, making this region the leading producer and consumer of cowpea in the world. In Côte d'Ivoire, this food is consumed mainly by the populations of the North (Tengo, 2011). Unfortunately, several factors limit cowpea production in West Africa and particularly in Côte d'Ivoire. Pests are the major constraints to cowpea production (Alzouma, 2001). The damage caused by these pests can reach 70 to 80% (Séri-Kouassi *et al*., 2004). To deal with this scourge, the chemical control method has been considered. However, this method quickly showed its limits given the risk of these products accumulating in the seed. Thus, the method of varietal control should be considered. This new method will only be effective following knowledge of the cowpea pest entomofauna. It is in this context that this study was initiated. Overall, it aims to select cowpea varieties resistant to pest insects. Specifically, the study aims to (i) make an inventory of the entomofauna associated with cowpea, (ii) identify cowpea pest insects (iii) describe the damage caused by cowpea pest insects and (iv) assess the damage caused by insect pests.

Study area: The city of Daloa is located in the center-west of Côte d'Ivoire, in West Africa. Its geographic coordinates are 6 ° 53 'North latitude and 6 ° 27' West longitude. The experimental plot is located 400 meters from the library of the Jean Lorougnon Guédé University which covers an area of 342 m^2. The climate has four (4) seasons. The main rainy season starts from April to mid-July, the short dry season from mid-July to mid-September, the short rainy season from mid-September to November and the long dry season from December to March (N'Guessan *et al*., 2014). The dry and wet seasons alternate with temperatures varying from 24.65 ° C to 27.75 ° C on average. With annual rainfall that fell from 1,868.5 mm in 1968 to 1,200 mm in 2014, the region is experiencing a drop in rainfall of around 40% (Ligban *et al*., 2009). Almost the entire basin is in a humid tropical zone with regressively evolving dense forest vegetation. The soils are of the ferralitic type.

MATERIAL AND METHODS

Presentation of the experimental plot: The study plot was located 400 meters from the library of the Jean Lorougnon Guédé University. It had an area of 342 m^2. The experimental plot was set up manually using hoes, machetes, and rakes. After clearing, followed the installation of the planks, sixteen in number per block, each with an average of 3 m long and 1.5 m wide (3 m x 1.5 m), then stakes to determine the points of seedlings. The plowing of the field was carried out with the hoe and the daba in order to stimulate a good penetration of the roots as well as their development. The spacing between these boards is on average 0.5 m. All of these 16 boards were a block repeated three times at random. The experimental plot consisted of three blocks (Figure 1). The insects were collected from sixteen (16) varieties of cowpea (*Vigna unguiculata*) which were distributed over all three blocks. These are: N2KBoBg, N3KR, N4KBNp, N5BBr, N6BR, N7BRc, N8BRcp, N9BN, N10BBrp, N11BBoBp, N13KBoNm, N14BBoBg, N15ZBoNg, N18ZR, N19ZBoBp and N21DR from different areas of Côte d'Ivoire (Table I).

Insect sampling method: The capture of insects dependent on cowpea was carried out successively on the blocks with a view to quantifying them. The capture of insects took place 10 days after semi. The method of physical capture was used. It consisted in shaking the cowpea plants early in the morning between 6 a.m. and 8 a.m. so as to drop the insects into the petri dishes (case of Coleoptera). The mower net was used to immobilize flying insects. After capture, samples are transported to the laboratory for storage and for identification later. The collected insects were stored in pill boxes containing alcohol diluted to 70%. The samples were labeled with an indelible marker. These labels show the block number, the log number and the date of collection. Insects collected were identified using the literature by Mike *et al*. (2004) and Lecoq (1988). Identification was based on external morphological characters.

Data analysis: The species diversity present on cowpeas was assessed using the Shannon index. This index reflects the specific richness (number of species) of a given environment. This index is expressed under the following formula:

$$H' = -\Sigma ((ni / N) * \log2 (ni / N)) \quad (1)$$

with ni: number of individuals of a given species, i ranging from 1 to S, N: total number of individuals (Blondel, 1979). It varies from 0 to 5. Also the Piélou equity index which results in the distribution of species in a given environment was evaluated. That is :

$$E = H' / Hmax \quad (2)$$

$$Hmax. = LogS \quad (3)$$

Hmax being the maximum diversity expressed in bit units and S the total number of species in the medium (Blondel, 1979). The fairness index is very useful for comparing potential dominance between blocks or between sampling dates. When E tends towards 1, which reflects a good distribution of insects at the level of the different blocks and when E tends towards 0 the distribution of insects is uneven at the level of the different blocks.

Damage estimate: For each block and bed, ten plants are chosen at random to assess leaf and pod damage. The count is done manually, namely the number, the number of healthy leaflets, the number of leaflets attacked, the number of pods and the number of pods stung. The rate of leaflet and pod attacked was determined for each variety by the ratio of the number of leaflets attacked to the number of healthy leaflets and the number of pitted pods stung out of the number of healthy pods. The R software was used to calculate the diversity indices. As for the STATISTICA 7.1 software, it was used for the comparison tests (Anova) at the 5% threshold. For each of the variables studied, the means were compared using the Newman-Keuls test.

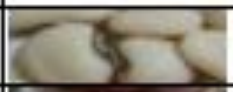
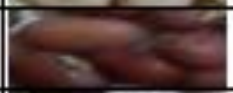
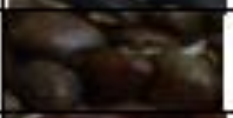
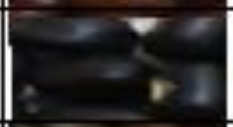
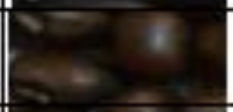
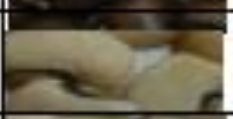
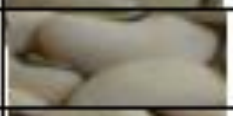
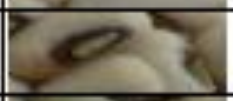
RESULTS

3-1- Inventory of the entomofauna all the blocks combined

A total of 771 insects were captured. They are divided into 9 Orders, 20 Families and (25) Species. The different orders are Coleoptera, Orthoptera, Heteroptera, Diptera, Odonata, Homoptera, Thysanoptera, Hymenoptera and Lepidoptera. The order Coleoptera has more individuals with 56.81% of the insects collected. It is followed by Orthoptera (20.62%), Lepidoptera (6.70%), Heteroptera (5.19%), Diptera (4.41%), Homoptera (2.10%), Hymenoptera (1.69%), Thysanoptera (1.29%) and Odonata (1.19%) (Table II). The species belonging to the orders mentioned are subservient to the different organs of cowpea plants (Table III). The different species of Coleoptera collected on cowpea are : *Podagrica decolorata* and *Podagrica sjostedti* belonging to the Chrysomelidae family, *Cheilomenes lunata* to the Coccinellidae family, *Callosobruchus maculatus* to the Bruchidae family, *Lagria villosa* to the Tenebrionidae family and *Mylabris* spp to fhe Meloidae family. The first three species mentioned were observed on the leaves and flowers throughout the collection period. *C. maculatus* has been observed on the stem, leaves and fruits. The latter two species were only observed during the flowering of the plant.

Specific diversity of the blocks sampled: Overall the Shannon-Weaver diversity index (H ') varies very little per block. It is 1.11 for the block1, 1.16 for the block2 and 1.13 for the block3. These values show that the diversity of insect species collected on cowpea is low.

Table I. Sixteen varieties of cowpea from four areas of Côte d'Ivoire

Administrative region of origin	City of origin	Accessions	Denomination of varieties
Savannah region	Korhogo		N2KBoBg
Savannah region	Korhogo		N3KR
Savannah region	Korhogo		N4KBNp
Tonkpiregion	Biankouma		N5BBr
Tonkpiregion	Biankouma		N6BR
Tonkpiregion	Biankouma		N7BRc
Tonkpiregion	Biankouma		N8BRcp
Tonkpiregion	Biankouma		N9BN
Tonkpiregion	Biankouma		N10BBrp
Tonkpiregion	Biankouma		N11BBoBp
Savannahregion	Korhogo		N13KBoNm
Tonkpiregion	Biankouma		N14BBoBg
Marahouéregion	Zuénoula		N15ZBoNg
Marahouéregion	Zuénoula		N18ZR
Marahouéregion	Zuénoula		N19ZBoBp
Haut-Sassandraregion	Daloa		N21DR

Meaning of varietiesnames: N2KBoBg (number 2 Korhogo white eye white big seed), N3KR (number 3 Korhogo red), N4KBNp (number 4 Korhogo white black small seed), N5BBr (number 5 Biankouma white red), N6BR (numberBiankoumared), N7BRc (number 7 Biankoumared short seed), N8BRcp (number 8 Biankoumared short smallseed), N9BN (number 9 Biankouma black), N10BBrp (number 10 Biankouma white redsmallseed), N11BBoBp (number 11 Biankouma white eye white smallseed), N13KBoNm (number 13 Korhogo white eye black medium seed), N14BBoBg (number 14 Biankouma white eye white big seed), N15ZBoNg (number 15 Zuénoula white black eye big seed), N18ZR (number 18 Zuénoulared), N19ZBoBp (number 19 Zuénoula white eye white littleseed) et N21DR (number 21 Daloa rouge)

Table II. Abundance of orders and species collected on cowpea

Orders	Species	Abundance	Total	Frequency (%)
Orthoptera	*Zonocerus variegatus*	92	159	20,62
	Tettigonia viridissima	14		
	Schistocerca pollens	53		
Coleoptera	*Podagrica sjostedti*	133	438	56,81
	Podagrica decolorata	125		
	Mylabris spp	22		
	Callosobruchus maculatus	17		
	Cheilomenes lunata	38		
	Lagria vilosa	103		
Homoptera	*Edwardsiana bergmanni*	4	16	2,10
	Empoasca spp	12	40	5,19
Heteroptera	*Hyalymenus* sp	12		
	Anoplocnemis curvipes	15		
	Dysdercus sp	13	52	
Lepidoptera	*Polyommatus icarus*	13		
	Heliothis armigera	12		
	Spodoptera littoralis	6		6,70
	Papilio machaon	9		
	Maruca testulalis	12		
Diptera	*Calliphora vomitoria*	16	34	4,41
	Luciliacaesar	18		
Hymenoptera	*Bombus terrestris*	8	13	1,69
	Xylocopa olivacea	5		
Odonata	*Crocothemis ecarlate*	9	9	1,19
Thysanoptera	*Megalurothips sjostedti*	10	10	1,29

Table III. Infested Insects to cowpea organs and their plague status

Orders	Famillies	Genus	Species	Statut	Steam	Leave	Flower	Fruit
Orthoptera	Pyrgomorphidae	*Zonocerus*	*Zonocerus variegatus*	P	X	X		
	Tettigoniidae	*Tettigonia*	*Tettigoniaviridissima*	P		X		
	Tettigoniidae	*Schistocerca*	*Schistocerca pollens*	P		X		
Coleoptera	Chrysomelidae	*Podagrica*	*Podagricasjostedti*	P		X		
	Chrysomelidae	*Podagrica*	*Podagricadecolorata*	P		X		
	Meloidae	*Mylabris*	*Mylabris*spp.	P		X		
	Bruchidae	*Callosobruchus*	*Callosobruchus maculatus*	P	X	X		X
	Coccinellidae	*Cheilomenes*	*Cheilomeneslunata*	A	X	X	X	
	Tenebrionidae	*Lagria*	*Lagriavilosa*	P		X	X	
Heteroptera	Alydidae	*Hyalymenus*	*Hyalymenus*sp.	P				X
	Coreidae	*Anoplocnemis*	*Anoplocnemiscurvipes*	P				X
	Pyrrhocoridae	*Dysdercus*	*Dysdercus*sp	P				X
Homoptera	Cicadellidae	*Edwardsiana*	*Edwardsianabergmanni*	P			X	X
	Jassidae	*Empoasca*	*Empoasca* spp.	P			X	X
Odonata	Libellulidae	*Crocothemis*	*Crocothemisecarlate*	P	X	X	X	
Lepidoptera	Lycaenidae	*Polyommatus*	*Polyommatusicarus*	P			X	X
	Noctuidae	*Heliothis*	*Heliothisarmigera*	P		X		
	Noctuidae	*Spodoptera*	*Spodoptera littoralis*	P		X		
	Papilinidae	*Papilio*	*Papiliomachaon*	P		X		
	Pyralidae	*Maruca*	*Marucatestulalis*	P		X	X	X
Diptera	Calliphoridae	*Calliphora*	*Calliphora vomitoria*	A		X		
	Calliphoridae	*Lucilia*	*Luciliacaesar*	A		X		
Hymenoptera	Apidae	*Bombus*	*Bombus terrestris*	A		X	X	X
	Apidae	*Xylocopa*	*Xylocopa olivacea*	A			X	
Thysanoptera	Thripidae	*Megalurothips*	*Megalurothipssjostedti*	P		X	X	
A: Auxiliary	R : Pest		X : Presence					

Table IV. Comparison of the quantitative parameters of the sixteen varieties of cowpea

Varieties	Leaflet (Avg±Sd)	Attack (Avg±Sd)	Pod Attack (Avg±Sd)
N10BBrp	369,0 ±105,15^{ab}	63,8± 18,59^{abc}	5,8±4,21 ^{abc}
N11BBoBp	333,6±99,13^{ab}	63,2±21,02^{abc}	3,7±3,30^{ab}
N13KBoNm	396,0±78,00^{ab}	87,6±27,57^{abc}	5,5±4,85^{c}
N14BBoBg	456,1±99,76^{b}	108,9 ±46,05^{c}	6,5±5,81^{abc}
N15ZBoNg	456,4±132,08^{ab}	105,7± 30,30^{cd}	4,2±4,28^{ab}
N18ZR	318,2±63,54^{ab}	51,4±18,67^{ab}	1,4±1,42^{a}
N19ZBoBp	378,3±148,00^{ab}	108,4±30,49^{cde}	5,5±4,16^{abc}
N21DR	372,9±114,18^{ab}	42,1±15,66^{a}	1,6±1,57^{a}
N2KBoBg	402,1±144,27^{ab}	105,3 ±33,87^{cde}	5,9±2,76^{abc}
N3KR	300,8±78,61^{ab}	72,5±30,87^{abc}	5,7±5,22 ^{abc}
N4KBNp	324,9±72,25^{ab}	105,5±36,02^{cde}	4,5±2,59^{abc}
N5BBr	375,7±132,41^{ab}	141,6±39,23^{de}	5,9±4,30^{abc}
N6BR	270,6±57,17^{a}	93,2 ±24,79^{bc}	8,1±4,48^{abc}
N7BRc	354,5±105,50^{ab}	150,2 ±66,70^{e}	6,8±2,69 ^{abc}
N8BRcp	345,2±104,34^{ab}	60,7±33,57^{abc}	2,5±1,26^{ab}
N9BN	405,3±96,16^{b}	96,7±42,26^{bcd}	4,8±3,35^{abc}
P	0,00	0,00	0,00
Ddl	15	15	15

Column averages affected by the same letter are statistically identical

Table V . Agronomic parameters of the sixteen less attacked varieties

Varieties	NGos	NbGr	PGos(g)	Pcoq(g)	PGr(g)
N3KR	19,2±6,76^{c}	241,6±89,48^{de}	25,7±5,11^{bcd}	6,06±2,55^{abc}	15,43±2,72^{de}
N5BBr	17,2±4,14^{bc}	231,6±77,37^{d}	26,65±3,78^{cd}	9,09±1,73^{bcdef}	12,77±2,37^{cd}
N6BR	18,4±3,28^{bc}	240,2±61,50^{de}	27,09±1,30^{cd}	7,02±1,25^{abcde}	15,93±1,00^{de}
N7BRc	19,80±5,97^{c}	263,2±78,13^{def}	35,62±5,35^{def}	12,53±3,49^{fg}	15,41±3,43^{de}
N8BRcp	27,6±8,04^{de}	367,00±133,27^{fg}	36,23±15,82^{def}	10,79±5,91^{ef}	19,79±7,80^{e}
N9BN	16,80±3,34^{bc}	250,8±80,62^{de}	29,83±6,43^{de}	8,32±1,72^{bcde}	16,96±3,79^{de}
N10BBrp	23,20±7,69^{cd}	355,40±165,71^{efg}	35,10±8,60^{de}	10,37±3,69^{def}	20,15±5,54^{e}
N15ZBoNg	8,00±0,70^{a}	65,20±21,6^{ab}	14,72±2,56^{ab}	7,47±1,84^{bcde}	01,46±0,88^{a}
N18ZR	27,4±10,31^{de}	381,8±186,62^{g}	34,34±13,7^{def}	9,76±4,94^{cdef}	20,20±5,69^{e}
N21DR	30,6±7,33^{e}	409,8±104,05^{g}	41,23±13,75^{f}	15,21±5,32^{g}	18,49±3,19^{e}
N2BoBg	18,8±1,64^{c}	175,4±35,02^{bcd}	36,04±8,93^{def}	8,27±3,49^{bcde}	19,59±1,96^{e}
N4KBNp	11,4±1,34^{ab}	107±17,79^{abc}	25,89±3,11^{cd}	6,53±1,67^{abcd}	8,41±1,04^{bc}
N11BBoBp	22±7,84^{cd}	190,2±85,11^{cd}	40,20±14,49^{ef}	9,53±2,96^{cdef}	17,08±5,55^{de}
N13KBoNm	7,8±3,11^{a}	47,4±22,68^{a}	18,68±7.03^{abc}	5,17±2,10^{ab}	6,71±2,05^{b}
N14BBoBg	20±2,12^{c}	173,6±19,44^{bcd}	41,38±2,68^{f}	10,19±0,54^{def}	16,67±3,63^{de}
N19ZBoBp	9,2±5,06^{a}	77,8±53,7^{abc}	12,16±7,49^{a}	3,39±2,16^{a}	3,91±2,7^{ab}

NB: For eachcharacter, the values bearing the sameletters are statisticallyidentical (Newman and Keuls test).
NGos: number of pods; NbGr: number of seeds; PGos (g): podweight in grams; PCoq (g): weight of the hulls in grams; PGr (g): weight of seeds in gra

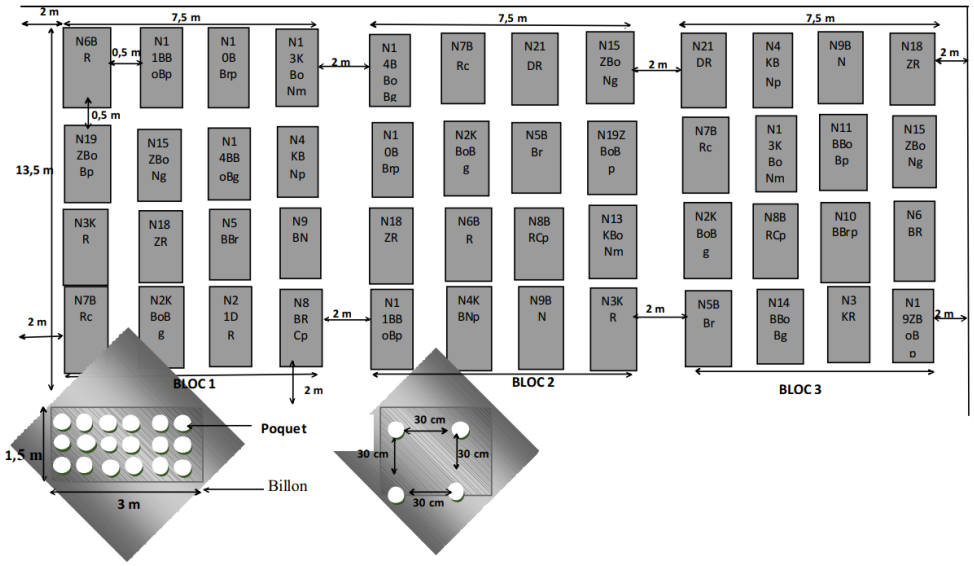


Figure 1. The experimental plot

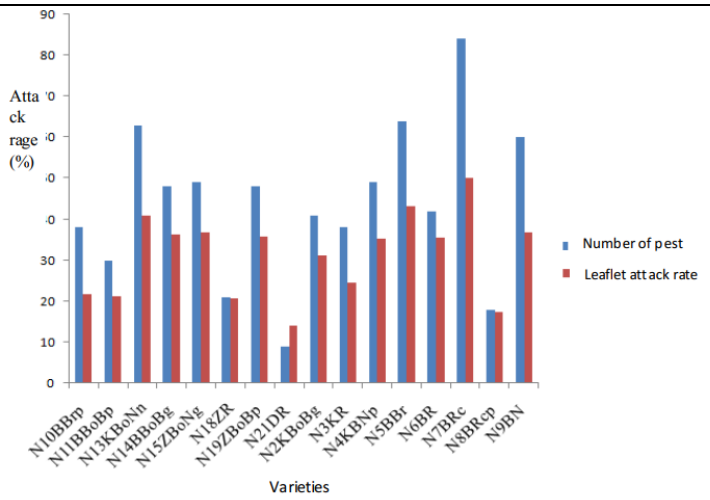


Figure 2. Abundance of pestsidentified on cowpeavarieties and theirattack rate

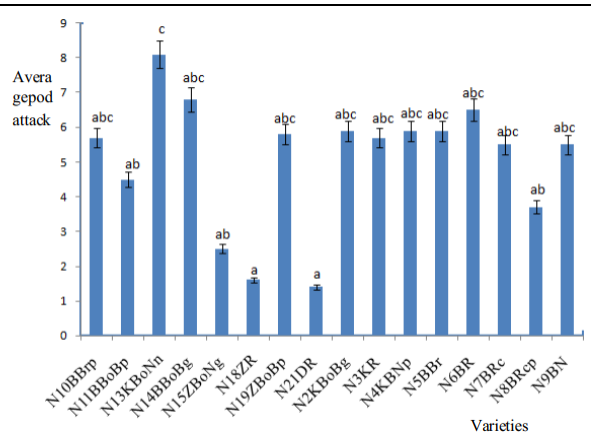


Figure 3. Averagenumber of seedpodsaccording to the variety Varietieswith the sameletters are statisticallyidentical

The equity indices (E) are markedly high for each block. The blocks 1, 2 and 3 have respectively 0.80; 0.83 and 0.80 as equity index values.

Assessment of damage according to the variety and by phenological stage

Leaves damage: The parameters such as average leaflet, average leaflet attacked were evaluated on the sixteen varieties of cowpea studied. The results of the analyzes showed a significant difference between varieties for these parameters.
To this end, a correlation was established between the number of insects and the number of leaflets attacked. The varieties N10BBrp, N11BBoBp, N13KBoNm, N3KR, N8BRcp are identical for the average leaf attack parameter. Variety N7BRc recorded a higher average leaflet attack (150.2 ± 66.70), while variety N21DR variety recorded the smallest average leaflet attack (42.1 ± 15.66) (Table IV).

Pod damage: The varieties N9BN, N7BRc, N6BR, N5BBr, N4KBNp, N3KR, N2KBoBg, N19ZBoBp, N14BBoBg, N10BBrp recorded substantially the same damage in terms of pods. The N21DR and N18ZR varieties recorded the low damage while the N6BR recorded the high damage (270.6±57.17).

Comparison of yields of different cowpea varieties: Agronomic parameters such as number of pods, number of seeds, weight of pods, weight of seeds and weight of hulls were estimated in the sixteen varieties of cowpea. The results obtained made it possible to distinguish the varieties because a highly significant difference was observed (Table V).

Number of seeds: The measurements made on the number of seeds show that the variety N21DR recorded the highest number of seeds (409.8 ± 104.05) while the variety N15ZBoNg recorded the lowest number of seeds (65.20 ± 21.6). The number of seeds is appreciably equal for the varieties N3KR, N6BR, N9BN ditto for the varieties N14BBoBg and N2BoBg.

Pod weight in grams (g): The results from statistical analyzes show that the N14BBoBg variety has the highest pod weight (41.38 ± 2.68) while the N19ZBoBp variety has the lowest pod weight (12.16 ± 7.49). The pod weight is appreciably equal between the varieties N5BBr, N6BR, N4KBNp, then between the varieties N8BRcp, N18ZR, N7BRc ditto for the varieties N21DR and N14BBoBg.

Shell weight in grams (g): In terms of shell weight, variety N7BRc gives the highest value (12.53 ± 3.49) while variety N19ZBoBp has the lowest shell weight (3.39 ± 2.16). The weight of the hulls is appreciably identical for the varieties N9BN, N15ZBoNg and N2BoBg, then the same between N14BBoBg and N10BBrp and finally between N11BBoBp and N18ZR.

Seed weight in grams (g): The weight of the seeds is approximately equal between the varieties N3KR, N6BR, N7BRc, N9BN, N14BBoBg and N11BBoBp same for the varieties N8BRcp, N10BBrp, N2BoBg, N18ZR, N21DR. Variety N18ZR gave the highest seed weight (20.20 ± 5.69) while variety N15ZBoNg gave the lowest seed weight (01.46 ± 0.88).

Sensitivity of different varieties to pest attacks: The parameters evaluated made it possible to determine the susceptible varieties on the one hand and the resistant varieties on the other.

Leaflet attack rate: Varieties N8BRcp, N18ZR, N21DR, N10BBrp and N11BBoBp recorded low rates of leaflet attack while high rates of leaflet attack were observed in varieties N6BR, N7BRc. The varieties that harbored the greatest number of pests experienced the highest rates of leaflet attack (Figure 2). The rate of leaflet attack varies proportionally with the number of pests.

Attack on pods: The varieties N2KBoBg, N3KR, N4KBNp, N5BBr, N6BR, N7BRc and N9BN are roughly equal in terms of pod attack. The N18ZR and N21DR varieties show the lowest pod attack while the N13KBoNm variety shows the highest average pod attack (Figure 3). Of the three parameters evaluated, the varieties N8BRcp, N18ZR, N21DR, N10BBrp and N11BBoBp differ from the other varieties. These five varieties recorded low pest abundances, low leaflet attack rate and low pod attack, which made them resistant to pests. Varieties with high pest abundance, low leaflet attack rate and weak pod attack are considered to be the most susceptible.

DISCUSSION

During the two months of collection, the identified insects belong to nine (9) orders. These are Coleoptera, Orthoptera, Heteroptera, Diptera, Odonata, Thysanoptera, Hymenoptera and Lepidoptera. These results are close to those obtained by Séri-Kouassi (2004) who obtained ten (10) orders in lower Côte d'Ivoire (Abidjan). Of these orders, four of them (Coleoptera, Orthoptera, Heteroptera, Lepidoptera) were listed as the main pests. Under experimental conditions, the appearance of the first pests took place five days after semi. The order Coleoptera with 56% of the insects are considered dangerous for the cultivation of cowpea. This could be explained by their feeding activity throughout the different stages of plant development. In addition, the high percentage of this order would result from the sampling period (6 am and 8 am) important for their development. These observations are contrary to those of Séri-Kouassi (2004) who obtained a low number due to the capture period between 9 am and 2 pm. The Shannon indices calculated for each block indicate a low diversity because they are lower than the threshold value which is 5. Indeed, the fairness is high for each block because it tends towards 1, which shows that it does not there is no dominance between the different insect families on the blocks. This low diversity obtained could be linked to the climate. Indeed, the low rainfall recorded during the period of our experiment could have negative influences on the development of insects. These observations are confirmed by the results of Craufurd *et al*. (1996) that low rainfall considerably reduces the number of insect species. In addition, the good maintenance of the plot (manual weeding) could also be the basis of the absence of certain species. This is the case for certain species such as: *Amsacta moloneyi*, *Maruca testulalis*, *Taeniothrips sjostedti*, *Callosobruchus maculatus*, *Ootheca mutabilis*, *Bruchidius atrolineatus*, *Callosobruchus chinensis*, *Callosobruchus rhodesianus* which were not mentioned by Séri-Kouassi (2001) which were not identified on our study plot.

For damage, varieties N19ZBoBp, N14BBoBg, N13KBoNn, N15ZBoNg, N4KBNp and N5BBr had strong pest averages. This would explain a high rate of damage on these varieties. Hence the production of a relatively low number of pods and seeds for the latter. In contrast, varieties N11BBoBp, N8BRcp, N18ZR, N21DR and N10BBrp recorded low abundances and attacks, which may be due to resistance. These two remarks made, allow us to say that the number of insect pests varies proportionally with their attacks. This slight damage experienced by varieties N11BBoBp, N8BRcp, N18ZR, N21DR and N10BBrp is believed to be due to phytotoxins contained in the leaves of these. This point was made by Zakari (2013). Indeed, these variations of attacks could explain the significant differences between the yields as already pointed out by Habiba (2004). Across all three blocks, varieties N11BBoBp, N8BRcp, N18ZR, N21DR and N10BBrp gave low mean attacks, which would give them resistance to pests. In addition, these varieties provided a greater number of agronomic parameters such as number of pods, number of seeds, weight of pods, weight of seeds and weight of hulls. The ability of these varieties to resist pests could be one way to increase seed yield.

This confirms the results of certain authors (Aggarwal and Ouédraogo, 1989; Maïga and Issa, 1988) according to which, in its ecology, the cowpea plant capable of resisting pests is a guarantee of a good yield when it is already adapted to his living environment.

CONCLUSION

The study of the selection of 16 cowpea varieties collected in four zones of Côte d'Ivoire made it possible to distinguish promising varieties in terms of resistance to pests and yield. This study also identified the pests which include five subgroups of pod and seed borers, defoliators, flower bud borers and flower borers, sucker stingers and floricultural plants. Four main orders have been identified as the most harmful to cowpea cultivation. They are: Lepidoptera, Heteroptera, Coleoptera and Orthoptera. Low diversity was observed and a good distribution of insect species. At the end of this study, the cowpea varieties identified as being the most resistant are : N11BBoBp, N8BRcp, N18ZR, N21DR and N10BBrp. Indeed, these varieties are little attacked and give a good yield. The use of these varieties as a control method must be initiated against the insect pests of this crop if we want to improve the seed yield. In addition, the varieties having recorded the greatest damage and abundance could be used as cover crops in order to minimize the damage of the most resistant ones.

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Key points: This study will allow to know:

- the entomofauna of cowpea in Daloa which was still unknown compared to other regions of Côte d'Ivoire
- Cowpea varieties resistant to insect attack that should be promoted to farmers

This study will also make it possible to popularize less resistant varieties as cover crops to reduce insect damage to cowpea.

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