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## Pest incidence and yield losses on five Cowpea (*Vigna unguiculata* L. Walp) varieties in field at Garoua (North Cameroon)

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### ABSTRACT

Cowpea is a cash crop in the Sudano Sahelian zone however its production is affected by many constraints including pest pressure. The objective of this study was to assess the incidence and quantify the yield losses caused by pests in the field of five cowpea varieties *Vigna unguiculata* L. Walp popularized by research in Garoua North Cameroon. The experiment was designed using a split plot design two-factor for four replications in two rainy seasons 2022 and 2023 at the Garoua Multipurpose Agricultural Research Station. Insecticide application was the main factor and varieties were the secondary factor. The following observations were made: percentage of plants attacked by Thrips; count of black and brown pod-sucking bugs, health analysis of flower buds, yield and yield losses. The results showed that plant protection by the application of insecticides is a determining factor for good yield and limits losses due to pests in the field. Thrips and Pod-sucking bug insects had a strong incidence respectively on variety V3: *Fekem* and variety V2: *Lori-3*. Among the different varieties, no difference was observed in terms of pod yield and grain yield. However, variety V3: *Fekem* recorded a grain yield of  $420.6 \pm 76.7$  kg/ha with a significantly lower seedless yield. In the absence of appropriate phytosanitary protection, yield losses can reach up to  $83.5 \pm 10.7\%$ . Variety V2: *Lori-3* recorded the highest yield loss rate while variety V3 recorded the lowest percentage of losses due to pests.

**Keywords:** Incidence, Yield losses, Pest, *Vigna unguiculata* L. Walp, North Cameroon.

### RESUME

#### Incidence des ravageurs et pertes de rendement sur cinq variétés de niébé (*Vigna unguiculata* L. Walp) en plein champ à Garoua (Nord du Cameroun)

Le niébé est une culture de rente dans la zone soudano-sahélienne, mais sa production est affectée par de nombreuses contraintes, notamment la pression des ravageurs. L'objectif de cette étude était d'évaluer l'incidence et de quantifier les pertes de rendement causées par les ravageurs sur cinq variétés de niébé (*Vigna unguiculata* L. Walp.) vulgarisées à station de recherche de Garoua, au nord du Cameroun. L'expérimentation a été menée selon un dispositif en split-plots à deux facteurs, avec quatre répétitions, sur deux saisons des pluies (2022 et 2023) à la Station Polyvalente de Recherche Agricole de Garoua. L'application des insecticides était le facteur principal et les variétés le facteur secondaire. Les observations suivantes ont été réalisées : pourcentage de plantes attaquées par les thrips ; dénombrement des punaises noires et brunes suceuses de gousses ; analyse de l'état sanitaire des boutons floraux ; rendement et pertes de rendement. Les résultats ont montré que la protection des plantes par l'application d'insecticides est un facteur déterminant pour un bon rendement et limite les pertes dues aux ravageurs. Les thrips et les punaises suceuses de gousses ont eu une forte incidence respectivement sur la variété V3 : *Fekem* et la variété V2 : *Lori-3*. Parmi les différentes variétés, aucune différence n'a été observée en termes de rendement en gousses et de rendement en grains. Cependant, la variété V3 : *Fekem* a enregistré un rendement en grain de  $420,6 \pm 76,7$  kg/ha avec un rendement en tégument significativement inférieur. En l'absence de protection phytosanitaire appropriée, les pertes de rendement peuvent atteindre jusqu'à  $83,5 \pm 10,7\%$ . La variété V2 : *Lori-3* a enregistré le taux de perte de rendement le plus élevé, tandis que la variété V3 : *Fekem* a enregistré le pourcentage de perte due aux ravageurs le plus faible.

Mots-clés : Incidence, Pertes de rendement, Ravageur, *Vigna unguiculata* L. Walp, Nord Cameroun.

### INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) is a grain legume, an important staple food for households in sub-Saharan

Africa (Omoigui *et al.*, 2018). Cowpea seeds represent a valuable source of protein, vitamins and income for

humans, as well as an important source of fodder for animals (Diaga, 2011). This legume is widely cultivated in the northern part of the country and is generally sown in late July or early August, with yields in farmers' fields being very low, below 500 kg.ha<sup>-1</sup> (C2D/PAR, 2013). The production of this interesting legume is limited by several biotic and abiotic constraints, including attacks by harmful insects, poor soils, availability of quality seeds and poor distribution of rainfall. Pest pressure is one of the most significant constraints, especially since cowpea is attacked throughout its growth phase, mainly by seven species, the most important of which are the aphid *Aphis craccivora* Koch and the bug *Clavigralla tomentosicollis* Stal (Abdourahmane *et al.*, 2020). Insect attacks are on productive organs such as flowers and pods, as well as leaves and stems (N'Gbesso *et al.*, 2013). Damage results

in plant destruction, reduced seed quality, or even total loss (Zakari *et al.*, 2019). Several studies have identified the main constraints of the production of this crop; however very little research has focused on the incidence and quantification of yield losses due to pests.

## MATERIALS AND METHODS

### Presentation of the experimental site

This study was carried out on the experimental site of Sanguere Ndjio of the Multipurpose Agricultural Research Station of Garoua (SPRA-Garoua) located in the Department of Benoue, district of Garoua III, North Region of Cameroon (Fig.1). This area is characterized by a long dry season of seven to nine months and a short rainy season of four to three months with little rainfall.

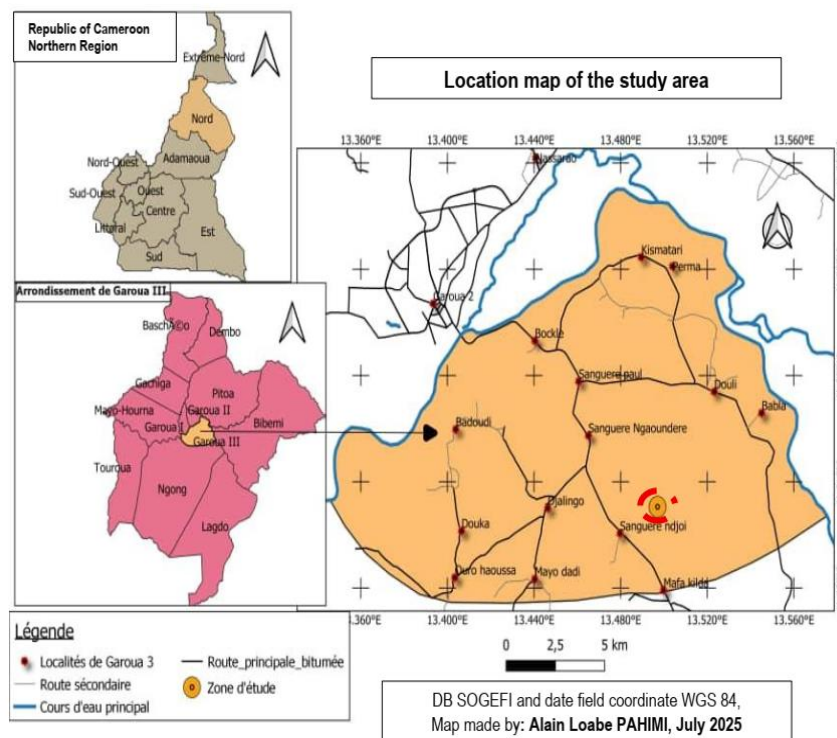


Figure 1. Study area.

### Plant material

The plant material used in this study constituted of five cowpea varieties: V1: *Lori-2*, V2: *Lori-3*, V3: *Fekem*, V4: *P5* and V5: *Black eye*.

### Experimental design

This study was carried out over two campaigns (2022 and 2023) using a split-plot design with two factors and four repetitions (Fig. 2). Insecticide applications sprayed versus no insecticides or unsprayed constituted factor 1, while the five cowpea varieties constituted factor 2. This gives a total of 40 experimental units. Each unit consisted of six lines of six meters, consisting of four central lines and one border line on either side. The distance between each block was 1.5 meters. The seeding density was 0.80m between the rows and 0.5m between the pockets.

### Trial conduct

For both campaigns, sowing was carried out in the first ten days of August on sandy soil after superficial plowing. Two manual weeding were carried out to keep the plots clean until harvest.

### Phytosanitary treatment

45 days after sowing (DAS), from the appearance of the first flower, the insecticide treatment program below was carried out every week only in the plots under protection. That is a total of six insecticide treatments. All insecticide treatments were carried out using the Ulva Plus device with a capacity of 10 liters of spray per hectare. The 6 rows of each plot or experimental unit were treated row by row in a single pass.

Table 1. Plant protection program for the two campaigns.

Weeks	Active ingredient	g active ingredient by l ou Kg	ml or g commercial product by ha
w1	Acetamiprid+ Spinetoram	64/56	250ml
w2	Cypermethrin	360	100 ml
w3	Acetamiprid+ Spinetoram	64/56	250ml
w4	Cypermethrin	360	100 ml
w5	Acetamiprid+ Spinetoram	64/56	250ml
w6	Cypermethrin	360	100 ml

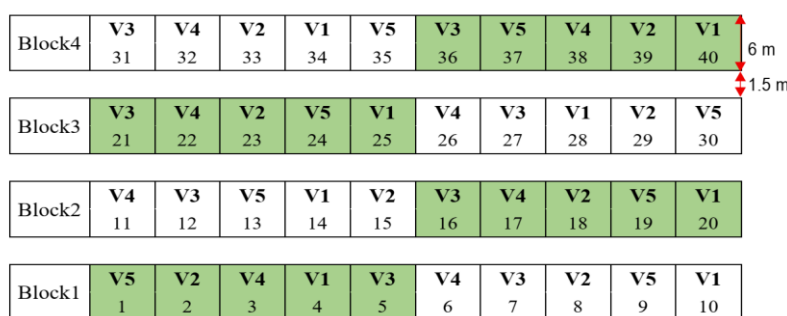
**Data collection**

The following observations were carried out weekly early in the morning: Counting of plants attacked by Thrips, Counting of black and brown bugs on the 4 central lines. A health analysis of the flower buds was carried out on the 60 days after sowing DAS on 10 buds taken from line 1 and line 6 of each plot. The buds were stored in glass bottles with 70° alcohol. In the laboratory, the number of healthy and pierced buds was counted, then the number of *Maruca vitrata* Fabricius larvae, *Spodoptera littoralis* Boisduval larvae, aphid and thrips was classified and then

counted under a magnifying glass. The four central lines (lines 2, 3, 4 and 5) were harvested and the weight of the pods, then that of the seeds, were evaluated in each plot to determine the yield. An assessment of yield losses was made as a percentage.

**Statistical analysis**

Data from the study were subjected to analysis of variance (ANOVA) and significant means were separated by the Newman-Keuls (NK) test method within 5% with the StaBox Pro version 6.5 software.



□: Unsprayed, ■: Sprayed, V1: Lori-2; V2: Lori-3; V3: Fekem; V4: P5; V5: Black eye.  
**Figure 2:** Plot plan.

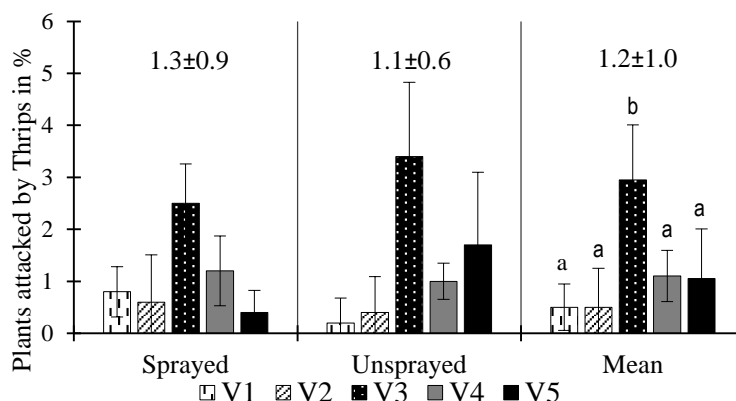
**RESULTS**

**Plant protection and variety response to pest infestations in the field**

**Percentage of plants attacked by Thrips (*Megalurothrips sjostedi* Trybom)**

Thrips are tiny insects found inside flowers and flowers buds. Their attacks on plants during the 2022 season

were practically null and could not be statistically analysed. The percentages of plants attacked by thrips for the 2023 season are illustrated in figure 3. The insecticide applied had no significant (P>0.05) effect on the percentage of plants attacked by this pest. However, variety V3: *Fekem* was the most impacted and recorded significantly (P<0.05) the highest percentage of attacked plants compared to all other varieties



**Figure 3:** Percentage of plants attacked by thrips season 2023.

V1: Lori-2; V2: Lori-3; V3: Fekem; V4: P5; V5: Black eye. Each means followed by the different letter are not significantly different according to NEWMAN-KEULS test, P=0.05).

**Number of pod-sucking bug *Anoplocnemis curvipes* Fabricius and *Clavigralla tomentosicollis* Stal**

The cowpea Pod-sucking bug attacks the pods that end up rotting as illustrated in figures 4 and 5. Pod-sucking bug infestations were significantly (P<0.05) higher in the 2023 season compared to the 2022 season presented in the table

2. The applied insecticide treatment program had no significant (P>0.05) effect on the two types of pod-sucking bugs. An impressive and significantly P<0.05) number of pod-sucking bugs was observed on the V2: *Lori-3* variety compared to all other varieties V1: *Lori-2*, V3: *Fekem*, V4: *P5* and V5: *Black eye*.



Figure 4. Pod-sucking bug *Anoplocnemis curvipes* Fabricius. Figure 5. Damage (rot) caused by pod-sucking insects

Table 2. Number of pod-sucking bug.

Season	Varieties	Sprayed	Unsprayed	Mean
2022	V1	3.1±11.8	12.5±14.9	7.8±12.4
	V2	31.3±25.5	37.5±18.0	34.4±20.4
	V3	9.4±13.9	3.1±28.6	6.3±20.8
	V4	3.1±18.0	6.3±30.4	4.6±23.1
	V5	9.4±6.0	18.8±18.0	14.1±12.4
	<b>Mean</b>		11.3±14.6	15.6±20.3
2023	V1	18.8±11.8	43.8±14.9	31.3±12.4
	V2	68.8±25.5	71.9±18.0	70.3±20.4
	V3	12.5±13.9	81.3±28.6	46.9±20.8
	V4	31.3±18.0	53.1±30.4	42.2±23.1
	V5	18.8±6.0	34.4±18.0	26.6±12.4
	<b>Mean</b>		30.0±14.6	56.9±20.3
Mean grouped	V1	10.9±10.9	28.1±13.8	<b>19.5±12.2<sup>a</sup></b>
	V2	50.0±23.6	54.7±16.1	<b>52.3±3.3<sup>b</sup></b>
	V3	10.9±12.8	42.2±26.5	<b>26.6±22.1<sup>a</sup></b>
	V4	17.2±16.6	29.7±28.1	<b>23.4±8.8<sup>a</sup></b>
	V5	14.1±5.5	26.6±16.1	<b>20.3±8.8<sup>a</sup></b>
	<b>Mean</b>		<b>20.6±14.2</b>	<b>36.3±20.0</b>
Source	DF1/DF2/DF3	1	4	1
	SS1/SS2/SS3	4882.81	11925.77	17999.99
	MS1/MS2/MS3	4882.81	2981.44	17999.99
	F1/F2/F3	4.10	2.86	22.81
	P1/P2/P3	0.1352	0.0453	0.0001

DF: Degree of Freedom; SS: Sum of Squares; MS: Mean Squares; F: Variance; P: Probability of F; V1: Lori-2; V2: Lori-3; V3: Fekem; V4: P5; V5: Black eye. The means followed by the different letter are not significantly different (NEWMAN-KEULS test, P=0.05).

**Analysis of flower buds**

The results of the analysis of flower buds (Table 3) reveal that the 2022 season was marked by a significantly (P<0.05) higher number of thrips and *Maruca vitrata* Fabricius larvae compared to the 2023 season. The

different plots under protection (insecticide sprayed) recorded significantly (P<0.05) lower percentages of pierced flower buds and the lowest number of thrips compared to plots without any protection (Unsprayed). Similarly, a significantly (P<0.05) high number of thrips was observed in the flower buds of variety V3: *Fekem*

(18.3±7.5 thrips) in contrast to variety V4: P5 (7.8±2.2 thrips) which recorded the lowest number of thrips counted.

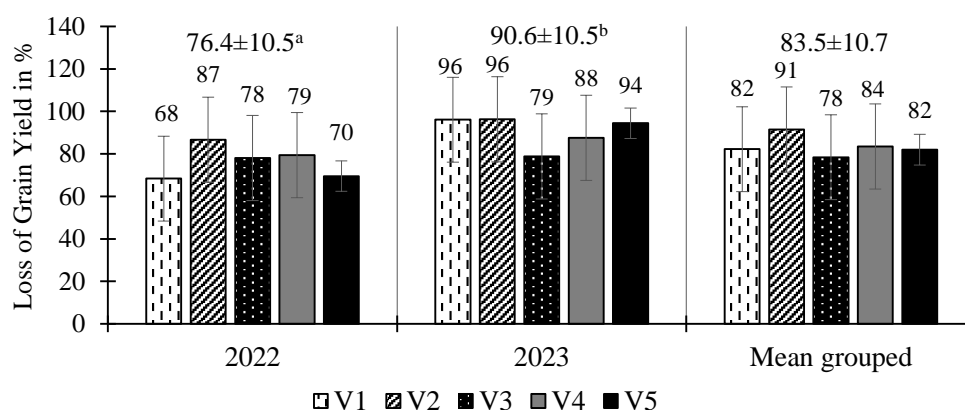
**Yield component**

Table 4 presents all the yield components of all the varieties. The 2023 season was significantly more productive than the 2022 season (pod and seedless yield). The applied protection (insecticide sprayed) has significantly (P<0.05) improved all components of yield of this crop. While, between the different varieties no significant (P>0.05) difference was observed on the pod and grain yield.

The variety V3: *Fekem* obtained 420.6±76.7 kg/ha of grain yield with a significantly lower seedless yield 174.5±18.5 kg/ha compared to the other varieties.

**Yield Losses**

The grain yield losses of different cowpea varieties over the two years of experimentation are illustrated in Figure 6. Overall, yield losses in the absence of phytosanitary protection are approximately 83.5±10.7% for this crop of interest for the Sudano-Sahelian zone. The 2023 season recorded a significant (P<0.05) high yield loss (90.6±10.5%) compared to the 2022 season (76.4±10.5%). No significant difference (P>0.05) was found between the different varieties. However, variety V3 (*Fekem*) recorded the lowest loss rate 78% and variety V2 (*Lori-3*) recorded the highest loss 91%.



V1: Lori-2; V2: Lori-3; V3: Fekem; V4: P5; V5: Black eye. Each means followed by the different letter are not significantly different according to NEWMAN-KEULS test, P=0.05).

Figure 6: Grain yield loss of different varieties.

Table 3. Analysis of the health status of flower buds.

Years	Varieties	Pierced flower Dud in%			Number of Thrips			Number of <i>Maruca</i> larva		
		Sprayed	Unsprayed	Mean	Sprayed	Unsprayed	Mean	Sprayed	Unsprayed	Mean
2022	V1	4.9±4.5	25.2±9.4	15.0±6.6	16.5±2.6	21.3±8.2	18.9±5.6	1.8±1.1	1.0±0.5	1.4±0.8
	V2	2.5±7.5	6.9±9.3	4.7±7.8	9.8±2.5	36.5±8.2	23.1±5.6	1.8±0.8	1.5±0.4	1.6±0.6
	V3	7.5±14.9	14.0±1.2	10.7±9.8	11.8±2.9	36.8±11.6	24.3±7.9	1.3±1.0	1.8±0.9	1.5±0.8
	V4	4.3±4.1	19.1±10.1	11.7±7.2	10.0±2.5	10.0±2.4	10.0±2.3	1.3±1.0	1.5±0.3	1.4±0.7
	V5	7.5±7.5	15.6±12.4	11.6±9.5	14.3±5.9	26.0±7.6	20.1±6.3	0.3±0.4	2.8±0.3	1.5±0.3
	<b>Mean</b>	5.3±7.7	16.2±8.3	<b>10.7±7.9</b>	12.5±3.1	26.1±7.3	<b>19.3±5.5<sup>b</sup></b>	1.6±0.8	1.7±0.4	<b>1.5±0.6<sup>b</sup></b>
2023	V1	10.0±4.5	14.4±9.4	12.2±6.8	0.8±2.6	10.5±8.2	5.6±5.6	1.0±1.1	0.3±0.5	0.6±0.8
	V2	10.0±7.5	14.0±9.3	12.0±7.8	0.3±2.5	5.5±8.2	2.9±5.6	0.8±0.8	0.5±0.4	0.6±0.6
	V3	15.0±14.9	23.9±1.2	19.5±9.8	0.0±2.9	24.5±11.6	12.3±7.9	0.8±1.0	0.0±0.9	0.4±0.8
	V4	5.0±4.1	9.6±10.1	7.3±7.2	0.0±2.5	11.3±2.4	5.6±2.3	0.3±1.0	0.3±0.3	0.3±0.7
	V5	0.0±7.7	22.3±12.4	11.2±9.5	0.3±5.9	14.8±7.6	7.5±6.3	0.3±0.4	0.3±0.3	0.3±0.3
	<b>Mean</b>	8.0±7.7	16.9±8.3	<b>12.4±7.9</b>	0.3±3.1	13.3±7.3	<b>6.8±5.5<sup>a</sup></b>	0.6±0.8	0.3±0.4	<b>0.4±0.6<sup>a</sup></b>
Mean grouped	V1	7.4±4.2	19.8±8.7	<b>13.6±6.6</b>	8.6±2.4	15.9±7.6	<b>12.3±5.4<sup>ab</sup></b>	1.4±1.0	0.6±0.4	<b>1.0±0.8</b>
	V2	6.3±6.9	10.4±8.6	<b>8.3±7.6</b>	5.0±2.3	21.0±7.6	<b>13.0±5.4<sup>ab</sup></b>	1.3±0.8	1.0±0.4	<b>1.1±0.6</b>
	V3	11.3±13.8	19.0±1.2	<b>15.1±9.5</b>	5.9±2.7	30.6±10.8	<b>18.3±7.5<sup>b</sup></b>	1.0±0.9	0.9±0.8	<b>0.9±0.8</b>
	V4	4.6±3.8	14.3±9.4	<b>9.5±6.9</b>	5.0±2.3	10.6±2.2	<b>7.8±2.2<sup>a</sup></b>	0.8±0.9	0.9±0.2	<b>0.8±0.7</b>
	V5	3.8±6.9	19.0±11.5	<b>11.4±9.2</b>	7.3±5.5	20.4±7.0	<b>13.8±6.1<sup>ab</sup></b>	0.3±0.4	1.5±0.3	<b>0.9±0.3</b>
	<b>Mean</b>	<b>6.7±7.6<sup>a</sup></b>	<b>16.5±8.2<sup>b</sup></b>	11.6±2.8	<b>6.5±3.1<sup>a</sup></b>	<b>19.7±7.2<sup>b</sup></b>	13.0±3.7	<b>0.9±0.8</b>	<b>1.0±0.4</b>	1.0±0.1
Source	DF1/DF2/DF3	1	4	1	1	4	1	1	4	1
	SS1/SS2/SS3	1938.30	502.30	56.53	3564.45	891.07	3125.00	0.05	0.93	22.05
	MS1/MS2/MS3	1938.30	125.58	56.53	3564.45	222.77	3125.00	0.05	0.23	22.05
	F1/F2/F3	47.59	1.31	0.35	14.47	2.83	39.43	0.05	0.32	21.00
	P1/P2/P3	0.0050	0.2959	0.5650	0.0303	0.0468	0.0000	0.8289	0.8611	0.0001

**DF:** Degree of Freedom; **SS:** Sum of Squares; **MS:** Mean Squares; **F:** Variance; **P:** Probability of F; **V1:** Lori-2; **V2:** Lori-3; **V3:** Fekem; **V4:** P5; **V5:** Black eye. The means followed by the different letter are not significantly different (NEWMAN-KEULS test,  $P=0.05$ ).

Table 4. Yield component.

Years	Varieties	Pod Yield in Kg/ha			Grain Yield in Kg/ha			Seedless Yield in Kg/ha		
		Sprayed	Unsprayed	Mean	Sprayed	Unsprayed	Mean	Sprayed	Unsprayed	Mean
2022	V1	784.2±62.9	273.5±97.2	528.9±75.8	560.3±56.1	176.1±73.3	368.2±60.4	223.9±23.7	97.4±24.0	160.7±22.1
	V2	969.4±110.0	155.8±27.5	562.6±74.3	659.6±87.1	81.4±12.1	370.5±57.6	309.8±40.6	74.4±15.5	192.1±28.4
	V3	849.3±98.2	207.1±109.7	528.2±96.4	690.7±77.5	139.8±93.3	415.3±79.4	158.6±23.2	67.3±17.8	113.0±19.1
	V4	932.1±108.4	222.0±44.6	577.1±76.7	647.0±90.3	128.8±39.3	387.9±64.6	285.1±28.1	93.2±9.1	189.2±19.4
	V5	704.8±163.2	193.9±67.1	449.3±115.6	510.7±136.1	131.9±47.2	321.3±94.3	194.1±40.6	61.0±20.5	128.0±29.8
	<b>Mean</b>		848.0±100.6	210.5±67.4	<b>529.2±84.5<sup>b</sup></b>	613.7±82.8	131.6±53.4	<b>372.6±68.8</b>	234.3±28.6	78.0±16.1
2023	V1	1258.1±62.9	176.8±97.2	717.5±75.8	795.1±56.1	31.8±73.3	413.4±60.4	463.0±23.7	145.1±24.0	304.0±22.1
	V2	1228.6±110.0	171.1±27.5	699.9±74.3	742.7±87.1	28.4±12.1	385.5±57.6	485.9±40.6	142.7±15.5	314.3±28.4
	V3	1011.2±98.2	312.5±109.7	661.8±96.4	707.6±77.5	144.1±93.3	425.8±79.4	303.6±23.2	168.4±17.8	236.0±19.1
	V4	1088.8±108.4	237.5±44.6	663.2±76.7	683.6±90.3	76.3±39.7	379.9±64.6	405.2±28.1	161.2±9.1	283.2±19.4
	V5	1197.9±163.2	180.6±67.1	689.3±115.6	787.8±136.1	40.6±47.2	414.2±94.3	410.2±40.6	140.0±20.5	275.1±29.8
	<b>Mean</b>		1157.0±100.6	215.7±67.4	<b>686.3±84.5<sup>a</sup></b>	743.3±82.8	64.2±53.4	<b>403.8±68.8</b>	413.6±28.6	151.5±16.1
Mean grouped	V1	1021.1±58.3	225.2±90.0	<b>623.2±73.2</b>	677.7±51.9	104.0±67.9	<b>390.8±58.4</b>	343.5±22.0	121.2±22.2	<b>232.4±21.3<sup>a</sup></b>
	V2	1099.0±101.9	163.5±25.4	<b>631.2±71.7</b>	701.2±80.7	54.9±11.2	<b>378.0±55.6</b>	397.8±37.5	108.6±14.3	<b>253.2±27.5<sup>a</sup></b>
	V3	930.3±90.9	259.8±101.6	<b>595.0±93.1</b>	699.1±71.8	142.0±86.4	<b>420.6±76.7</b>	231.1±21.5	117.8±16.5	<b>174.5±18.5<sup>c</sup></b>
	V4	1010.5±100.3	229.7±41.3	<b>620.1±74.1</b>	665.3±83.6	102.5±36.8	<b>383.9±62.4</b>	345.2±26.1	127.2±8.4	<b>236.2±18.7<sup>a</sup></b>
	V5	951.4±151.1	187.2±62.1	<b>569.3±111.6</b>	649.2±125.9	86.3±43.7	<b>367.7±91.1</b>	302.1±37.6	101.0±19.0	<b>201.6±28.8<sup>b</sup></b>
	<b>Mean</b>		<b>1002.4±99.3<sup>a</sup></b>	<b>213.1±66.5<sup>b</sup></b>	607.8±90.5	<b>678.5±81.7<sup>a</sup></b>	<b>97.9±68.8<sup>b</sup></b>	388.2±31.5	<b>324.0±28.2<sup>a</sup></b>	<b>115.2±15.9<sup>b</sup></b>
<b>DF1/DF2/DF3</b>		<b>1</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>1</b>
<b>SS1/SS2/SS3</b>		12461850	41325	493589	6741178	25516	19414	871902	62861	317219
<b>MS1/MS2/MS3</b>		12461850	10331	493589	6741178	6379	19414	871902	15715	317219
<b>F1/F2/F3</b>		1006.07	1.16	26.59	528.92	1.24	1.58	1323.19	12.30	232.61
<b>P1/P2/P3</b>		0.0001	0.3543	0.0000	0.0001	0.3201	0.2163	0.0000	0.0000	0.0000

**DF:** Degree of Freedom; **SS:** Sum of Squares; **MS:** Mean Squares; **F:** Variance; **P:** Probability of F; **V1:** Lori-2; **V2:** Lori-3; **V3:** Fekem; **V4:** P5; **V5:** Black eye. The means followed by the different letter are not significantly different (NEWMAN-KEULS test,  $P=0$ ).

## DISCUSSION

The results obtained showed that higher yields, low infestations and damage on the different varieties were observed in the plots under plant protection (sprayed insecticide). Osipitan *et al.*, 2012 found that treatment of cowpea varieties with dimethoate reduced infestation by *Anoplocnemis curvipes* Fabricius, *Helicoverpa armigera* Hübner, *Clavigralla tomentosicollis* Stal, *Riptortus dentipes* Fabricius, *Megalulothrips sjostedti* Trybom and *Opephora mutabilis* Sabbe & Wyverman, and increased grain yield. In Niger, Zakari *et al.*, 2019 report that the management of pests such pod-sucking bug, aphids, and the pod borer *Maruca vitrata* Fabricius must start with raising awareness among producers about the early diagnosis of infestations and the stages of their development on the crop. These results reaffirm the importance of implementing a good phytosanitary protection program to control the pest complex of this valuable crop in the Sudano Sahelian zone and obtain optimal yield. The studies by Sobda *et al.*, 2018 in the Sudano-Sahelian zone of Cameroon classified thrips on the floral buds of the cowpea as the most damaging insect

pest, followed by flower beetles, Maruca, aphids, and pod-sucking bugs. The relatively low incidence of thrips *Megalulothrips sjostedti* Trybom on the four varieties *Lori-2*, *Lori-3*, *P5* and *Black eye* could be due to resistance expressed by non-preference or tolerance of these to this particular pest. Since a long time ago, Snelling (1941) defined host plant resistance as those characteristics that will enable a host to avoid, tolerate or recover from the attack of insects under conditions that will cause injury to other hosts and Singh (1985) reported that host plant resistance could be expressed as non-preference, antibiosis and or tolerance. Today, resistance is considered as the heritable ability of certain plants within a plant species to limit the development and damage caused by pest insects. Although the *Lori-3* variety has proven sensitive to attacks from sucking pest insects, it resists or tolerates attacks from thrips. This implies that insects differ in their preference for the host as feeding and oviposition sites. A detailed preference study may be necessary to better understand the orientations of a specific pest on a specific variety. In these studies, yield losses were recorded in the order of

*Lori-3* > *P5* > *Lori-2* > *Black eye* > *Fekem*. These observed yield losses were facilitated by the proliferation of pests that could likely be responsible for the significant damage caused to the pods and seeds of this variety. Several authors Zakari *et al.*, 2019; Issoufou *et al.*, 2017; Sreelakshmi *et al.*, 2016; N'gbesso *et al.*, 2013; Dugje *et al.*, 2009 have noted parasitic pressure as the main constraint on the production of this legume. Insects feed by inserting their stylets through the cowpea pod wall into the developing seeds to suck the sap (Jackai, 1989). Singh and Jackai (1985) reported that PSB suck the sap from the pods, causing premature drying and shrivelling of young seeds and pods, wrinkling of seeds, appearance of half-filled seeds, abortion of seeds and abscission of pods. Biophysical factors such as pod structure, pod wall hardness, pod and seed size, and the density of the pod's glandular hairs influence the selection of specific varieties by the *C. tomentosicollis* bug (Jackai *et al.*, 2001; Koono *et al.*, 2002). Today, climate change is altering the behavior of pests and their distribution. The risks of increased pest pressure due to disruptions to the environment and agrosystems are real and are of concern to all agricultural stakeholders. These changes increase yield losses, threatening farmers' food security and livelihoods (Cilas *et al.*, 2015).

## Conclusion

At the end of this study, it clearly appears that an adequate plant protection program improves significantly the yields of this crop and that the use of potentially pest-tolerant varieties is complementary to an intensive production strategy. In terms of productivity, the *Fekem* variety recorded the highest grain yield despite its high incidence of thrips. This variety may be capable of tolerating insects or possess properties that make them less suitable for feeding, reproduction, and development. In-depth studies should be conducted to determine the morphological and biochemical bases of resistance or tolerance in these varieties.

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