

Screening Twenty Cowpea (*Vigna unguiculata* (L.) Walp) Genotypes for Resistance to Thrips (*Megalurothrips sjöstedti*) in Burkina Faso

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Abstract

Losses caused by flower thrips in cowpea are important. These pests can cause from 60% to total crop yield loss. There is, therefore, an urgent need to address this issue. This work has been undertaken to identify sources of resistance to thrips in cowpea. Twenty cowpea genotypes were screened at Kamboinsé research station under improved netting in pots. The number of aborted flowers per line, the percentage of damage to flowers and stipules, and the number of thrips per genotype were evaluated. The results revealed the existence of six genotypes of cowpea resistant to thrips. Among these genotypes three are already known thrips resistant lines (TVU1509, TVx3236 and Sanzi). Moreover, Sanzi showed interesting potentialities that may be exploited. The new identified lines are Nafi, variety popularized in 2012 and variety KVx780-3 which is being popularized. The KVx165-14-1 (old popular variety) showed sources of tolerance while the KN1 genotype was susceptible to thrips. In another hand, all the wild genotypes showed high susceptibility to thrips.

Keywords: cowpea, *Vigna unguiculata*, genotypes, *Megalurothrips sjostedti*, lines resistances

1. Introduction

Cowpea is an important food crop in sub-Saharan Africa, particularly in the arid savannah zones of West Africa (Murdock *et al.*, 2008). It is a valuable source of vegetable protein and vitamins for humans and animal fodder. The leaves and immature pods are consumed as vegetables (Pasquet *et al.*, 1998).

Cowpea is a good crop for soil improvement by fixing atmospheric nitrogen. For Ennin-Kwabiah and Osei-Bonsu (1993), cowpea can fix 30-125 Kg of nitrogen per hectare in the soil and also serves as a residue, which benefits the succeeding crops. It can also provide substantial income for producers and processors.

However, cowpea production is facing some biotic and abiotic constraints. The major biotic constraints are insect pests. They attack cowpea at all growth stages. The main insect pests of cowpea in Africa are aphids, flower bud thrips, pod borer, pod bugs and bruchids (Dabiré *et al.* 2001). Among these insects, thrips (*Megalurothrips sjostedti*) are responsible for very important economic losses. They attack buds, racemes and flowers causing premature abortion of these reproductive organs. Yield losses, due to thrips, ranged between 20–100% have been reported (Singh *et al.*, 1980). Their damage can sometimes lead to change a cowpea nutritional composition (Alabi *et al.*, 2003). Several control methods have been developed. Like the chemical method, it has immediate results but it is dangerous for the human, animal and environment health. In long-term, using the chemical method can be responsible to the insects' resistance. The use of resistant varieties is more advantageous for the health economic and environment.

Sanzi, TVu1509, Sewe and Moussa local, IT90K-277-2, IT91K-180, KVx404-8-1 and TVx3236 have been reported to be resistant to flower bud thrips by Alabi *et al.* (2003). These known sources of resistance mentioned above can be considered as good breeding material (donors) for the breeding program.

However, these resistant varieties do not meet the preference of producers and consumers in

Burkina Faso, therefore it is crucial to screen the local germplasm in order to determine the status of released varieties in terms of resistance / tolerance to thrips. The insect (Thrips) causes enormous damage to the production of cowpea in Burkina Faso and that no real study has been made in this direction. Screening of the local germplasm can lead to the identification of preferred varieties well adapted to the environment and combining resistance/tolerance to thrips.

The objective of this work was to identify levels of resistance in twenty (20) cowpea cultivars to *M. sjostedti* by screening the local germplasm in Burkina Faso under sleeve cage.

2. Materials and Methods

2.1 Plant Material and Experimental Design

The study was conducted in pots under a sleeve cage at INERA/Kamboinsé during the rainy season 2016-2017. Twenty genotypes were used including two controls Sanzi and KN1, resistant and susceptible respectively (table 1). The experimental design was the randomized complete block design (RCBD) with three replications. Each replication consists of 20 pots. The pots were filled with a mixture of sand and topsoil. Each line was represented by a pot corresponding to the experimental unit. Two to three seeds were initially planted in the pots and thinned to one plant per pot after emergence. After infestation, the plants were protected from other types of insects with improve netting. Each plant was infested with twenty (20) thrips at flower bud initiation and /or the appearance of the first flower.

Table 1. Twenty genotypes used for thrips screening

Genotypes	Origin	Pedigree	Source of resistance
Nafi	Burkina Faso	(KVx414-22-2 x KVx640) x [(B301 x 994) X KVx 396-4-2D)]	Striga, Virus, Early maturity and large seed
Komcallé	Burkina Faso	KVx396-4-4 x Sakoula x IT85D-3577	Striga, Virus, Early maturity and large seed
Tiligré	Burkina Faso	KVx640 x [B301x 994] x KVx640	Striga, Virus, Early maturity and large seed
KVx165-14-1	Burkina Faso	KN 1 x (KN 1 x TVX 36)	Tolerant of thrips
KVx780-1	Burkina Faso	[KVx640 x (B301x 994) x KVx640] x IT93-693-2	Striga, Virus, Early maturity and large seed
KVx780-2	Burkina Faso	[KVx640 x (B301x 994) x KVx640] x IT93-693-2	Striga, Virus, Early maturity and large seed
KVx780-3	Burkina Faso	[KVx640 x (B301x 994) x KVx640] x IT93-693-2	Striga, Virus, Early maturity and large seed
KVx780-4	Burkina Faso	[KVx640 x (B301x 994) x KVx640] x IT93-693-2	Striga, Virus, Early maturity and large seed
KVx780-6	Burkina Faso	[KVx640 x (B301x 994) x KVx640] x IT93-693-2	Striga, Virus, Early maturity and large seed
KVx61-1	Burkina Faso	Gorom local x (TVx3236)	<i>Striga gesnerio ÷les</i>
KVx745-11P	Burkina Faso	KVx623 x (IAR7/180-4-5-1)	Striga, fodder
Moussa local	Burkina Faso	Landrace	
Dossin local	Burkina Faso	Landrace	
Pobélocal	Burkina Faso	Landrace	
KN 1	IITA, Burkina Faso	Vita 7	Bruchids,
Sanzi	Ghana	Landrace	Thrips, bug
TVU 1509	IITA	-	Thrips
TVX 3236	IITA	-	Thrips
KVx404-8-1	Burkina Faso	TVU1509 x KVx 396-4-2	
Farako-Ba	Burkina Faso	Wild cowpea	
NS	Burkina Faso	Wild cowpea	
NS	Burkina Faso	Wild cowpea	

2.2 Thrips Rearing

Before infestation, the thrips were reared in the laboratory. The variety KN-1 was planted at different sowing dates to ensure continuous flower production and thrips population development. The peduncles were cut into sizeable pieces and sprinkled with a little amount of water on a tissue paper. Make a bundle of peduncles by wrapping them in the damp tissue paper. Ensure that only the base of the peduncles is covered with the tissue. Using the pair of scissors, cut out the brown paper. Fold it in diagonally to make a pouch. Secure the ends with a tape. Put the bunch of peduncles into this pouch. Pour out the sampled flowers onto a laid white sheet on the laboratory table. Gently tease out the petals of the flowers to reveal the thrips. With the aid of an aspirator, collect the thrips and place them in the pouch containing the peduncles. Sample as many thrips as possible into the pouch and seal the opened end with a masking tape.

Place the sealed pouch into a plastic container, cover the container with a white cotton cloth and secure with a plastic band. Leave the set up on a table at room temperature. After every 48 hours replace the old peduncles with new ones and if needed infest with more thrips.

2.3 Artificial Infestation

Sample 20 thrips into a vial and plug the opening of the vial with cotton to prevent the thrips from escaping. Place the vial on an ice pack or the fridge for approximately 3-5 minutes to knockdown the thrips to ease their handling during infestation.

Infest each plant with the 20 thrips by placing the thrips on the lower leaves or near or on the flower buds. Cover the infested plant with an insect-proof sleeve cage to prevent the thrips from escaping and also ensure no further external environmental influence. (Figure 1)

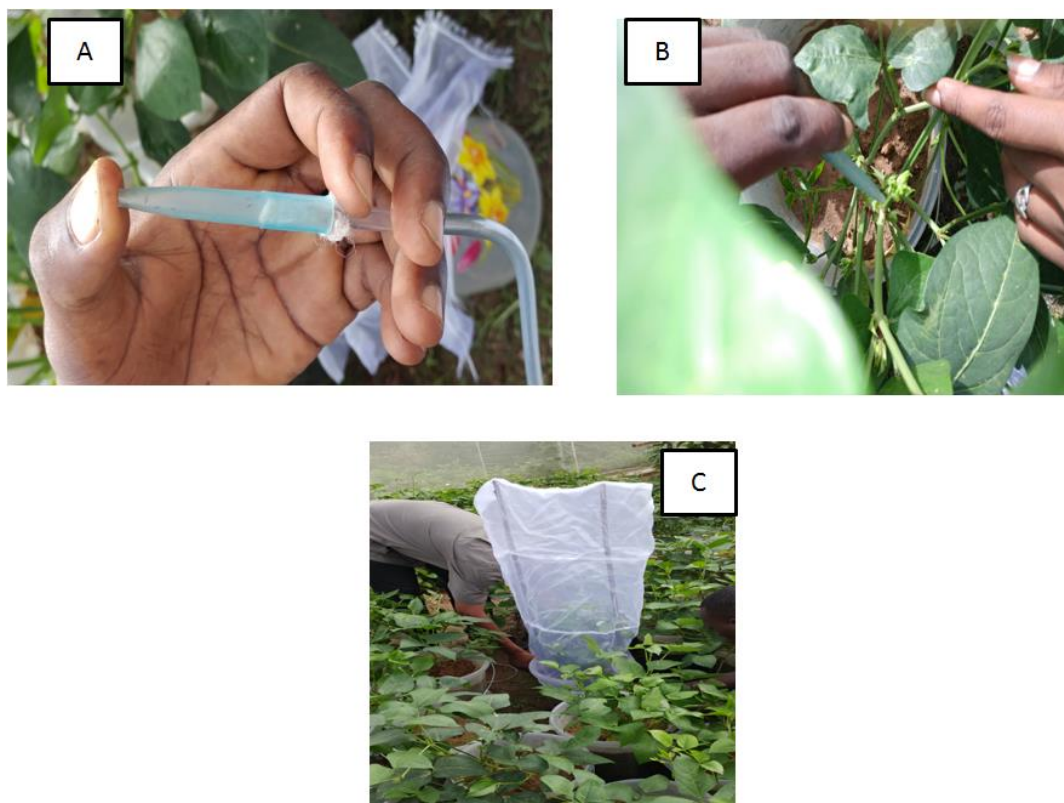


Figure 1. A: collection of twenty (20) thrips; B: Infest each plant with the 20 thrips; C: Cover the infested plant with an insect-proof sleeve cage

2.4 Data Collection and Analysis

The data were collected base on the scale described previously by Jackai and Singh (1988). After the infestation by twenty (20) thrips on each pot, a period of ten (10) days is observed before the collection and counting of thrips of the infested plants begins. This period is consistent to observe a change in the density of thrips on infested plants.

2.4.1 Plant Damage

- The number of buds aborted per plant
- The number of aborted flowers per plant
- The number of thrips per plant

2.4.2 Flower Damages(Figure 2)

- 1: No browning/drying of flowers (highly resistant)
- 3: Initiation of browning of the flowers (resistant)
- 5: Distinct browning/drying of flowers (moderately resistant)
- 7: Serious browning/drying of flowers (susceptible)
- 9: heavy browning/drying of flowers (highly susceptible)

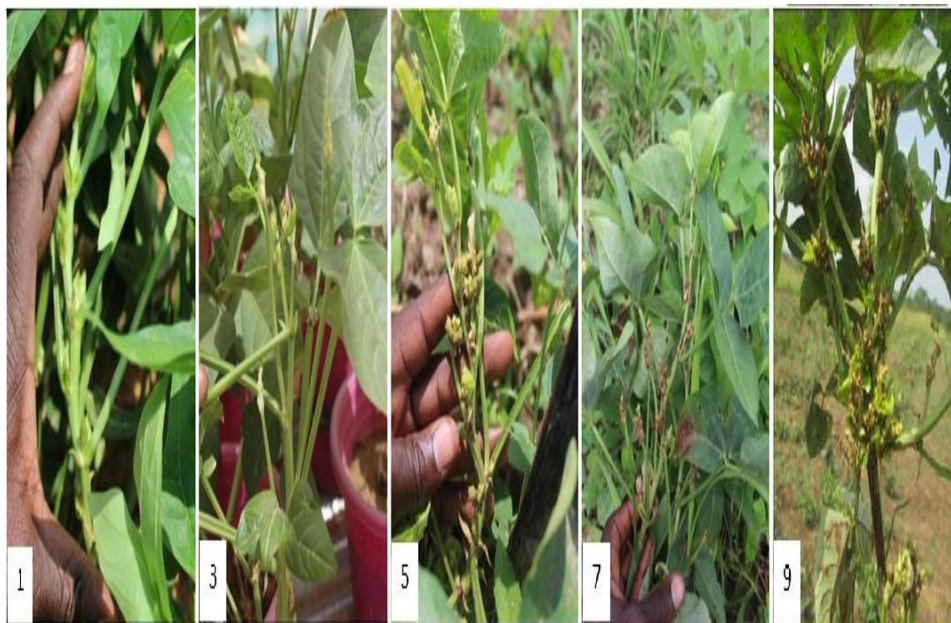


Figure 2. Adapted scale used for scoring plant damage

2.4.3 Count number of Thrips Per Plant

Balde and Diop (1995); Balde (1997) method was used for thrips count. Five flowers were collected once a week from each plant and placed in plastic vials containing 30% alcohol.

In the laboratory, the content of each vial was transferred into a white petri dish. Carefully tease out the petals of the flowers to reveal the thrips and count their number with the aid of a hand lens. Alternatively, the flowers are dissected in the laboratory and submerged in a plastic vial containing 30% alcohol. It should be noted that the alcohol is added in advance of the red dye. For the preparation of the solution one liter of alcohol, 4.7 ml of the dye are required. The plastic vial is finally placed under the magnifying lamp for observation.

2.5 Data Analysis

Statistical analysis was done using the BMS 3.09 and XLSTAT 2015 software. The LSD test was used for mean separation at the 5% confidence level.

3. Results and Discussion

3.1 Results

The results for all the parameters studied were significantly different. These parameters were:

- The number of buds aborted per plant
- The number of aborted flowers per plant
- The number of thrips per plant
- Flower damages

Table 2. Response of cowpea varieties to *Megalurothrips sjöstedti*

Varieties	Thrips number	Flowers damage	Flowers abortion	Buds abortion
Dossin local	2.000a ± 1.15	1.667ab ± 0.88	7.000ab ± 5.57	103.33a ± 87.0
Gourgou	2.333a ± 1.20	2.000ab ± 1.00	10.000ab ± 0.57	40.33a ± 23.0
KN 1	14.333a ± 3.84	6.333b ± 1.20	11.000ab ± 2.65	66.67a ± 48.0
Komcalle	6.667a ± 3.67	3.667ab ± 0.67	15.333ab ± 1.66	35.67a ± 16.0
Kvx165-14-1	12.000a ± 2.52	5.333ab ± 0.88	7.000ab ± 3.06	61.00a ± 45.0
Kvx404-8-1	5.000a ± 2.52	3.333ab ± 0.88	12.000ab ± 1.53	59.67a ± 32.0
Kvx61-1	4.667a ± 2.40	2.333ab ± 1.20	10.000ab ± 5.03	27.67a ± 0.0
Kvx745-11P	4.000a ± 2.65	2.333ab ± 1.45	5.333ab ± 2.33	90.67a ± 61.0
Kvx780-1	9.667a ± 8.21	3.667ab ± 2.03	9.000ab ± 1.15	30.67a ± 16.0
Kvx780-3	4.000a ± 2.65	2.333ab ± 1.45	6.000ab ± 1.73	31.33a ± 24.0
Kvx780-6	6.000a ± 1.00	3.333ab ± 0.33	9.333ab ± 2.73	42.00a ± 26.0
Moussa local	2.000a ± 1.15	1.667ab ± 0.88	3.000ab ± 1.53	96.33a ± 71.0
Nafi	3.000a ± 1.53	1.500ab ± 1.50	5.333ab ± 2.73	25.67a ± 0.0
NS-Farakoba	2.333a ± 1.20	2.000ab ± 1.00	7.000ab ± 2.00	83.33a ± 56.0
NS 1	2.333a ± 1.20	2.333ab ± 1.20	7.000ab ± 2.00	81.00a ± 40.0
Pobe local	7.667a ± 1.20	3.667ab ± 0.67	14.000ab ± 0.58	94.33a ± 52.0
Sanzi	0.000a ± 0.00	0.000a ± 0.00	0000a ± 000	59.33a ± 47.0
Tiligre	9.667a ± 5.24	4.000ab ± 2.08	10.333ab ± 3.84	23.67a ± 17.0
TVU 1509	3.667a ± 1.86	2.000ab ± 1.00	5.333ab ± 3.38	65.33a ± 36.0
TVX3236	3.000a ± 1.53	2.333ab ± 0.67	4.666ab ± 0.88	53.33a ± 28.0
Mean ±	5.217 ± 0.72	2.814 ± 0.28	7.933 ± 0.69	58.57 ± 4.42

Means in each column followed by the same letter(s) are not significantly different at $p \leq 0.01$ using Student –Newman – Kuels test. Values are mean of 3 replication.

3.1.1 Number of Thrips Per Plant

The Analysis of Variance (ANOVA) of thrips was not significant but the number of thrips shows a difference between the genotypes. The mean of thrips infestation across the genotypes was 5.217 ± 0.720 . The minimum thrips count was zero and the maximum was 26 thrips per plant. All genotypes with thrips number greater than or equal to six (6) were considered as thrips-susceptible. The action threshold was set at six thrips per flower bud, a population density which insecticide application is justified so as to prevent further increasing density from causing economic damage (Nabirye *et al.*, 2003). The genotypes were separated into two groups, the first group with thrips number higher than six thrips per genotype and the 2nd group with a thrips number below six or lower than six. Thus, the variety KN1 was the most infested. It is followed by the variety Kvx165-14-1, Kvx780-1, Tiligr é Pob é local, Komcall é and KVx780-6. Amongst the resistant varieties TVU1509, TVX3236 and Sanzi (0 thrips) had the lowest number of thrips.

3.1.2 Buds Abortion

The number of buds' abortion was varied from one variety to another. the evaluation of the average of buds' abortion per line showed different results as indicated in table 2. The analysis was statistically significant ($R^2 = 0,576$; $P < 0.01$). The genotypes have a higher number of aborted bud than the improved varieties.

After parameter the genotype (lines popularized in 2012) Tiligr é and Nafi have the less lost number than Komcall é and Gourgou.

The genotypes (extension lines) Kvx 780-1, Kvx 780-3, Kvx 780-6) but Kvx 780-1 was the best.

3.1.3 Flowers Abortion

The analysis was statistically significant ($R^2 = 0.515$; $F = 1.923$; $Pr > F = 0.039$).

For resistant genotypes, Sanzi (0) had a few Flowers abortion than other resistant lines like TVx3236 (4.66), TVu1509 (5.33) and Moussa local (3.0).

Among the newly released lines, the genotype Komcallé (15.33) had the highest number of aborted flowers than the lines Tiligré (10.33), Nafi (5.33) and Gourgou (10.0).

Among genotypes in the process of extension Kvx780-3 (6.0), KVX 780-1 (9), KVX 780-6 (9.33) was the best.

3.1.4 Flowers Damages

The percentage of genotypes tested ranged from 0 to 77% for flower damage and from 0 to 76% for stipule varieties. Thrips damage on flowers and stipules of genotypes KN1, Komcallé wild cowpea Farako-ba were high. This is synonymous with very dark browning of flowers and stipulates its varieties. Contrary Sanzi had a zero attack percentage. Thus the browning of the flowers and stipules of the genotypes TVX3236 and TVU1509 remains very weak.

4. Discussion

The objective of this study was to identify sources of resistance to hedgehog thrips of some lines of cowpea by comparing the tested genotypes versus the three genotypes considered resistant (TVU1509, TVX3236 and Sanzi). Parameters such as the number of aborted flowers, the total number of thrips, the damage to flowers and stipules per genotype are relevant for the identification of thrips resistant varieties.

The results for the total number of thrips per genotype showed that the susceptible check, KN1 (14.3 thrips on average) was the most infested line. On the other hand, the resistant genotype checks TVU1509, TVX3236 and Sanzi had the lowest thrips population 3.66, 3, and 0 thrips respectively. The action threshold was set at six thrips per flower bud, a population density which insecticide application is justified in order to prevent further increasing density from causing economic damage (Nabirye *et al.*, (2003). These results confirm the earlier work done by Singh, (1987), Salifu *et al.*, (1988) and Dabiré *et al.* (2002) who reported that these genotypes were resistant to the thrips population. According to IITA, (1982) the resistance of TVU1509 is due to antibiosis.

Among the genotypes (newly released lines in 2012) Nafi, Komcallé, Tiligré, Gourgou, the genotype Nafi was the least infested.

For genotypes (lines undergoing extension) Kvx780-1, Kvx780-3 and Kvx780-6, the genotype Kvx780-3 performs better than the others.

As for the old genotype (popularized varieties) KVx61-1, KVx404-8-1, KVx745-11P, KVx165-14-1, the KVx745-11P presented less population of thrips.

At the level of genotypes (local varieties), Moussa local, Donsin local, Pobé local, Moussa

local had fewer thrips than the others. These results confirm the work of Dabiré (2002) who had tested without insecticide treatment several varieties of cowpea (Moussa local, Boussé local, Kaokin local, KVx 404-19-3J, KVx404-2J, KVx404-8- 1, Sanzi, TVx3236 and TVu1509) throughout Burkina Faso.

The results for the number of aborted flowers ranged from 0% (Sanzi) to 100% (wild cowpea). It was 45.16% for the released genotypes in 2012 and 37.58% for varieties undergoing the release process. As for local varieties (Moussa local and Pobélocal) it ranged from 33.33% to 70%. In addition, the percentage of aborted flowers for this trial is 43.53%. These results confirm the work of Ndoye *et al.*, (1984) in Bambe, which showed that the damage of thrips is manifested by abortion and by the fall of the flower (80.46%).

Out of the lines popularized in 2012 (Nafi, Komcallé Tiligré Gourgou), Nafi behaves better in terms of damage on flowers and stipules.

For varieties undergoing extension (KVx780-1, KVx780-3 and KVx780-6), the flowers and stipules of the variety KVx780-6 showed less damage than the others.

5. Conclusion

Our study allowed to know the status of twenty cowpea genotypes in the local germoplasm for their resistance to thrips. It may be able to advise some genotypes (Nafi) in areas of high infestation of thrips in Burkina Faso. Crossing between the Sanzi genotype, a better genotype but less productive, and the Komcallé genotype, which is very susceptible to thrips but a variety adapted and preferred by producers.

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