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Research article

Assessment of the sensitivity of some varieties of okra [*Abelmoschus esculentus* (Moench)] to cercosporiose of the leaves caused by *Cercospora malayensis* and *Pseudocercospora abelmoschii*

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SUMMARY

In order to face the diseases and pests that affect the output of okra, while protecting the ecosystem, it seems necessary to propose shapes that are more compatible with the local production environment to producers. This calls for the necessity of a large genetic variability of the species to be collected, characterized, preserved and managed. To this effect, the general objective of this work was to identify among some varieties of okra, those that have a capacity to tolerate leaf cercosporiose. Two types of tests have been done. The first test was done in the laboratory on the plant's leaf disks and consisted to make some inoculations of the suspension of spores of pathogenic agents, and evaluate the sensitivity of varieties following the scale. The second experimentation consisted to evaluate the sensitivity of varieties in the natural's conditions. Results from laboratory and field experimentation show that the incidence and severity of cercosporiose caused by *Cercospora malayensis* and *Pseudocercospora abelmoschii* vary according to the different varieties of okra, the environment and the season. The Local 2 and Local 2 (P) varieties have a better behavior in the field and could be used as the least sensitive varieties to cercosporiose caused by *Cercospora malayensis* and *Pseudocercospora abelmoschii*. These two varieties could be used in improvement schemes as parents having the capacity to resist against damages caused by the aforementioned disease.

Keywords: *Abelmoschus esculentus*, leaf cercosporiose, disease, Okra, *Cercospora malayensis*, *Pseudocercospora abelmoschii*.

RESUME

Pour faire face aux maladies et attaques des insectes qui affectent le rendement du gombo tout en protégeant l'écosystème, il s'avère nécessaire de proposer aux producteurs des formes plus compatibles avec l'environnement de production autochtone. Pour cela, il faudrait disposer d'une variabilité génétique large, qu'il faut collecter, caractériser, conserver et gérer. D'où l'objectif général de ce travail qui consiste à identifier parmi quelques variétés de gombo, celles qui ont une capacité à tolérer la cercosporiose foliaire.
Deux types de tests ont été effectués. Le premier test a été effectué en laboratoire sur les disques de feuilles de plants et a consisté à faire des inoculations des suspensions de spores des agents pathogènes, et évaluer la sensibilité des différentes variétés suivant une échelle. La deuxième expérimentation a consisté à évaluer la sensibilité des variétés dans les conditions naturelles.
Les résultats montrent que l'incidence et la sévérité de la cercosporiose due à *Cercospora malayensis* et *Pseudocercospora abelmoschii* varient en fonction des différentes variétés de gombos, du milieu et de la saison. Les variétés Locale 2 et Locale 2 (P) auraient un meilleur comportement en champ et pourrait être utilisée comme les variétés les moins sensibles à la cercosporiose due à *Cercospora malayensis* et *Pseudocercospora abelmoschii*. Ces deux variétés pourraient être utilisées dans le système d'amélioration comme géniteur ayant la capacité à résister aux dommages causés par ladite cercosporiose.

Mots clés : *Abelmoschus esculentus*, cercosporiose foliaire, *Cercospora malayensis*, *Pseudocercospora abelmoschii*.

INTRODUCTION

Okra (*Abelmoschus esculentus*) is one of the most important traditional vegetables that one can find on almost all African markets (INERA/BF, 2001; Nguelieu, 2010). According to the United States Agency for International Development (USAID, 2006), okra is the object of an intensive production system in urban and rural agriculture. Its nourishing value is important, far behind carrot but above that of tomato (Sawadogo et *al*., 2006). It is cultivated on the whole of Africa for its fruit (consumed as boiled soup or fried like spinach), its leaf (used as basis of cataplasm and food for livestock), its stem, its rhizome, its inflorescence and its seed (as coffee substitute, as flocculating agent for water purification) (Agarwal et *al*., 2003; Siemonsma and Kouamé, 2004; Okigbo, 1975; cit. Nguelieu, 2010).

In spite of its merits, okra is subject to numerous constraints such as diseases and the devastating insect attacks thus provoking an important reduction of its production (Dubey et Bhagat, 1998; Fugro, 1999; Ali and Hossain, 2000). Two pathogenic agents *Cercospora malayensis* and *Pseudocercospora abelmoschii* were identified as being responsible of cercosporiose of the leaves of okra and causing, a huge or enormous loss at the level of production. Fungicides which are used to fight against the diseases are still very expensive for the local producers. Moreover, the increased risk of contamination of the environment by the continuous use of chemical or synthetic pesticides constitutes a real threat for the ecosystems (Smith, 1984 cit. Iroumé, 2004).

The alternative would be to operate an adjustment of the plant material to be proposed to the producers toward more compatible shapes with the local production environment (Iroumé, 2004). Studies led by Dabandata and *al*. (2010) showed that heterosis effect exists between the hybrids of okra. Moreover, the heritability of the characters has also been verified (Dabandata and *al*., 2012). In this context, it is necessary to have a large genetic variability possible through collection, characterization, preservation and management. The exploitation of the genetic variability of the different varieties of okra by the combination and grouping of characters into genotypes of interest could contribute to the varietal improvement of this species (Lukonge, 2005).

In Cameroun, some studies carried out have based on the evaluation of the yield of okra and brought farmers to be more interested to the introduces or exotics varieties, which are very often, less adapted to the locale conditions (AVRDC, 2008). It sounds also important to evaluate the sensitivity of those varieties in the locale ecological conditions.

To the best of our knowledge however, very little or no work on the assessment of the resistive capacity of the local varieties of okra has been done. In this regard, the general objective of this work was to identify among some varieties of okra, those that have a capacity to tolerate leaf cercosporiose.

MATERIAL AND METHODS

Fungic Material

Two pathogenic agents were used during those tests: it is *Cercospora malayensis* and *Pseudocercospora abelmoschii*.

Isolation of *Cercospora malayensis* and *Pseudocercospora abelmoschii*

Plant material and experimental site

The field work was done in a farm located within the campus of the University of Yaounde I. Laboratory experimentation was carried out in the laboratory of the Institute of Agricultural Research for Development (IRAD) at Nkolbisson - Cameroon. The biological material consisted of six (06) local varieties and three (03) exotic varieties (Red of Thiès, Clemson, Indiana) of okra. The characters fruits length, intermodal length, plants color, number of fruits per plant and plant pilosity were the potent factors in differentiating the germplasm of okra under study.

Laboratory evaluation

Composition and preparation of the culture media

Gelose water (EG) and potato dextrose agar (PDA) media were used in the process of isolation, purification, maintenance of fungi and the realization of the different tests.

Culture of the fungi

The pathogenic agents were collected from the leaves naturally infected by Cercosporiose(s). These were previously detached from the stems. The isolation was done at the level of the growth front of the necrosis and the black spot (Fig. 1). The purification was done by successive reseeding on PDA medium of a fraction of agar-agar collected from the growth front of the mycelium (Fig. 2). The identification of strains was done by the help of a key after observation of conidia on microscope according to Vaz (1987), Hsieh and Goh (1990), Crous and Uwe (1996) (Fig. 3).

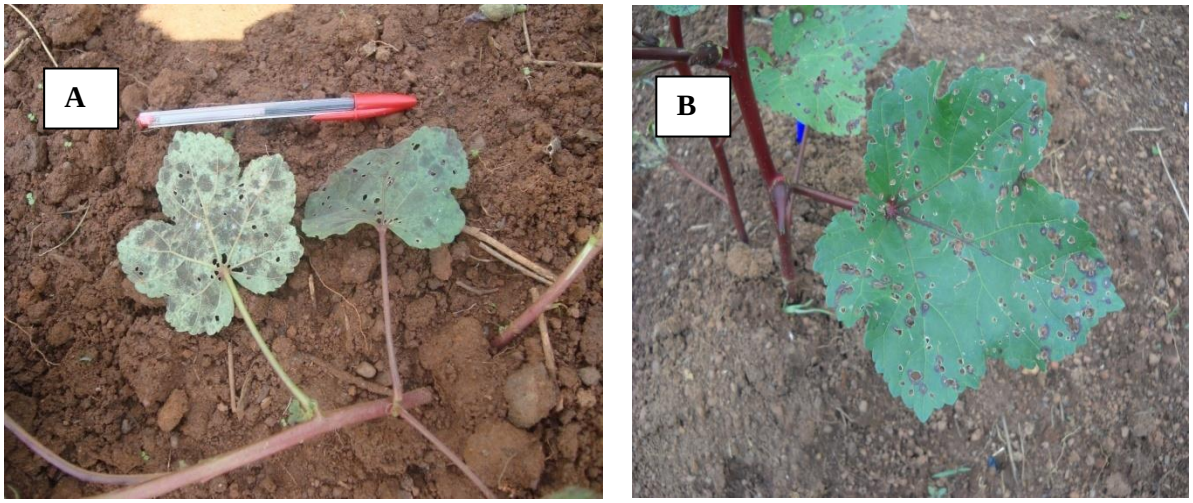


Figure 1 : Symptoms characteristic of the cercosporiose due to *Pseudocercospora abelmoschii* (A) et à *Cercospora malayensis* (B).

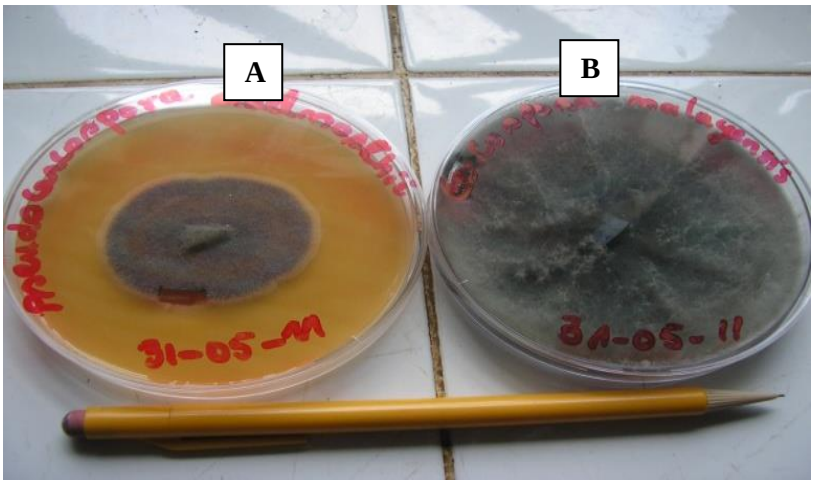


Figure 2: Purification of the mycelium of *Pseudocercospora abelmoschii* on medium V8 (A) and of *Cercospora malayensis* on medium PDA (B).

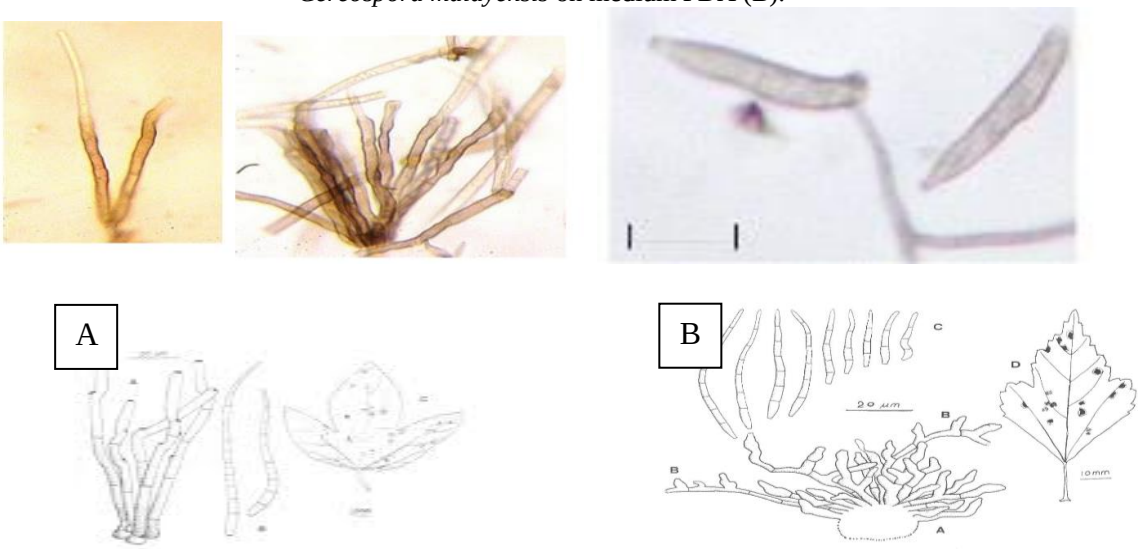


Figure 3: Key of identification of the conidies of *Cercospora malayensis* (A) (Vaz da Costa, 1987) and of *Pseudocercospora abelmoschii* (B) (Hsieh et Goh, 1990).

Inoculation and incubation of the leaf disks

The leaf disks of 15 mm diameter of the different genotypes were cut and placed randomly in pots according to the modified method put in place by Nyassé (1992). The suspension of spores of *Cercospora malayensis* and *Pseudocercospora abelmoschii* was then calibrated with the help of an electron microscopy and a Malassez cell slide to a concentration of 2 to 3 x 10^5cfc/ml. A volume of 10 µl of every suspension of cfc/spores was placed in the center of each leaf disk with the help of an Eppendorf PZ automatic micropipette. After the inoculation, the pots were covered and incubated in a darkroom at a temperature between 24 and 26 °C. The reading of the symptoms on the leaf disks was done 7 days after the inoculation. The presence and the increase of the diameter of the necrosis or the black stain revealed the successful infection of leaves by the pathogenic agent and its faculty to penetrate and develop in the tissues of the host (Nyassé, 1997). The degrees of evolution of the symptoms were appreciated with reference to "the standard assessment scale for improved sensitivity" (Nyassé et *al*., 1995) (Fig. 4).

Figure 4: Discs of sheets inoculated of the various varieties of gombo.

Field assessment of the moderate (intrinsic) resistance of okra varieties

Two (02) field tests were realized. The first test took place at a small rain season and last 63 DAP while the second one at a great rain season, and remained 84 DAP. It should be noted that, the field was every time pulled up and watered when they were no rains. The organ fertilizer (fowl's droppings) was applied twice.

Every week, the different disease symptoms were noted on the leaves of the different varieties of okra. The degree of infection of each of the diseases was determined on plant leaves in each plot before extending to the whole experimental field according to the identification key used to determine the intensity of necrotic infection for symptoms caused by *Cercospora malayensis* and the intensity of the leaf spots for the symptoms caused by *Pseudocercospora abelmoschii* (Hahn et *al*., 1989). The incidence and disease severity was determined by the formulas of Tchumakov and Zaharova (1990).

$I = (Nm / Nt) \times 100$ and $S = [\sum (a \times b) / n] \times 100$

I = Incidence of the disease concerned

Nm = number of plants attacked (infected) in the trial plot;

Nt = total Number of plants (healthy + sick) in the trial plot.

S = Severity of the infection;

$\sum (a \times b)$ = sum of the products of the number of the sick plants (a) corresponding to the degree of infection (b); n = number of sick plants.

After calculating the data of the severity and the incidence, these were transformed into arcsine, and the severity and incidence of the disease was calculated while taking into account the surface area of the disease below its evolution curve according to the formula:

$\sum[(X_i + X_{i+1})/2](t_{i+1} - t_i)$ (Dagostin et *al*., 2011).

Xi = Severity / incidence of the disease at the time i;

Xi+1 = Severity / incidence of the disease at the time i + 1;

ti+1 – ti = Number of days between the two assessments / evaluations.

Statistical analyses

The experimental design used in the study is the complete random blocks design. Each block was subdivided into nine plots corresponding to the nine varieties of okra studied. The number of repetition was three and the experimental unit was constituted of 30 plants for each variety. In the laboratory, each variety was represented by 15 disks of leaves. The tests of artificial infection were repeated three times.

The goal of the study being, to bring out among the varieties of okra cultivated in Cameroun, those which resist or better tolerate the cercosporiose of the leaves for an eventual genetic improvement, it have not been then necessary, to have a particular positive or a negative witness.

The data collected on the incidence and severity from the field and laboratory experiments were typed in the SPSS software. These data were submitted to analysis of variance (ANOVA) in order to evaluate the different genotype effects. The significantly different means were separated by the least significant difference calculated at the threshold of 5%. Correlation and regression analysis permitted to show the existence of more or less narrow relations between some evaluated parameters. The analysis of main components was also done to sort out the different groups or classes of the studied okra varieties.

RESULTS

Assessment of the sensitivity of the different varieties of okra to cercosporiose of the leaves

The results of the ANOVA show that the incidence and severity of cercosporiose caused by *Cercospora malayensis* and *Pseudocercospora abelmoschii* vary according to the different varieties of okra, the environment and the season.

In the laboratory, cercosporiose caused by *Cercospora malayensis* was less expressed (34.67 ± 9.33) on the Local variety 2 (P) and more (72.00 ± 8.74) on the Local variety 1. Concerning cercosporiose caused by *Pseudocercospora abelmoschii*, the Indiana variety was the less (38.67 ± 26.23) sensitive and the Local variety 4 the more (68.00 ± 4.00) sensitive (table I).

ICCML: Incidence of cercosporiose due to *Cercospora malayensis* ; SCCML : Severity of cercosporiose due to *Cercospora malayensis* ; ICPAL : Incidence of cercosporiose due to *Pseudocercospora abelmoschii* ; SCPAL : Severity of cercosporiose due to *Pseudocercospora abelmoschii* in laboratory (L).

	L1	L2	L2(P)	L3	L4	L5	T	I	C
ICCML	100 ± 0,00 b	86,67 ± 6,66 ab	75,55 ± 23,41 a	82,22 ± 16,77 ab	95,55 ± 3,85 b	88,89 ± 7,70 ab	100 ± 0,00 b	93,33 ± 11,55 ab	100 ± 0,00 b
SCCML	72,00 ± 8,74 d	39, 56 ± 4,07 ab	34,67 ± 9,33 a	40,45 ± 12,39 ab	60,89 ± 4,29 cd	41,33 ± 4,81 ab	57,77 ± 6,84 c	43,56 ± 10,18 ab	52,44 ± 9,08 bc
ICPAL	100 ± 0,00 b	97,78 ± 3,85 b	93,33 ± 6,66 ab	93,33 ± 11,5 ab	100 ± 0,00 b	84,44 ± 21,43 ab	84,44 ± 13,88 ab	80,00 ± 20,00 a	100 ± 0,00 b
SCPAL	64,67 ± 5,46 b	44,89 ± 9,83 a	47,11 ± 12,68 a	41,78 ± 15,33 a	68,00 ± 4,00 b	42,22 ± 18,92 a	44,44 ± 20,84 a	38,67 ± 26,23 a	45,78 ± 5,55 a

During the first field test, the Clemson variety proved to be less sensitive (0.225 ± 0.134) while the Local variety 2 (P) was more sensitive (0.551 ± 0.370) to cercosporiose caused by *Cercospora malayensis*. Concerning cercosporiose caused by *Pseudocercospora abelmoschii*, the Local 2 and Local 3 varieties were respectively the least (0.147 ± 0.100) and the most (0.935 ± 0.507) sensitive (Table II).

a) ICCML: Incidence of cercosporiose due to *Cercospora malayensis* ; SCCML : Severity of cercosporiose due to *Cercospora malayensis* ; ICPAL : Incidence of cercosporiose due to *Pseudocercospora abelmoschii* ; SCPAL : Severity of cercosporiose due to *Pseudocercospora abelmoschii* for the 1st test in field.

	L1	L2	L2(P)	L3	L4	L5	T	I	C
ICCM1	8,115 ± 2,569 c	7,182 ± 2,094 b	8,272 ± 2,391c	7,157 ± 2,140 b	8,275 ± 2,563 c	7,711 ± 2,730 bc	7,758 ± 2,591 bc	6,087 ± 1,806 a	6,045 ± 1,703 a
SCCM1	0,316 ± 0,141abc	0,380 ± 0,319 bc	0,551 ± 0,370 d	0,258 ± 0,145 ab	0,313 ± 0,182 abc	0,252 ± 0,179 ab	0,442 ± 0,263cd	0,310 ± 0,155 abc	0,225 ± 0,134 a
ICPA1	3,360 ± 2,175 abc	3,794 ± 2,578 bcd	4,901 ± 4,224 d	4,166 ± 2,491cd	2,748 ± 2,412 ab	2,971 ± 2,648 ab	3,134 ± 3,534 abc	2,416 ± 2,183 a	2,430 ± 2,458 a
SCPA1	0,410 ± 0,184 c	0,147 ± 0,100 a	0,315 ± 0,158 abc	0,935 ± 0,507 d	0,482 ± 0,148 c	0,258 ± 0,148 abc	0,405 ± 0,192 bc	0,273 ± 0,118 abc	0,163 ± 0,063 ab

The second field test showed that Local variety 5 is least sensitive (0.098 ± 0.071) while the Local variety 1 most sensitive (0.431 ± 0.412) to cercosporiose caused by *Cercospora malayensis*. With regard to cercosporiose caused by *Pseudocercospora abelmoschii*, the Local 2 and Local 3 varieties were once more revealed as less (0.013 ± 0.000) and more (0.204 ± 0.182) sensitive respectively (Table III).

ICCML: Incidence of cercosporiose due to *Cercospora malayensis* ; SCCML : Severity of cercosporiose due to *Cercospora malayensis* ; ICPAL : Incidence of cercosporiose due to *Pseudocercospora abelmoschii* ; SCPAL : Severity of cercosporiose due to *Pseudocercospora abelmoschii* for the 2nd test in field.

	L1	L2	L2(P)	L3	L4	L5	T	I	C
ICCM2	4,202 ± 2,635 e	3,486 ± 2,033 cd	3,032 ± 1,488 b	3,586 ± 1,975 d	3,408 ± 1,510 cd	2,471 ± 1,651 a	3,076 ± 1,478 bc	3,353 ± 1,834 bcd	2,914 ± 1,517 b
SCCM2	0,431 ± 0,412 c	0,210 ± 0,173 b	0,190 ± 0,141 ab	0,163 ± 0,130 ab	0,129 ± 0,063 ab	0,098 ± 0,071 a	0,202 ± 0,118 b	0,183 ± 0,122 ab	0,110 ± 0,063 ab
ICPA2	1,325 ± 1,678 bc	0,796 ± 1,035 a	1,067 ±1,194 ab	2,205 ± 2,094 d	1,513 ± 1,397 c	1,366 ± 1,533 bc	1,084 ± 1,499 ab	1,096 ± 1,301 ab	1,123 ± 1,398 abc
SCPA2	0,039 ± 0,055 a	0,013 ± 0,000 a	0,031 ± 0,045 a	0,204 ± 0,182 b	0,208 ± 0,173 b	0,032 ± 0,179 a	0,039 ± 0,055 a	0,032 ± 0,179 a	0,017 ± 0,000 a

Assessment of diseases resistance

The simple statistics obtained from the analysis in main components also showed that the phytopathological parameters (incidence and severity) of cercosporiose vary from one variety to the other, thus confirming the results of the ANOVA (table IV).

Table II: Simple statistics of the parameters obtained from the analysis in main component (ACP).

Variables	Minimum	Maximum	Average	Standard deviation
ICCM1	6,045	8,275	7,400	0,861
SCCM1	0,225	0,551	0,339	0,104
ICPA1	2,416	4,901	3,324	0,832
SCPA1	0,147	0,935	0,376	0,238
ICCM2	2,471	4,202	3,281	0,487
SCCM2	0,098	0,431	0,190	0,099
ICPA2	0,796	2,205	1,286	0,402
SCPA2	0,013	0,208	0,068	0,079
ICCML	75,550	100,000	91,357	8,710
SCCML	34,670	72,000	49,187	12,324
ICPAL	80,000	100,000	92,591	7,779
SCPAL	38,670	68,000	48,618	10,378

The matrix of correlation generated by the ACP shows that positive and perfect correlations and a negative and perfect correlation exist between the evaluated parameters. Parameters with positive and perfect correlations are: ICPA2 and SCPA1, SCPA2 and SCPA1, SCPA1 and ICPA2. The only negative and perfect correlation is observed between ICCML and ICPA1 (table V).

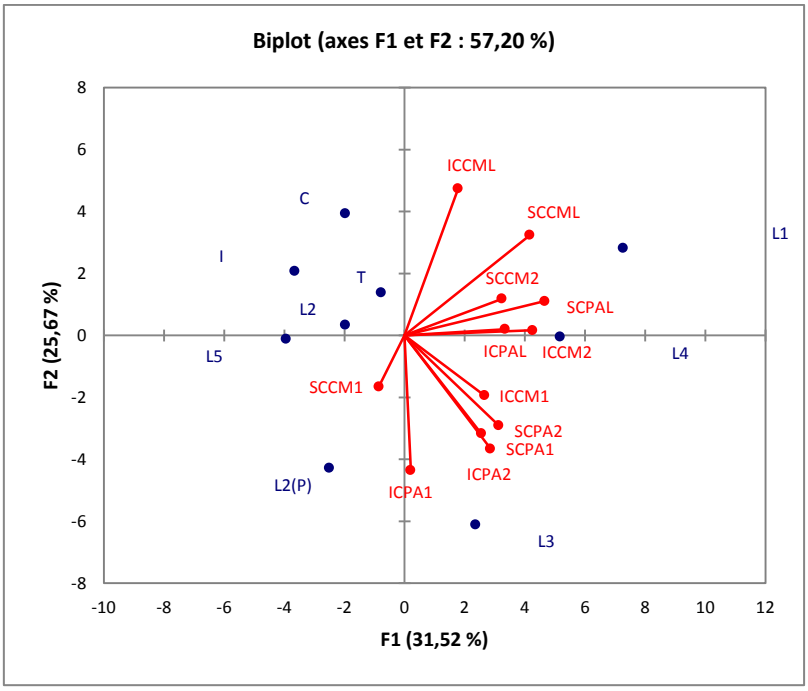
Table III: Matrix of correlation (Pearson (n))

Variables	ICCM1	SCCM1	ICPA1	SCPA1	ICCM2	SCCM2	ICPA2	SCPA2	ICCML	SCCML	ICPAL	SCPAL
ICCM1	**1**	0,500	0,492	0,230	0,152	0,314	0,124	0,266	-0,211	0,256	0,227	0,602
SCCM1	0,500	**1**	0,634	-0,157	-0,013	0,213	-0,454	-0,262	-0,421	-0,219	-0,103	-0,007
ICPA1	0,492	0,634	**1**	0,333	0,157	0,210	0,148	0,086	**-0,815**	-0,456	0,183	-0,085
SCPA1	0,230	-0,157	0,333	**1**	0,371	0,058	**0,920**	**0,822**	-0,231	0,055	0,045	0,101
ICCM2	0,152	-0,013	0,157	0,371	**1**	**0,807**	0,205	0,268	0,173	0,510	0,446	0,522
SCCM2	0,314	0,213	0,210	0,058	**0,807**	**1**	-0,109	-0,209	0,234	0,558	0,253	0,442
ICPA2	0,124	-0,454	0,148	**0,920**	0,205	-0,109	**1**	**0,826**	-0,181	0,040	0,085	0,107
SCPA2	0,266	-0,262	0,086	**0,822**	0,268	-0,209	**0,826**	**1**	-0,133	0,122	0,249	0,375
ICCML	-0,211	-0,421	**-0,815**	-0,231	0,173	0,234	-0,181	-0,133	**1**	**0,828**	0,076	0,359
SCCML	0,256	-0,219	-0,456	0,055	0,510	0,558	0,040	0,122	**0,828**	**1**	0,362	**0,754**
ICPAL	0,227	-0,103	0,183	0,045	0,446	0,253	0,085	0,249	0,076	0,362	**1**	0,662
SCPAL	0,602	-0,007	-0,085	0,101	0,522	0,442	0,107	0,375	0,359	**0,754**	0,662	**1**

The values in bold are significantly different from 0 to a level of significance alpha=0.05

The figure combining both the evaluated parameters and the different studied varieties reveal four (04) varietal classes. The first group is composed of the Clemson, Indiana, Red of Thiès and Local 2 varieties having no optimized parameter. The second group is made of the Local 5 (L5) and Local 2 (P) varieties having only one on twelve parameters optimized, namely the severity of cercosporiose caused by *Cercospora malayensis* obtained during the first field test. The third group is constituted of the Local 4 (L4) and Local 3 (L3) varieties of which five parameters out of twelve are optimized namely: the incidence of cercosporiose caused by *Cercospora malayensis* obtained from the first field test; the incidence of cercosporiose caused by *Pseudocercospora abelmoschii* obtained from the first and the second field tests; the severity of cercosporiose caused by *Pseudocercospora abelmoschii* obtained from the first and the second field tests.

The last group made up of the Local variety 1 (L1) has up to six parameters out of twelve optimized: the incidence and the severity caused by both *Cercospora malayensis* and *Pseudocercospora abelmoschii* obtained in the laboratory; the incidence and the severity caused by *Cercospora malayensis* obtained in field during the second test (Fig. 5).



DISCUSSION

The study of disease incidence revealed the presence of cercosporiose on almost all plants of the different cultivated varieties of okra on the experimental site. This entails the homogeneous distribution of the disease on the aforementioned site. These diseases were most expressive during flowering. This high frequency (100%) could be due to the humid and high temperature conditions during the observation period. This result corroborates that of AVRDC (2008).

There is great variability in the degree of attack of the plant leaves. This could be explained by the disposition of the leaves on the stem; the oldest leaves being closer to the soil would be attacked more easily than those situated at mid height or at the summit of the plant. In this light, the Local variety 1 would be the most sensitive because of its twisted stand which is almost creeping. Meanwhile, the fact that the Indiana and Clemson varieties are classified among those that lose their attacked leaves easily permits to classify the Local variety 2 once more as the most tolerant to this disease.

The contradictions observed between the field and laboratory results with regard to the Local 2 and Local 2 (P) varieties could be caused by the fact that in the field, the plants rarely lose their leaves even when attacked; this loss of leaves gives the impression that some varieties are less attacked than those that preserve their leaves longer in spite of the severity of the disease. In fact, observations made in the field permitted to note that, among the varieties that lose their leaves easily, one can cite Indiana and Clemson which are all exotic varieties. The divergence observed at the level of the results is possibly due to the fact that the first test was done in rough conditions (dry season) while the second during the rainy season. In the rainy season, each variety of okra certainly had the necessary time to develop normally and to be attacked by these pathogens. On the other hand during the dry season, the development cycle of these different varieties could have been shortened by the difficult climatic conditions, which would not have permitted the pathogenic agents to better develop on all the varieties with the same intensity. The results from laboratory test equally confirm this analysis. Indeed, these results show that the varieties are classified among those that tolerate cercosporiose better.

The differences noted between the results from the field and those of the laboratory could also be explained by the fact that in the field, apart from the action of each pathogenic agent, there might also exist a combined effect of the two fungi on the plants, or even the action of other parasites given that the Laboratory conditions are very different from those of the field. The plants in the field could develop defense mechanisms while the disks of leaves used in the laboratory result from leaves detached from the stems, and therefore are limited in their method of defense. Indeed, the process of infection of plants by a pathogen generally starts by exchanges of molecular signals. An example is that of acetosyringone which, pruned by the plant, activate the tumorous genes of *Agrobacterium tumefaciens* found in the neighborhood. The relation between the *Cercospora* genus and the okra plant is possibly necrotrophic. The okra plants possibly synthesize some antifungal phenolic compounds, or produce defense molecules like phytoalexines allowing them to naturally resist fungal attack.

CONCLUSION

The Local 2 and Local 2 (P) varieties seem to have a better behavior in the field and could be used as the less sensitive varieties to cercosporiose caused by *Cercospora malayensis* and *Pseudocercospora abelmoschii*. These two varieties could be used in improvement systems as parents having the capacity to resist to the damages caused by the aforementioned disease.

The results of this survey would help breeders to put in place improved varieties of okra that are tolerant to cercosporiose of the leaves.

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