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Impact of *Sesbania pachycarpa* dc. (Fabaceae) in Millet Culture [*Pennisetum glaucum* (L.) R. Br. (Poaceae)] in Eastern Southeast Niger

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Abstract

Millet [*Pennisetum glaucum* (L.) R. Br. (Poaceae)] is one of the most widely consumed crops in Niger. Its production, despite the efforts of farmers, is confronted with weed problems, in particular *Sesbania pachycarpa* DC. (Fabaceae). The aim of the present study in this area is to assess the impact of *Sesbania pachycarpa* on millet growth and yield. To achieve this objective, a completely randomized Fisher block design of twenty-four elementary plots was set up with four replications. The data collected were millet plant heights and plot yields. The data collected were subjected to analysis of variance and Duncan's test at the 5% threshold for comparisons of mean heights and yields with the control kept clean from sowing to millet harvesting. The results showed the sensitivity of millet plants to *Sesbania pachycarpa*. The results revealed that the threshold density for damage could be estimated at 6 *Sesbania pachycarpa* plants/m^2 and the critical interference period at the fourth week after sowing. This study showed that the presence of *Sesbania pachycarpa* influences millet yield. Indeed, the best yields were obtained in plots without *Sesbania pachycarpa*. Millet yield decreased with increasing *Sesbania pachycarpa* density. The average percentage yield reduction was 36.79%, with a minimum of 21.25% and a maximum of 80%. The findings of this study complete the efforts of developing weed control techniques in pearl millet fields densely populated with *Sesbania pachycarpa*.

Keywords

Impact, *Sesbania pachycarpa*, Yield, Millet, Niger

1. Introduction

Millet is the staple food of the Sahelian population. It is an essential foodstuff for Niger [1]. Every year, millet is grown on almost 5 million hectares, with a production of nearly 2 million tonnes [1]. Despite the efforts made by farmers, its production still does not cover the needs of the population [2]. Millet production constraints are climatic (climate variability and change); parasitic (blast and *Helminthosporiosis* attacks); edaphic (reduced soil fertility); varietal (low-productivity cultivars) [3]. Among the constraints to millet production, weed control is one of the most important. Improving food production goes hand in hand with effective control against weediness [4]. Through their proliferation, weeds compete with desired crops, reducing the quantity and quality of agricultural produce [5]. Botanical families such as Poaceae, Cyperaceae, Asteraceae, Fabaceae contain numerous crop weeds. Among the Fabaceae, *Cassia mimosoides* L., *Cassia nigricans* Vahl, *Alysicarpus ovalifolius* (Schumach.) J. Léonard and *Indigofera astragalina* DC. are recognized as invasive plants harmful to crops [6]. Our study focused on *Sesbania pachycarpa*, a Fabaceae widespread in our crops and already reported by researchers notably [7] as an invasive plant worldwide. In Niger, it has begun to be increasingly present in food plots, and farmers are complaining of its aggressiveness, particularly in the millet-growing localities of Illéla and elsewhere in the country. The *Sesbania* genus is widespread throughout Africa, from Senegal to Ethiopia, from South Africa to Madagascar, and is represented by 51 species worldwide [8]. However, research into the causes of the sudden and abrupt proliferation of this weed in our food plots is rare or poorly disseminated. We, therefore, propose to carry out a study that will contribute to better management of food plots weeded or infested by *Sesbania pachycarpa*.

2. Materials and Methods

2.1. Study Site and Materials

The study was carried out in the commune of Illéla. It covers an area of 2700 km^2 and lies between the geographical coordinates 5˚14'38" East longitude and 14˚27'43" North latitude (**Figure 1**) [9]. The climate is Sahelo-Sudanian, semi-arid, characterized by three main seasons: a cold, dry season from November to February; a hot dry season from March to May; and a rainy season from June to October. Average annual rainfall varies between 300 and 450 mm [10]. Agriculture and livestock breeding are the main activities in the commune. These two activities are supplemented by handicrafts, trade and fishing [9].

The plant material used consisted of the local "Guèreguera" millet variety and *Sesbania pachycarpa* seedlings, a crop weed. Sowing and weeding of the plots were carried out manually using a hoe. Millet plants competed with *Sesbania pachycarpa* plants. Corn grain was weighed using a kitchen scale (Camry brand; sensitivity model and 50 g - 20 kg spring). Statistical tests were carried out using R software version 4.4.1.

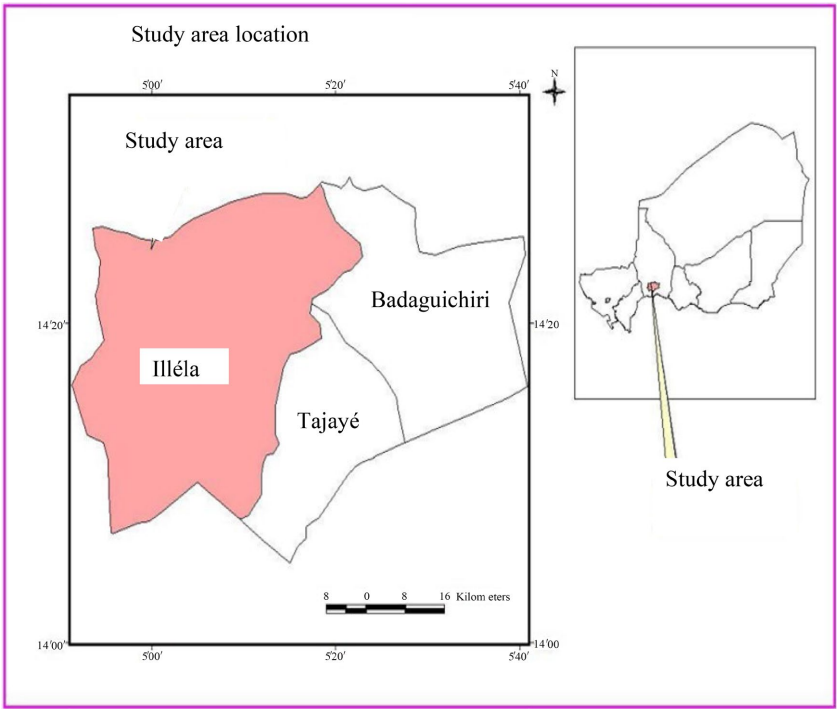

Figure 1. Location of the study in the Department of Illéla [9].

2.2. Experimental Design

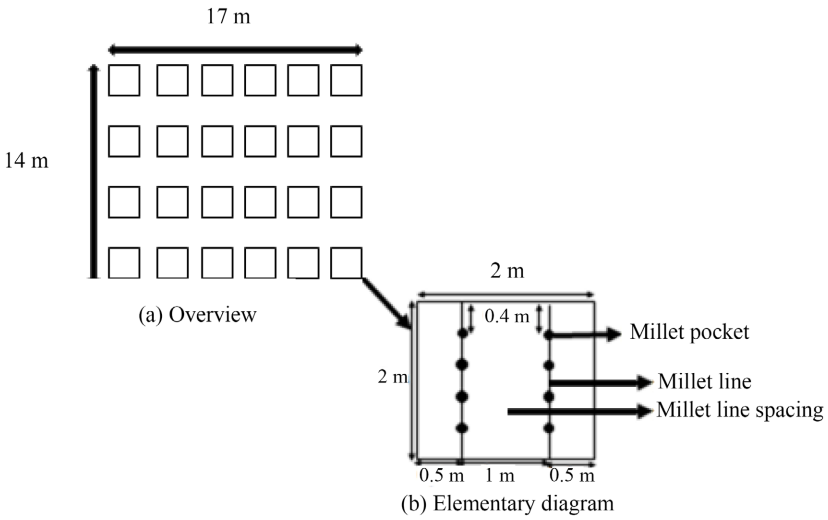

Figure 2. Experimental design, (a) Overview; (b) Elementary diagram.

The experimental set-up is a completely randomized Fisher block consisting of five treatments and one (1) control (kept clean from sowing to harvesting), with four (4) replications (**Figure 2**). The surface area of the elementary plots measured 4 m^2 (2 m × 2 m). The space between elementary plots in the same block was 1 m. The distance between two blocks is 2 m (**Figure 2(a)**). Each elementary plot consists of 2 crop lines, 1 m apart. Crop lines are spaced 50 cm apart. The cultivation lines were located 50 cm from the plot boundary and comprised four bunches 40

cm apart (Figure 2(b)). Five millet seedlings were selected per plot, *i.e.* 40 millet seedlings per elementary plot. Throughout the cultivation cycle, the plots were maintained by regular weeding. Only *Sesbania pachycarpa* plants were retained, to avoid competition from other weeds (Table 1).

Table 1. Definition of treatment characteristics.

Codes	Number of *Sesbania pachycarpa* plants around a pearl millet pocket	Density of *Sesbania pachycarpa* (number/m^2)
TM	0	0
T1	1	8
T2	2	16
T3	3	24
T7	7	56
T10	10	80

TM: Control parcel; Numbers 1; 2; 3; 7 and 10 assigned to *Sesbania pachycarpa* and representing, respectively, the numbers of plants of *Sesbania pachycarpa* around a pocket of pearl millet.

2.3. Data Collection and Analysis

Data collected included millet height, number of plants and plot weight. Dry ears were harvested by hand from each elementary plot to assess millet performance. Harvests were weighed on a plot-by-plot basis. This method was used to estimate the average dry weight per plot and per hectare of millet, based on different *Sesbania pachycarpa* plant densities. The parameters observed (millet plant growth and development) were used to calculate weekly millet plant heights and plot grain mass of harvested ears. Means of weekly heights, number of plants and millet weight were subjected to a one-factor repeated-measures analysis of variance to assess their significance at the 5% level. They were then compared using Duncan's test at the 5% significance level. Treatment averages were compared with the control, which was kept clean throughout the crop cycle.

3. Results

3.1. Effect of *Sesbania pachycarpa* Plant Density on Millet Plant Height Growth

Table 2. Comparison of average height of pearl millet plants at 7 days after sowing (DAS).

Treatments	TM	T1	T2	T3	T7	T10	Average	S. D	T. E
					Average				
Height (cm)	7.35 a	7.35 a	7.37 a	7.34 a	8.11 a	7.36 a	7.48	2.04	N. S

a: average followed by the same letter in a given column, are not significantly different according to the Duncan test at 5%; S. D. standard deviation; T. E. treatment effect; N. s. not significant difference at probability 0.001.

The results of the analysis of variance and Duncan's test at the 5% threshold

revealed that there was no significant difference between the mean height of millet plants in the control and those in the different treatments with p = 0.01 (Table 2). All the millet plants had approximately the same height (7.48 cm) in the first week after sowing.

On the other hand, the analysis of variance and Duncan's test carried out on the mean heights of millet plants in the fourth week showed a highly significant difference between the mean heights of millet plants in the control and those in the different treatments, with p = 0.001 (Table 3). The performance of the millet plants is characterized by five classes of average heights. This analysis revealed four homogeneous groups: a, b, bc and c. Group a comprises millet plants from the TM control with an average height of 67 cm. Class b comprises millet plants from treatments T1 and T2, with mean heights of 59.50 cm and 41.62 cm respectively. Class bc represents millet plants from treatments T3 (35.25 cm) and T7 (32 cm). Class c represents the average height of millet plants in treatment T10 (29.75 cm). The best growth was obtained on plots kept clean (TM).

Table 3. Comparison of average height of pearl millet plants at 28 days after sowing (DAS).

Treatments	TM	T1	T2	T3	T7	T10	Average	S. D	T. E
				Average					
Height (cm)	67.00 a	59.50 b	41.62 b	35.25 bc	32.00 bc	29.75 c	44.19	13.68	***

a. b. c: average followed by the same letter in a given column, are not significantly different according to the Duncan test at 5%; S. D. standard deviation; T. E. treatment effect; ***: highly significant difference at probability 0.001.

Finally, the analysis of variance and Duncan's test on the average height of millet plants at week 14 showed a highly significant difference between the average heights of millet plants in the control and treatment plots, with p = 0.0001. The height growth of millet plants in the treatment plots showed a slowdown compared with the height growth of millet plants in the control. This analysis revealed five classes of average millet plant height, namely a, b, c, cd and d. Class a illustrates the heights of millet plants in the TM control, averaging 282 cm. The average height of the millet plants in this class is the greatest of the heights of the millet plants measured at week 14. Homogeneous classes b, c, cd and d represent the average heights of millet plants in the treatments. The differences observed between plots are therefore due to the competitive effect of *Sesbania pachycarpa*. Class b is characterized by the average height of millet plants in treatment T1, with an average height of 220 cm. Class c contains the average heights (167 cm) of millet plants in treatment T2. T3, reaching 123 cm and 115 cm respectively. Class cd comprises the average heights of millet plants in treatments T2 and T7, 152 cm and 143.37 cm respectively. Class d shows the average height (115.50 cm) of millet plants in treatment T10. The average height of the millet plants was 7.48 cm in the first week and 44.19 cm in the fourth week. This corresponds to 179.98 cm in the fourteenth week. In addition, the millet plant heights of the TM control had the highest value in each week's ranking. T1 treatment millet plant heights were

second highest in all rankings. Furthermore, analysis of variance of millet plant heights shows that there is no significant difference between the four blocks of experimental plots. As in the fourth week, the best growth was obtained on plots kept clean (Table 4).

Table 4. Comparison of average height of pearl millet plants at 98 days after sowing (DAS).

Treatments	TM	T1	T2	T3	T7	T10	Average	S. D	T. E
				Average					
Height (cm)	282 a	220.00 b	16700.00 c	152.00 cd	143.37 cd	115.50 d	179.98	49.35	***

a. b. c. cd. d: average followed by the same letter in a given column, are not significantly different according to the Duncan test at 5%; S. D. standard deviation; T. E. treatment effect; ***: highly significant difference at probability 0.001.

3.2. Effect of *Sesbania pachycarpa* Plant Density on Millet Yield

Table 5. Comparison of average weights of pearl millet with respect to treatments.

Treatments	TM	T1	T2	T3	T7	T10	Average	S. D	T. E
				Average					
Weight (Kg/ha)	0.95 a	0.73 b	0.61 bc	0.55 c	0.48 c	0.15 d	0.58	0.19	***

a. b. bc. c. d: average followed by the same letter in a given column, are not significantly different according to the Duncan test at 5%; S. D. standard deviation; T. E. treatment effect; ***: highly significant difference at probability 0.001.

Table 6. Change in the average weight of pearl millet with different treatments in Kg/ha.

Treatments	TM	T1	T2	T3	T7	T10	Average	S. D	T. E
				Average					
Weight (Kg/ha)	2375	843.70	1537.50	1387.50	1212.50	375.00	1455.20	478.12	***

a. b. bc. c. d: average followed by the same letter in a given column, are not significantly different according to the Duncan test at 5%; S. D. standard deviation; T. E. treatment effect; ***: highly significant difference at probability 0.001.

Table 5 presents the results of the variance analysis and Duncan's test at the 5% threshold carried out on the grain masses of the millet plants obtained. These results showed a highly significant difference with $p = 0.01$. The grain masses of the millet plants in the treatments showed a deficit compared with the grain masses of the millet plants in the control kept clean throughout the millet crop cycle. This analysis revealed five homogeneous groups (a, b, bc, c and d). Group a shows the average yield of millet plants from the TM control. The grain weight obtained was 2375 kg/ha (Table 6). Group b includes the yield of millet plants from treatment T1, with an average grain mass of 1843.70 Kg/ha. Group bc refers to the yield of millet plants from treatment T2, which recorded 1537.50 Kg/ha. Group c comprises the average millet yields of treatments T3 (1387.50 kg/ha) and T7 (1212.50 kg/ha). Group d shows the yield of millet plants from treatment T10 (375 kg/ha). The difference in average millet yield between the control and treatments is 1103.76 kg/ha. The difference in average millet yield between the control and T1 treatment is 531.30 kg/ha, and that between the control and T10 treatment is 2000

kg/ha. Yield was higher in the control plots without weeds. Yield decreased with increasing *Sesbania pachycarpa* density.

3.3. Change in Number of Millet Plants as a Function of *Sesbania pachycarpa* Density

Table 7 below presents the results of the analysis of variance and Duncan's test at the 5% threshold carried out on the number of millet plants as a function of *Sesbania pachycarpa* density. This analysis shows that the treatment effect is significant, with p-value = 0.0001. The number of millet plants in the TM control plots (49.50 plants/m^2) was virtually identical to that in the T1 treatment (47.75 plants/m^2). Plots T2 recorded an average of 44.75 feet/m^2 of millet at harvest. Plots T3 (42.25 feet/m^2), T7 (41 feet/m^2) and T10 (40.75 feet/m^2) had more or less the same number of millet plants at harvest. The number of millet plants resulting from tillering decreased from treatment T1 (47.75 plants/m^2) to treatment T10 (40.75 plants/m^2).

Table 7. Comparison of average numbers of millet plants in 98 DAS.

Treatments	TM	T1	T2	T3	T7	T10	Average	S. D	T. E
				Number of					
Millet plants	49.50 a	47.75 a	44.75 ab	42.25 b	41.00 b	40.75 b	15.58	14.44	***

a. b. bc. cd. d: average followed by the same letter in a given column, are not significantly different according to the Duncan test at 5%; S. D. standard deviation; T. E. treatment effect; ***: highly significant difference at probability 0.001.

4. Discussion

The study of the effect of *Sesbania pachycarpa* on the height growth of millet plants revealed that there was no difference between the average height of millet plants in control and those in the treatments during the first week. Being at a juvenile stage of the vegetative stage, the aggressive effect of *Sesbania pachycarpa* does not hinder the height growth of millet plants, and is bearable. These results are in line with those achieved by [11] in weed control in bean cultivation in central-eastern Côte d'Ivoire.

However, from the third week of cultivation, differences appear between the average height of millet plants in the control and those of millet plants in the treatments. These differences become increasingly important and are more pronounced right up to harvest. This shows that the "Guèreguera" variety can withstand the competitive effect of *Sesbania pachycarpa* plants during the first three weeks of cultivation.

The competitive effect increases as the stem branches out. Millet plants in treatments T1 (2 plants/m^2), T2 (4 plants/m^2) and T3 (6 plants/m^2) are tolerant right up to harvest. Indeed, beyond 6 plants/m^2, considered as the threshold density, the period of interference of *Sesbania pachycarpa* plants on millet plants begins in the third week. Nevertheless, [12] in central-eastern Côte d'Ivoire showed that the interference period is 21 days after sowing for densities higher than 2 plants of

Rottboellia cocchinchinensis in maize cultivation. The difference observed could be due to the nature of the crop, climatic and ecological conditions, the type of experiment and the weed present.

Observation of the tillers reveals that their multiplication is not identical within the different treatments. In fact, the lower the density of *Sesbania pachycarpa* plants, the greater the number of tillers produced. As *Sesbania pachycarpa* plants in low densities are well-aerated and less bulky, there is little intra- and interspecific competition. The competition exerted by *Sesbania pachycarpa* plants on the local "Guèreguera" variety is more noticeable in terms of yield. This is illustrated by the weight of the control, which far exceeds that of the treatments. In fact, the greater the density of *Sesbania pachycarpa* plants, the lower the yield. This is in line with observations by [13] on weed infestation in onion plantations in north-eastern Benin. Our results on losses caused to millet production by *Sesbania pachycarpa* plants are in line with the work of many authors, including [4] [11] [14] [15], who have also worked in weed-infested crop environments.

5. Conclusions

This study enabled us to observe and understand the behaviour of *Sesbania pachycarpa* on the local millet variety "Guèreguera". Competition between *Sesbania pachycarpa* and millet plants is noticeable after three weeks. The tolerant density of *Sesbania pachycarpa* can be estimated at 6 plants/m2. Beyond this critical value, competition between *Sesbania pachycarpa* plants and millet begins to appear after the third week. The infesting power of *Sesbania pachycarpa* was most noticeable in terms of millet yield losses. The average reduction in millet yield by *Sesbania pachycarpa* was 53.52%, with a minimum of 22.37% for treatment T1 and a maximum of 84.2% for treatment T10. The local millet variety "Guèreguera" is sensitive to competition from *Sesbania pachycarpa*.

The nuisance threshold density and interference period determined can serve as a reference in order to make decisions with respect to the control of this weed, at least until the fourth week of cultivation with respect to millet.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ouendeba, B. and Siaka, S.B. (2004) Le mil [*Pennisetum glaucum* (L.) R. Br. (Poaceae)] au Niger: Généralités et résultats de la sélection. In Gilles, B. and Jean-Louis, P., Ed., *Ressources génétiques des mils en Afrique de l'Ouest: Diversité, conservation et valorisation: Actes de l'atelier*, ICRISAT, 33-43.

[2] FAOSTAT (2022) Données de l'alimentation et de l'agriculture.

[3] Kadri, B.K., Halilou, H. and Karimou, I. (2019) Culture du mil [*Pennisetum glaucum* (L) R. Br] et ses contraintes à la production: Une revue. *International Journal of Biological and Chemical Sciences*, **13**, 503. https://doi.org/10.4314/ijbcs.v13i1.40

[4] Boraud, N., Kouame, K. and Kla, D. (2015) Impact des pratiques de gestion des

adventices sur le rendement du riz au centre de la Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, **9**, 1220-1228. https://doi.org/10.4314/ijbcs.v9i3.7

[5] Ipou Ipou, J. (2005) Biologie et écologie de Euphorbia heterophylla L. (Euphorbiaceae) en culture cotonnière, Au nord de la Côte d'Ivoire. Ph.D Thesis, Cocody University.

[6] Labrada, R. (2005) Gestion des mauvaises herbes pour les pays en développement. Etude FAO production végétale et protection des plantes.

[7] Le Bourgeois, T. (1993) Les mauvaises herbes dans la rotation cotonnière au nord Cameroun (Afrique). Thèse de Doctorat, Université de Montpellier II Sciences et Techniques du Languédoc.

[8] Le Bourgeois, T. and Merlier, H. (1995) Les adventices d'Afrique soudano-sahélienne. Editions Quae.

[9] Ministère de l'Agriculture et de l'Elevage du Niger (2013) Rapport national de synthèse: Evaluation des récoltes de la campagne agricole d'hivernage 2012 et résultats définitifs 2012-2013.

[10] Médecins Du Monde (2014) Evaluation de la couverture et de l'accessibilite du programme de nutrition de medecins du monde (MDM) dans le district sanitaire d'illela département d'illela. https://www.coverage-monitoring.org/wp-content/uploads/2015/03/Rapport-SQUEAC-MDM_Niger_Illela-2014.pdf

[11] Ahonon, B.A., Traore, H. and Ipou, J.I. (2018) Mauvaises herbes majeures de la culture de haricot (*Phaseolus vulgaris* L.) dans la Région du Moronou au Centre-Est de la Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, **12**, 310-321. https://doi.org/10.4314/ijbcs.v12i1.25

[12] Ipou Ipou, J., Adamou, M. and Kouakou, N.J. (2013) Impact de Rottboellia cochinchinensis (Lourd.) W.D. Clayton en culture de maïs en Côte d'Ivoire. 22*e Conférence du Comité français de Lutte contre les Mauvaises herbes* (*COLUMA*), *Journées internationales sur la lutte contre les mauvaises herbes Dijon*, 10-12 Décembre 2013, 10 p.

[13] Bello, S., Ahanchede, A. and Amadji, G.L. (2020) Détermination des périodes de compétition des mauvaises herbes en culture d'oignon (*Allium cepa L.*) au Nord-Est du Bénin. *International Journal of Biological and Chemical Sciences*, **13**, 2497-2512. https://doi.org/10.4314/ijbcs.v13i6.6

[14] Gué, A. (2017) Etude des caractéristiques biologiques de quelques adventices majeures des cultures vivrières du Centre-Ouest de la Côte d'Ivoire. Ph.D Thesis, Cocody University.

[15] Yapi, A.F. (2017) Mauvaises herbes majeures et itinéraires techniques de désherbage des cultures vivrières de la Région de la Mé au sud-est de la Côte d'Ivoire: Cas de la banane plantain et du manioc, Ph.D Thesis, Cocody Universit.