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INFLUENCE OF AGRONOMIC PARAMETERS ON THE PERFORMANCE OF TWO TYPES OF NUTGRASS ECOTYPES OF NIGER

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ABSTRACT - The existence of the technical standard for a well-defined cultural practice is an asset in controlling the productivity of a species such as nutgrass. This study highlights the combined influence of spacing between seedlings and the number of tubers sown per plant on the yield of two types of nutgrass in Niger. The two types of nutgrass are: large nutgrass (E1) and small nutgrass (E2). The trial was installed on an area of 220 m² at the experimental field of the Faculty of Agronomy of Abdou Moumouni University of Niamey (13 ° 29'58.7''Nord and 002 ° 05'25.0''EST) during the 2017 rainy season. The experimental set-up adopted is that of complete randomized blocks with 4 repetitions and 8 treatments, i.e.4 treatments per ecotype. A treatment consists of ecotype, number of tubers (1 or 2) and spacing between lines / poquets (10/10 or 20/20).Observations included: growth (number of tillers, number of leaves, root length) and yield (number of tubers, yield of tubers and biomass). The results of the study showed that small nutgrass (E2) seedling at 10 / 10cm spacing and two tubers per poquet has low vegetative development resulting in very low biomass and tubers yields. Seeding with two tubers for the large nutgrass (E1) gave a high biomass yield for the spacing (20 / 20cm and 10 / 10cm). But its tuber yield remains very low. This during the study found that tuber yield for both types of nutgrass is higher for sowing at 20/20 spacing with one tuber.
Keywords: Cyperus esculentus; ecotypes; spacing; number of tubers; Niger;

I. INTRODUCTION

The considerable scientific progress of the last decades has brought humanity to a technical level that man at the beginning of the 20th century could not have imagined [1]**.** Yet more than two-thirds of the world's population could not get enough to eat in the twenty-first century [1]**.** And more than 75 percent of the world's population, estimated at 6 billion in 2006, owes them food to less than a dozen crops (including rice, wheat, corn, sorghum, millet, potatoes ...) [1]**.**Given the strategic position occupied by secondary crops such as nutgrass [2]**,** further investigations are needed to better understand nutgrass and so they could, in the short and / or medium term, play a leading role in food security in Niger [1]**.**

As early as 1993, Niger adopted a framework document defining the guiding principles for its interventions in rural areas, which is a basic sector of its development [3]. In this document, food security and the intensification of agriculture through nutgrass production are the promising sectors which could occupy a prominent place in near future. Its production is estimated in 2015 to more than 68160 tons on a total area of 24 688 m² [4]. Thus, initiatives are developed around this agricultural sector with the creation of groups of producers. However, very few studies are devoted to this crops. This is why there is a few technical write up on the production of nutgrass. There is a lack of research program on nutgrass production [3], a lack of crop improvement. The producers lack technical know-how on nutgrass production [5]. Opportunities exist to improve nutgrass production when agronomic parameters (plant spacing, sowing date, etc.) are controlled, and this would effectively increase nutgrass production yield [6]. The objective of this study is to determine the number of tubers sown per poquet and the spacing between appropriate nut crops to optimize the yield of two local nutgrass ecotypes in Niger.

II. MATÉRIEL AND MÉTHODS

A. Expérimental site

The trial was installed on the experimental site of the Faculty of Agronomy of Abdou Moumouni University of Niamey (13 ° 29'58.7'North and 002 ° 05'25.0''EST) during the rainy season 2017. The choice of this site is justified by the environmental conditions similar to the nutgrass growing areas to ensure an expression of the agronomic traits of the nutgrass ecotypes. Thus, the Sahelian climate is characterized by a rainy season that extends from June to September. Rainfall at the experimental site over the last ten years' ranges from 500 to over 700 mm (Figure 1). The soil is characterized by a sandy to sandy-loamy texture. The rainy season of the year 2017 recorded an annual cumulative rainfall of 731.30 mm (Figure 2) distributed in twenty-nine (29) days. During this rainy-season, July was the wettest month and has a cumulative rainfall of 222 mm.

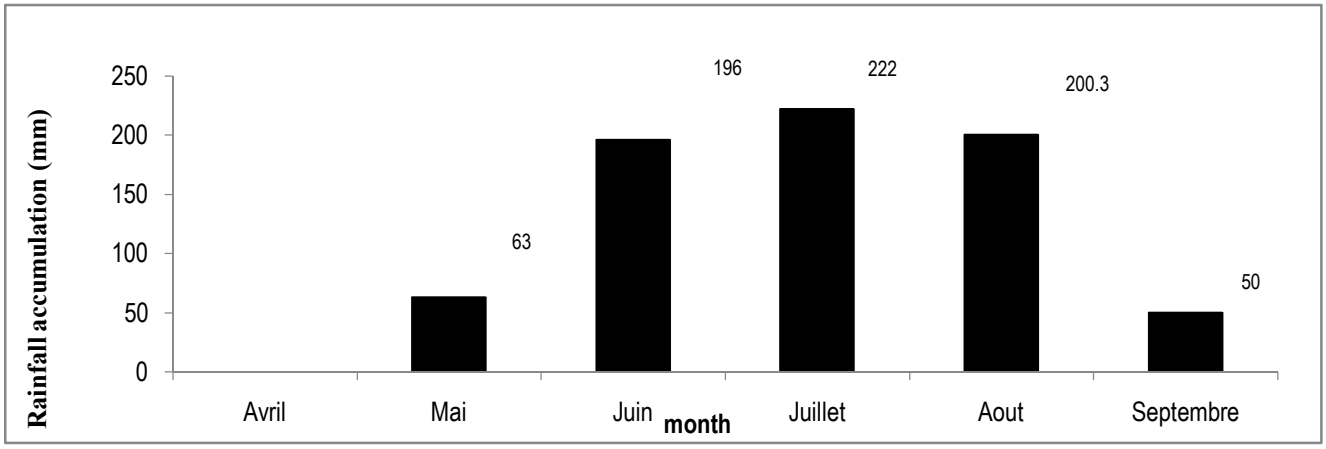


Figure 1: Rainfall accumulation of the last ten years

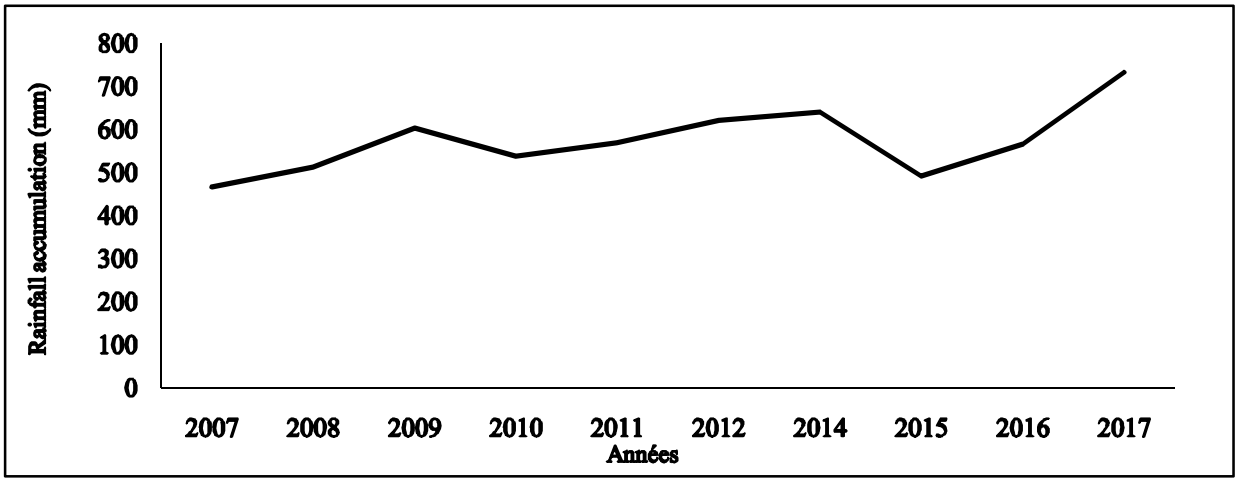
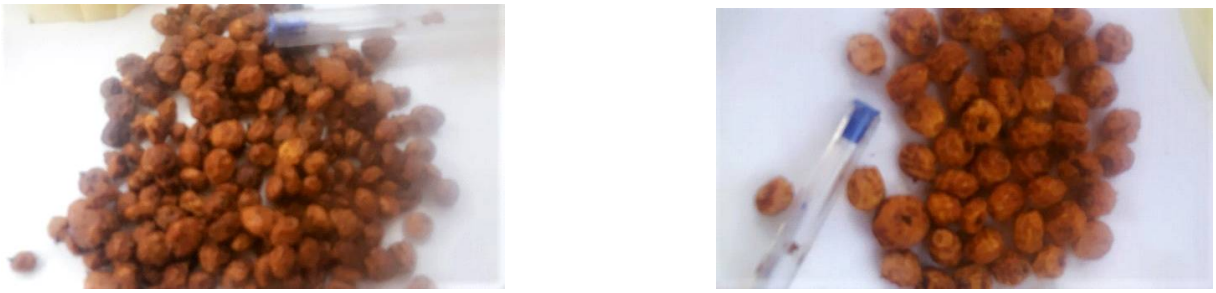


Figure 2: Cumulative rainfall recorded at the station of the Faculty of Agronomy

B. Plant material



E1: large nutgrass; E2: small nutgrass

Photo 1: types of nutgrass

The plant material consists of two (2) types of nutgrass (small and large nutgrass) collected from the producers in Niger.

C. Experimental design

The trial is installed on an area of 220 m². The experimental design adopted is that of complete randomized blocks fishers with five (4) replications and 8 treatments that is five (4) treatments per ecotype. The basic plots have an area of two (2) m² (2 m × 1 m). Elementary plots are spaced one meter from each other and the repetitions two (2) m from one (1) another. A treatment is consisting of ecotype, number of tubers sown per poquet (1tubers or 2 tubers) and spacing between lines and pockets (10 / 10cm or 20 / 20cm).

1 : E1T1e1, 2 : E2T1e2, 3 : E2T2e2, 4 : E1T2e1, 5 : E2T1e1, 6 : E1T1e2, 7 : E1T2e2, 8 : E2T2e1 ; REP : replication

Figure 3: Experimental plan

D. Data collections

1) Growth parameters

The growth parameters taken into account are the number of tillers per plant, the number of leaves per tiller and the length of the roots. Collection was done at the time of maximum tillering of the plants about 45 days after sowing. The method of data collection is the counting of tillers and leaves. For the number of tillers, fifty (50) poquets per treatment were chosen, i.e. four-hundred (400) pockets. For the number of leaves fifty (50) tillers were counted per treatment i.e. 400 tillers.

Photo 2: measure of root system

The length of the roots after harvest (Photo 2) was taken using a measuring-tape graduated into centimeter on a total of forty (40) poquets harvested per treatment.

2) Yield parameters

The yield parameters, which are the number of tubers per poquet assessed by counting forty (40) tubers harvested per treatment, yield of tubers and biomass, were determined after harvest. For this, yield squares (1m x 1m) were placed on each parcel, i.e. four squares per treatment. Harvesting occurs when more than 90% of the shots are yellow the picking of the seedlings was done (after watering to get fresh soil) with a hoe and / or by hand while taking care to not damage the roots. Separation of the tubers was done by hand. Measurement of tuber and biomass weights was done using an OHAUS precision electronic scale after drying.

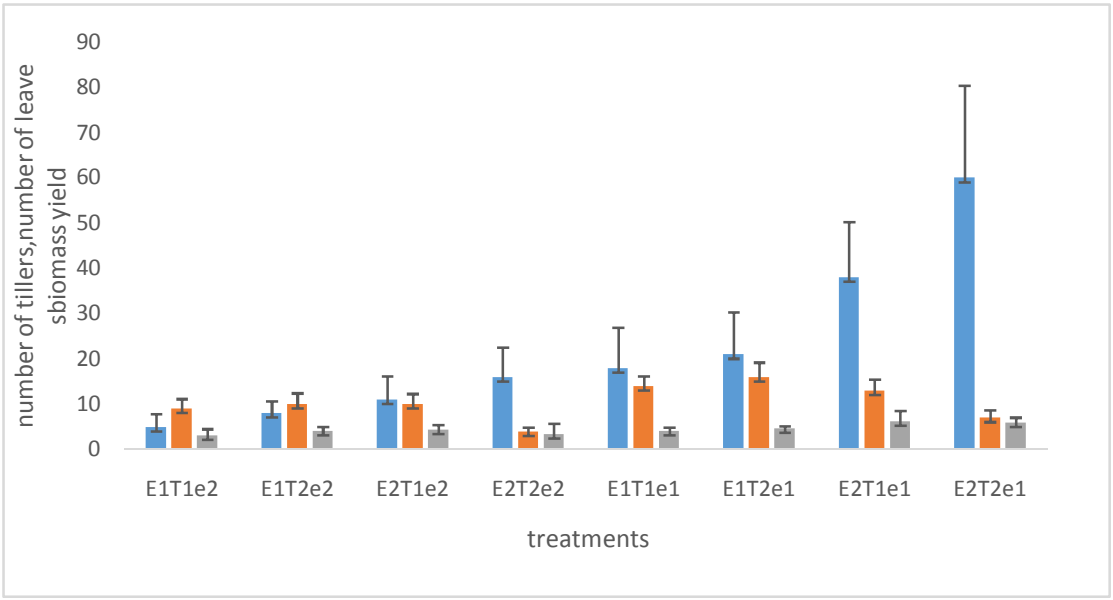
E. Statistical analysis

Analysis of variance (ANOVA) was performed with SPSS software version 20 on the data to compare agro-morphological parameters between different ecotypes. The Tukey test at the 5% threshold was used for the comparison of means.

III. RESULTS

A. Influence of spacing and number of tubers sown per poquet on the evolution of the above ground nutgrass biomass

The results on the influence of agronomic parameters (spacing e1 = 20/20 cm and e2 = 10/10 cm) and the number of tubers sown (T1 = 1tuber and T2 = 2 tubers) on the evolution of the above-ground biomass of the two types of nutgrass (small and large) in Niger are given in Figure 4.



means with the same letters are not significantly different (Tukey 5% test) E1: Large nutgrass; E2: small nutgrass; T1: one tuber; T2: two tubers; e1: 20/20cm spacing; e2: 10/10cm spacing

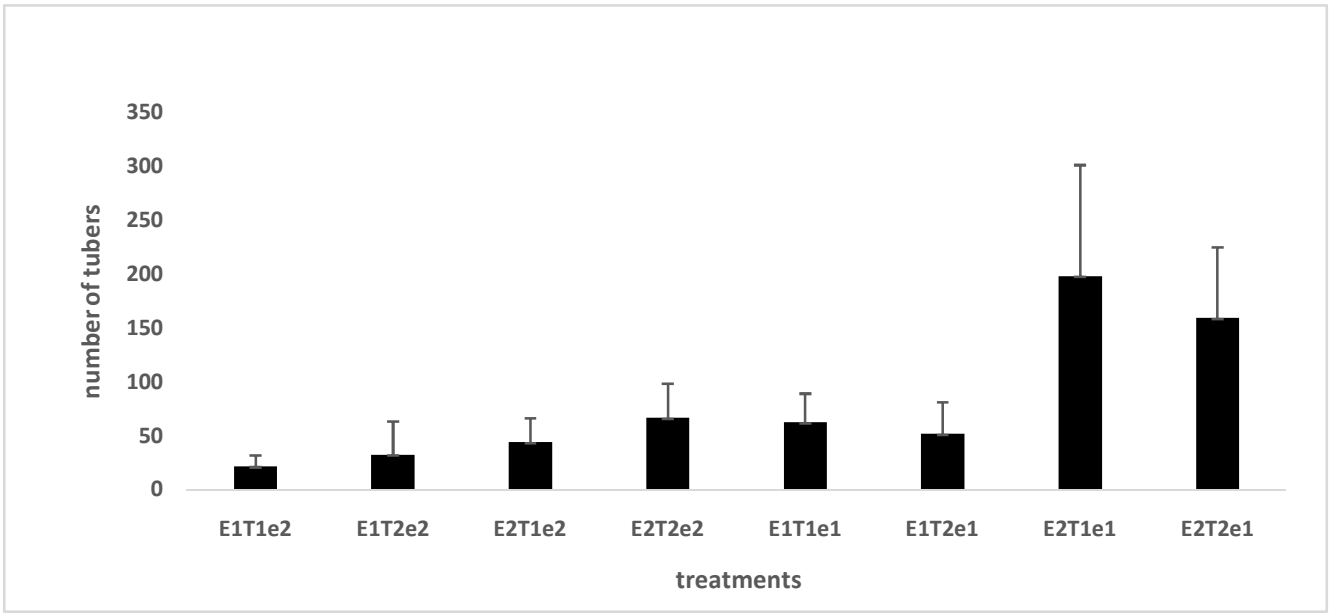
Legend: Number of tillers per poquet Number of leaves per tiller biomass yield

Figure 4: vegetative evolution of the ecotypes studied at full tillering stage (maximum tillering)

The analysis of the results of Figure 4 showed significant differences (P <0.0001) between the different treatments on the three parameters namely the number of tillers per pouch, the number of leaves per tillers and the biomass yield of ecotypes studied. The vegetative multiplication (tillering and the number of leaves) of treatments at 10 / 10cm (e2) spacing is significantly weak compared to other treatments at 20 / 20cm spacing at the two ecotypes studied. Tillering is significantly greater in two-tuber treatments (ET2e) and clearly higher for the small type nutgrass ecotype. The analysis also showed that the biomass yield for all treatments (for both types of nutgrass) at 20 / 20cm spacing is highly significant compared to other treatments at 10 / 10cm spacing. Biomass yields of small nutgrass seedlings (E2T1e2 and E2T1e1), sown on one tuber per poquet were higher than treatments of the same ecotype but sown with two tubers per poquet. In contrast to the large nutgrass ecotypes where the biomass yield of two tubers per treatment are higher compared to one tuber treatments.

B. Influence of spacing and number of tubers sown per poquet on the underground development of nutgrass

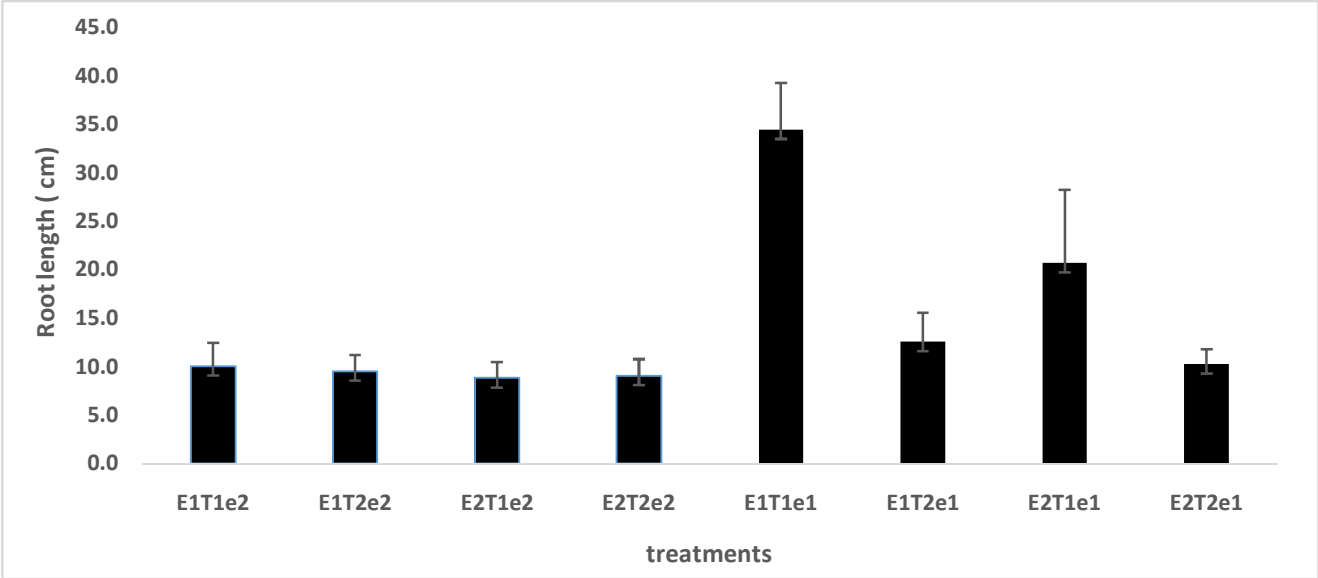
The results of the data collected on the influence of agronomic parameters (spacing (e1 and e2) and the number of tubers sown (T1 and T2) on the underground development of the two types of nutgrass (the small and the large) in Niger are given in Figures 5 and 6.



means with the same letters are not significantly different (Tukey 5% test) E1: Large nutgrass; E2: small nutgrass; T1: one tuber; T2: two tubers; e1: 20/20cm spacing; e2: 10/10cm spacing

Figure 5: number of tubers per poquet

Analysis of the results in Figure 5 shows a significant difference (P <0.0001) between different treatments on the number of tubers at harvest. The number of tubers (198 tubers) of treatment E2T1e1 (small nutgrass sown to a tuber at 20 / 20cm spacing) is significantly higher, and that of E1T1e2 treatment (nutgrass seeded to a tuber at 10/10cm spacing) is significantly smaller (22tubercules) compared to other treatments. The numbers of tubers of treatments at 20 / 20cm (e1) spacing are significantly greater compared to those of treatments at 10 / 10cm (e2) spacing.Treatments with the combination (T1e2) recorded numbers of tubers (44 tubers for the small nutgrass and 22 tubers for the large nutgrass) significantly lower than all other treatments.



means with the same letters are not significantly different (Tukey 5% test) E1: Large nutgrass; E2: small nutgrass; T1: one tuber; T2: two tubers; e1: 20/20cm spacing; e2: 10/10cm spacing

Figure 6 : Root length of treatments performed (cm)

Figure 6 gives the root length of the treatments put in place. Statistical analysis of the results showed a significant difference between these treatments. The root lengths of treatments at 10/10 cm (e2) spacing are statically identical and significantly smaller than treatments at 20 / 20cm (e1) spacing. The root length of the E1T1e1 treatment is significantly higher than the other treatments.

C. Influence of spacing and number of tubers sown per poquet on tuber yield of nutgrass

Statistical analysis of the results on the influence of spacing and number of tubers sown per poquet on tuber yield of both types of nutgrass showed significant differences in tuber yield between the two forms of nutgrass in Niger. Treatment yields with e1 (20 / 20cm) spacing are significantly higher (7.2t to 9.7t / ha) than those at e2 (10 / 10cm) spacing (5.5t to 6.2t / ha). Yields obtained for treatments at one tuber and spacing e1 and e2 (ET1e1 / e2) are higher than those for two tubers treatments and e1 and e2 (ET2e1 / e2) spacing. The E2T1e1 treatment yield (small nutgrass sown at one tuber and 20 / 20cm spacing) is significantly higher than those of other treatments. The yield of the E1T2e2 treatment (big nutgrass sown with two tubers at the 10/10 cm spacing) is significantly lower (Figure 7) than other treatments. means with the same letters are not significantly different (Tukey 5% test) E1: Large nutgrass; E2: small nutgrass; T1: one tuber; T2: two tubers; e1: 20/20cm spacing; e2: 10/10cm spacing

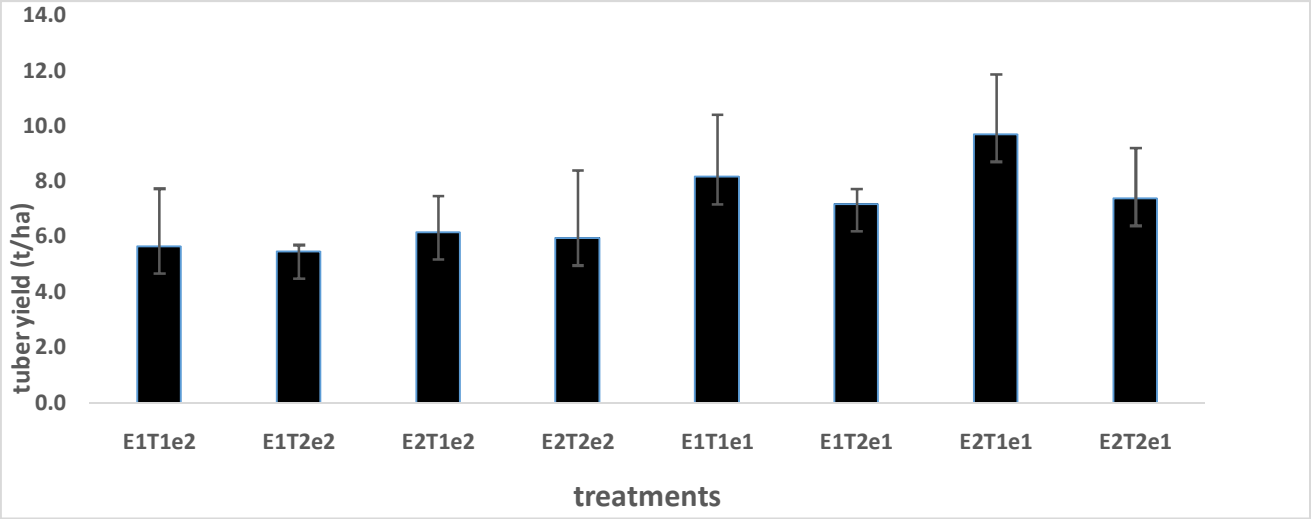


Figure 7: tuber yield of two types of nutgrass

The principal component analysis of the variables studied for all treatments (Table I) showed a positive correlation between the number of tillers and the biomass yield (r^2 = 0.843). A positive correlation was also observed between the number of tillers and the number of tubers (r^2 = 0.870), between biomass yield and number of tubers (r^2 = 0.893), between biomass yield and tuber yield (r^2 = 0.766) and finally between the number of tubers and tuber yield. There was no significant correlation between all the variables and the number of leaves, as well as the length of the roots.

TABLE I: MATRICES OF CORRELATION (ACP) BETWEEN THE VARIABLES.

Variables	NT	NFT	LR	RB	NTU	RT
NT	**1**	-0.059	0.097	**0.843**	**0.870**	0.610
NFT	-0.059	**1**	0.560	0.282	0.010	0.518
LR	0.097	0.560	**1**	0.174	0.217	0.679
RB	**0.843**	0.282	0.174	**1**	**0.893**	**0.766**
NTU	**0.870**	0.010	0.217	**0.893**	**1**	**0.800**
RT	0.610	0.518	0.679	**0.766**	**0.800**	**1**

NT; number of tillers, RB: biomass yield, NTU: number of tubers, RT: yield of tubers, NFT: number of leaves, LR: length of the roots. The results of the principal component analysis also showed that the first two axes F1 and F2 (Figure 8) expressed the greatest variability (87.852%). The contribution of each character is recorded by the values in bold (Table II).

TABLE II: CONTRIBUTION OF EACH CHARACTER OF 8 TREATMENTS.

	F1	F2	F3	F4	F5	F6
NT	**0.434**	-0.366	-0.039	-0.757	-0.321	-0.021
NFT	0.196	**0.623**	**0.650**	-0.144	-0.205	0.298
LR	0.257	**0.573**	-0.631	-0.252	**0.355**	0.133
RB	**0.484**	-0.175	**0.376**	0.041	**0.726**	-0.252
NTU	**0.480**	-0.271	-0.136	**0.437**	-0.100	**0.690**
RT	**0.493**	0.213	-0.132	**0.388**	-0.437	-0.594
Own value	3.628	1.643	0.515	0.160	0.049	0.005
Variability (%)	60.463	27.388	8.591	2.661	0.813	0.084
% accumulation	60.463	87.852	96.442	99.103	99.916	100.000

NT; number of tillers, RB: biomass yield, NTU: number of tubers, RT: yield of tubers, NFT: number of leaves, LR: length of the roots. The analysis of the results in Table II shows that Axis 1 (F1), which gives 60.46% of information, is defined by the number of tillers, the biomass yield, the number of tubers and the yield of tubers (Figure 8). Axis 2 of the same figure, with 27.38%, is defined by the number of leaves and the length of the roots.

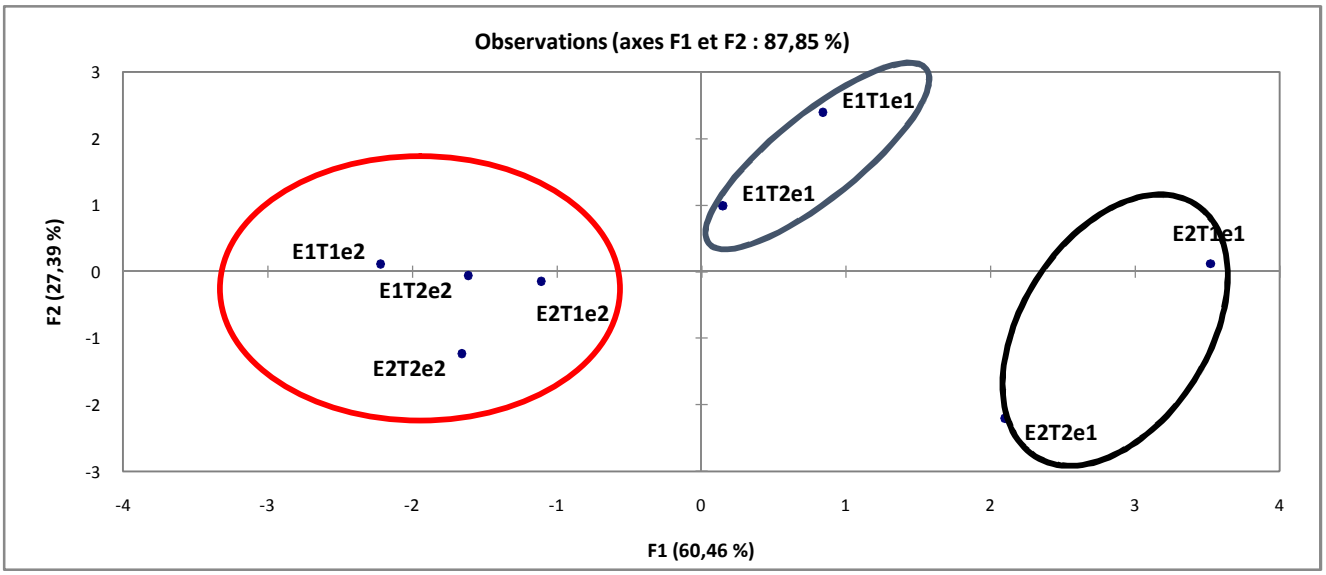


Figure 8: Distribution of different treatments than other principals axes.

The analysis of the results of figure 8 makes it possible to divide the studied treatments into three groups according to the spacing used. The first group (I) is composed of all the treatments at 10 / 10cm (e2) spacing. The second group is composed of treatments of the large nutgrass (E1) at 20 / 20cm spacing (e1) and finally the third group includes the treatments of small nutgrass with 20/20cm (e2). We also note that all the treatments at the 20 / 20cm spacing are on the positive side of the axes and those at the 10 / 10cm spacing are at the opposite side.

IV. DISCUSSION

Nutgrass (*Cyperus esculentus)* is a species that has not undergone many studies as a cultured food species. Most of the studies carried out on nutgrass, rank it among the weeds to be eradicated. This study, the first of its kind, aims at highlighting an adequate technique to boost the yield of nutgrass which is in the context of our study a species cultivated in Niger. The results of the study focused on the influence of spacing (10 / 10cm and 20 / 20cm) and the number of sown tubers (1 and 2 tubers) on the yield of both forms of nutgrass in Niger.

Analysis of our results showed that treatments that have 10 / 10cm (e2) spacing have low vegetative multiplication (tillering and number of leaves) compared to treatments that have 20 / 20cm spacing at both ecotypes studied. Closer poquets can create competition for space and prevent plants from developing normally. These results are similar to those of [7] in a cowpea study. He reports that as spacing between plants decreases, the point of strong competition for essential growth factors (nutrients, light and water) is reached. Yields of tubers and biomasses of treatments at 20 / 20cm (e1) spacing are significantly higher compared to treatments at 10 / 10cm (e2) spacing. These results corroborate those of [8] in his study conducted on soybean cultivation. It states that too small spacing delay flowering and decrease the number of branches, thus reducing yield. Our results are reinforced with those of [6] who reports the results on Cowpea of [9] saying that if planting density is high and competition appears, yield falls. Similar results were found by [10] with alfalfa where the author states that it is at large intervals that the best results in yields are obtained.

The root lengths of treatments at 10/10 cm (e2) spacing are statically identical and significantly smaller than the 20 / 20cm spacing treatments. The analysis of the results as a function of the number of tubers sown showed that tillering is more important for two-tuber treatments (ET2e) and significantly higher for the small-nutgrass ecotype. But the biomass yields of the small nutgrass ecotypes sown at one tuber per poquet (E2T1e2 and E2T1e1) are higher than the treatments of the same ecotype but sown with two tubers per poquet. In contrast to the large nutgrass ecotypes where the biomass yield of two-tuber treatments is higher compared to one tuber treatments. These results can be explained by the fact that the big nutgrass does not tiller much. Therefore, there will be no competition for the aboveground for the large nutgrass (E1) biomass. Tuber yields obtained for one tuber treatments (ET1e) are higher than those for two tubers treatments (ET2e). Root length tuber treatments are significantly higher than those with two tubers.

V. CONCLUSION

The study on the influence of the spacing and the number of tubers at the sowing on the yield made it possible to highlight the agronomic potential of nutgrass. The results of the study showed that seedlings for small nutgrass (E2) at 10/10 cm spacing and two tubers have low vegetative development resulting in very low yields of biomass and tubers. Seeding with two tubers for the large nutgrass (E1) gave a high biomass yield for the spacing (20 / 20cm and 10 / 10cm) cm. But its tuber yield remains very low. There for, the study found that tuber yield is higher for sowing at 20 / 20cm spacing to one tuber per poquet.

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