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RESEARCH ARTICLE

VARIETAL CHARACTERISTICS AND EVALUATION OF THE AGRONOMIC PERFORMANCE OF FONIO ECOTYPES IN THE SUDANESE ZONE OF CHAD

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ABSTRACT

Fonio is of major importance because it plays a significant role in feeding the population. It is traditionally cultivated in certain regions of Chad and remains marginal. However, fonio plays an important role in the fight against poverty by ensuring food security. The objective of this study is to identify varietal characteristics and evaluate the performance of fonio ecotypes. The plant material consisted of four ecotypes, Ts_Fon_20, Ts_Fon_13, Ts_Fon_24 and Ts_Fon_23, corresponding to treatments T1, T2, T3 and T4. The trial was conducted using a Fisher block design with four treatments repeated four times. Treatment T2 (25.66 cm ± 1.867) achieved the highest height, followed by T1 (25.13 cm ± 1.367). T2 (8.18 ± 2.68) recorded the highest number of shoots per plant, followed by T3 (6.38 ± 0.21). Treatment T2 (10.17 ± 4.34) recorded the highest number of ears, followed by T3 (9.06 ± 0.51) and T4 (5.012 ± 1.29). T2 (7.4 ± 0.86) recorded the highest number of racemes per ear, followed by T3 (6.51 ± 0.27) and T1 (3.5 ± 0.13). T2 (177.77 kg/ha ± 44.44) obtained the highest straw yield, followed by T1 (133.33 kg/ha ± 0.11) and T3 (133.33 kg/ha ± 33.33). The heritability values (h^2) obtained are very high for the number of tillers 60 JAR (h^2 = 0.982), the number of ears (h^2 = 0.97) and the number of racemes (h^2 = 0.982). The heritability values are coupled with selection gain percentages of 78.15 (number of tillers), 87 (number of ears), and 80.66 (number of racemes). T2 and T3 corresponded to Ts Fon13 and Ts Fon 24, which performed better. Furthermore, the results obtained could serve as a basis for data for the fonio genetic improvement programme in Chad.

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INTRODUCTION

In Chad, cereals play an important role in the basic diet of the population. Cereal production is mainly aimed at meeting the food needs of families (Stringer *et al.* 2009). This explains the diversification of crops. However, certain traditional varieties of cereal crops are now disappearing. The introduction of cash crops and improved high-yield varieties has contributed to restricting the cultivation area of these traditional varieties, which can now only be found in the most remote rural areas. Fonio, Digitaria exillis stapf, is a traditional cereal endemic to Africa that has been the subject of relatively little research but persists within production systems (Cruz *et al.* 2012; Vall *et al.* 2011). These authors hypothesised that its persistence was linked to its central role in seasonal household food security in coping with the lean season. It is considered a 'minor' crop compared to the 'major' cereals such as millet (*Pennisetum typhoïdes* L.), sorghum (*Sorghum bicolor* L.), maize (*Zea mays* L.), rice (*Oriza sativa* L.) and common wheat (*Triticum aestivum* L.), which are grown throughout Chad depending on climatic conditions (M'Sangaral, 2025). Fonio was overlooked by the 'green' revolutions, even though it played an important role in food security in emerging countries and is well suited to the climate and soil of areas with low rainfall (M'Sangaral, 2025). Despite its many potential virtues, fonio remains a marginal crop that is neglected in national programmes for research and promotion of food crops in Chad. Cultivation techniques remain traditional, rudimentary and little studied, resulting in the arduous cultivation operations that are characteristic of fonio, with very low yields generally ranging from 200 to 700 kg/ha (Badiane *et al.* 2006). In Africa, climate change scenarios differ substantially in terms of the likely increase or decrease in rainfall, but all agree on an increase in the variability of extreme weather events, namely an increase in the occurrence of droughts and torrential rains (Cooper *et al.* 2008, Niang *et al.* 2014, Torquebiau, 2015). African farmers have always been exposed to high variability in their production environment (Twomlow *et al.* 2008), partly due to the characteristics of the climate in sub-humid tropical areas (Cooper *et al.* 2008), underdeveloped supply chains and a lack of insurance systems (Adesina and Ouattara, 2000). As a result, farmers use a wide range of adaptation strategies, including selecting drought-tolerant varieties or crops, diversifying income sources through crop-livestock integration or non-agricultural activities (Abdulai and Croleress, 2001; Thornton *et al.* 2007).

Andrieu *et al*. (2015) reported that assessing the potential of existing strategies is the first step in the transition to climate-resilient systems. Climate change, a global phenomenon that is particularly pronounced in the Sahel, is completely disrupting the agro-sylvo-pastoral production systems of countries in this geographical area. In recent decades, we have witnessed exponential desertification, rising temperatures, recurrent droughts and floods, etc., resulting in loss of soil fertility and declining agricultural production, leading to famine with its corollary of disease and human and animal mortality. It should be noted that the ecosystem has been completely altered, making it urgent to resort to crops that have long been neglected in order to remedy this situation. This is why fonio, which has proven itself in West Africa, could be adapted and cultivated intensively in Central Africa, particularly in Chad. This small cereal, fonio (*Digitaria exilis stapf*), can play an important role in food security in most countries in general and in Chad in particular, as well as in soil conservation by providing vegetation cover on fragile land where other cereals (rice, sorghum or maize) would struggle to grow. Although fonio is traditionally grown in certain provinces of Chad, such as Mayo Kebbi West, Tandjilé East and West, Mandoul, and Logones West and East, it remains marginal. Until now, very little scientific research has been conducted on this crop. The main objective of the study is therefore to increase agricultural production and producers' incomes in the study area. Specifically, it aims to:

- Identify the most adaptable variety or varieties in the Sudanese zone of Chad;
- Evaluate the best-performing fonio varieties in the Sudanese zone of Chad.
- Identify the varietal characteristics of fonio ecotypes

MATERIALS AND METHODS

Geographical location of the study area: The study was conducted in Sarh, located in the south-east of the country, approximately 150 km from the border with the Central African Republic. The city of Sarh is the capital of the Moyen Chari Province, the Bahr-Kôh Department, and the rural sub-prefecture of Sarh. It lies between 9º 4'32"' and 9°5'28"' north latitude and 18º23'44"' and 18°25'98"' east longitude (Figure 1).

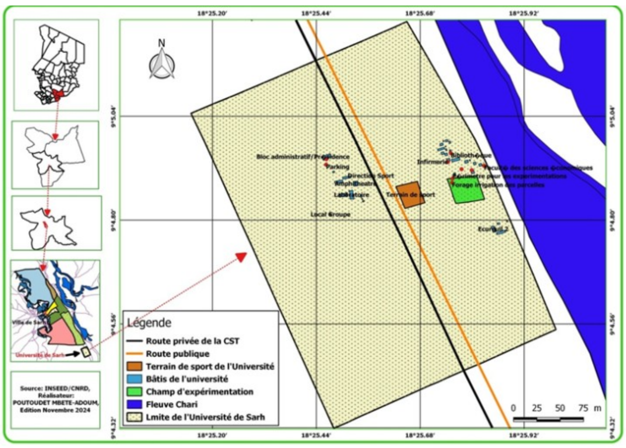

Figure 1. Map of the city of Sarh (study area)

The town of Sarh lies between two rivers, the Chari and the Bahr-Kôh, to the east and west. It was built on a vast floodplain and can only expand northwards and southwards. It stretches over 12 km from north to south and covers an area of approximately 3,000 hectares. The average altitude is around 370 m (Sarh Town Hall, 2018).

Experiment site: The experiment was conducted in July 2025 at the University of Sarh (UDS), Doyaba site (09'081"89°N, 18'42"947°E, altitude 360 m) in the Middle Chari Province, Barh kôh Department. The site is impoverished by the loss of organic matter and has a degraded structure. The climate is Sudanese, characterised by a dry, hot season from November to April and a wet, hot rainy season from May to October. Average temperatures range from 24 to 38°C.

Plant material: The plant material consists of four varieties of fonio: Ts_Fon_20, Ts_Fon_13, Ts_Fon_24 and Ts_Fon_23, with a cycle of approximately 95 to 100 days and an undetermined yield. The level of intensification was improved by light ploughing and weeding.

Methods

The trial was conducted using a Fisher block design with four treatments (T1, T2, T3 and T4) and four replicates. The varieties Ts_Fon_20, Ts_Fon_13, Ts_Fon_24 and Ts_Fon_23 corresponded to treatments T1, T2, T3 and T4 respectively. One factor studied: the genetic potential of ecotypes.

Cultivation: The nursery was set up after preparing four beds measuring 1.40 m x 2.5 m, or 3.5 m² for each bed. Seeds were sown in continuous rows 20 cm x 20 cm apart after rainfall of at least 20 mm. Weeding was carried out on the 12th day after sowing (DAS) and again on the 22nd DAS. The experimental plots were ploughed to a depth of 15-20 cm. Transplanting was carried out one (1) month after the plants had been in the nursery for 30 days. Two (2) plants per hole were transplanted at a depth of approximately 5 cm after beneficial rainfall. A spacing of 30 cm x 30 cm was used. The first weeding was carried out on the 15th day after transplanting (DAT), a second weeding on the 30th DAT and a third weeding as needed. No fertiliser, pesticides or herbicides were applied. The surface area of the experimental plot was 5 m x 3 m = 15 m², giving a total surface area of 15 m² x 16 = 240 m² for all the experimental plots. A 3 m border was left for passage and a 1 m space between blocks. The previous crop was sweet potatoes.

Phenological observations: Phenological observations focused on 50% and 100% heading/flowering and the crop cycle.

Calculated, measured or recorded parameters: Agronomic parameters focused on measuring or recording: stem height, number of tillers per plant, number of racemes per ear, straw yield, heritability (h^2) and selection gain for yield components.

Heritability (h^2): According to Mahmud and Kramer (1951), heritability in the broad sense (h^2) is estimated using the formula:

$$h^2 = \sigma_g^2/\sigma_p^2 = (\sigma_p^2-\sigma_E^2)/\sigma_p^2 = (\sigma_I^2-\sigma_i^2)/\sigma_I^2$$

- σ_I^2: inter-varietal variance, σ_i^2: phenotypic variance;
- σ_i^2: intra-varietal variance, σ_E^2 : environmental variance.
- Inter-varietal variance is calculated using the following formula:
- $\sigma_I^2=\sum[(X_m-X_i)^2] /n-1$
- Xm: is the mean value of all pure lines;
- Xi: the mean of each variety;
- n: number of varieties (n=4)

Intra-varietal variance is measured for each variety using the following formula:

$$\sigma_i^2=\sum[(r_m-r_i)^2] / r-1$$

rm: the average value of all repetitions;
ri: the value of each repetition;
r: the number of repetitions (r=4)
Heritability values are estimated for each parameter at the level of each variety and at the level of the total population.

By convention:

When $h^2 \geq 0.8$, heritability is said to be very high
When $0.6 \leq h^2 < 0.8$, it is said to be high
When $0.5 \leq h^2 < 0.6$, it is said to be moderate or moderately high
When $0.4 \leq h^2 < 0.5$, it is said to be average
When $0.2 \leq h^2 < 0.4$, it is said to be low
When $h^2 < 0.2$, it is said to be very low

Selection gain: Selection gain can be estimated from the value of heritability and phenotypic variance using the formula proposed by Allard (1960).

$G = h^2 \times K \times (\sigma^2_p)^{1/2}$

Where G = expected gain from selection; K = standardised selection differential or whose value depends on the selection percentage (K = 1.75 for a selection intensity of selection differential in standard deviation units of 10%), σ^2_p = phenotypic variance in the initial population, h^2 = broad-sense heritability.

As a percentage:

G (%) = G/M × 100
G (%): Expected selection gain as a percentage;
G: Selection gain;
M: Total mean of genotypes.

Statistical analyses: The data collected will be analysed using SPSS (Statistical Package for Social Sciences version 20.0) software. The means of the different parameters will be separated using the Student-Newman-Keuls (SNK) multiple comparison test.

RESULTS AND DISCUSSION

Results

Phenological observations: For all varieties tested, emergence was observed 3 to 6 days after sowing (DAS). A 98% recovery rate was observed for all cultivars 5 days after transplanting (DAT). Tillering began 15 DAT, followed by elongation in all varieties. Ear emergence was observed 28 DTR on the Ts Fon13 and Ts Fon24 varieties, then 30 DTR on the Ts Fon 20 and Ts Fon 23 varieties. Flowering was observed at 50% at 33 DTR and 100% at 41 DTR for the Ts Fon 13 and TS Fon 24 varieties. However, it was observed at 35 JAR at 50% and 100%, and at 49 JAR for the Ts Fon 20 and Ts Fon 23 varieties. The TS Fon13 and Ts Fon 24 varieties reached maturity at 65 JAR, while the Ts Fon 20 and Ts Fon23 varieties reached maturity at 70 JAR. The varietal characteristics observed in the different varieties are summarised in Table 1.

Results of measured parameters

Stem heights at 15 JAR: The results for stem heights at 15 JAR are shown in Figure 2. Treatment T2 (14.44 cm ± 1.26) recorded the highest height, followed by T1 (14.14 cm ± 1.077). Low stem heights were observed in T4 (12.2 cm ± 1.4) and T3 (12.4 cm ± 2.3). Statistical analysis of the treatment mean results showed that there was no significant difference in stem height (F = 0.89; P = 0.344). The differences observed are due to uncontrolled factors and not to treatments.

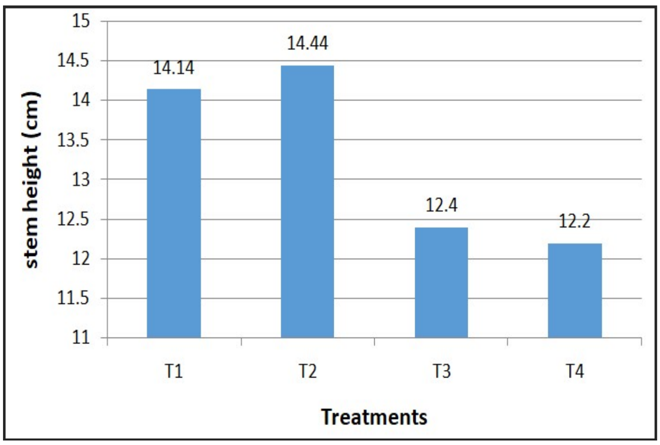

Figure 2. Stem heights at 15 JAR

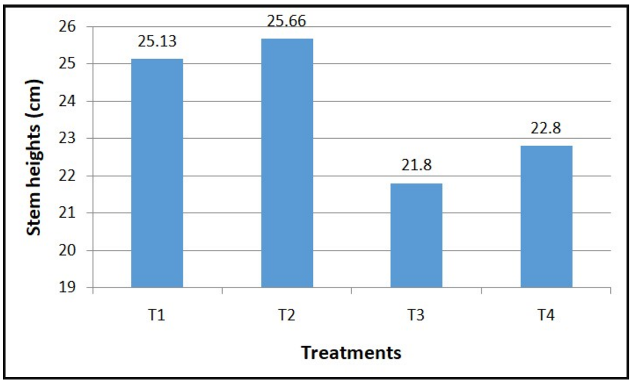

Figure 3. Height of stems at 60 JAR

Stem height at 60 JAR: The results for stem height at 60 JAR are shown in Figure 3. Treatment T2 (25.66 cm ± 1.867) had the highest height, followed by T1 (25.13 cm ± 1.367). Low stem heights were noted in treatments T3 (21.8 cm ± 0.2) and T4 (22.8 cm ± 1.5). Statistical analysis of the treatment mean results revealed that there was no significant difference in stem height (F = 3.27; P = 0.01). The differences observed are due to uncontrolled factors and not to the treatments.

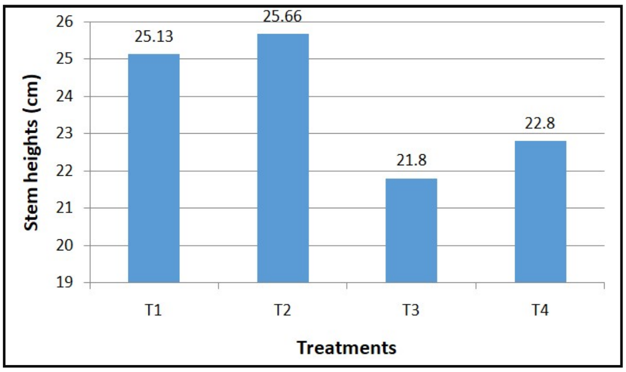

Figure 3. Height of stems at 60 JAR

Average number of shoots per plant at 60 JAR: The number of shoots per plant at 60 JAR is shown in Figure 5. Treatment T2 (8.18 ± 2.681) recorded the highest number of shoots, followed by treatment T3 (6.38 ± 0.219). Treatments T4 and T1 obtained T4 (5.48 ± 0.393) and T1 (4.31 ± 0.487), respectively. Statistical analysis of the treatment mean results revealed a significant difference at the 5% threshold in terms of the number of shoots at 60 JAR (F = 5.587; P = 0.174).

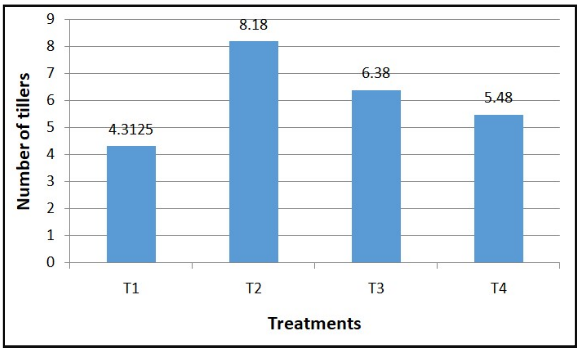

Figure 5. Average number of shoots per plant at 60 JAR

Average number of ears per plant: The average number of ears per plant is shown in Figure 6. Treatment T2 (10.175 ± 4.3453) recorded the highest number of ears, followed by treatments T3 (9.0625 ± 0.515) and T4 (5.0125 ± 1.2954). The lowest number of ears per plant was observed in treatment T1 (3.08 ± 0.1166). Statistical analysis of

Table 1. Morphological characteristics observed in the different varieties

Varieties	Earing (JAR)	50% flowering (JAR)	100% flowering (JAR)	Maturity (JAR)	Grain colour	Grain shape	Grain surface area	Pericarp
Ts_fon 20	30	35	49	70	Dark brown	Ovoid	Smooth	Non-persistent
Ts_fon 13	28	33	41	65	Light brown	Ovoid	Smooth	Non-persistant
Ts_fon 24	28	33	41	65	Light brown	Ovoid	Smooth	Non-persistant
Ts_fon 23	30	35	49	70	Brown	Ovoid	Smooth	Non-persistant

the treatment means revealed a highly significant difference in the number of ears per plant ($F = 9.8518$; $P< 0.001$).

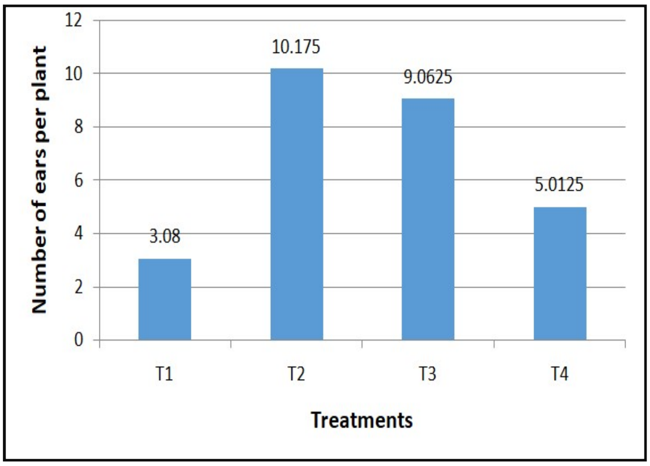

Figure 6. Number of ears per plant

Number of racemes per ear: The number of racemes per ear is shown in Figure 7. Treatment T2 (7.4± 0.8602) recorded the highest number of racemes per ear, followed by treatments T3 (6.5125 ± 0.2780) and T1 (3.5 ± 0.13391) . Treatment T4 (2.3375 ± 0.5218) had the lowest number of racemes per ear. Statistical analysis of the treatment means showed that there was a highly significant difference in the number of racemes per ear ($F = 45.1134$; $P = 0.254$).

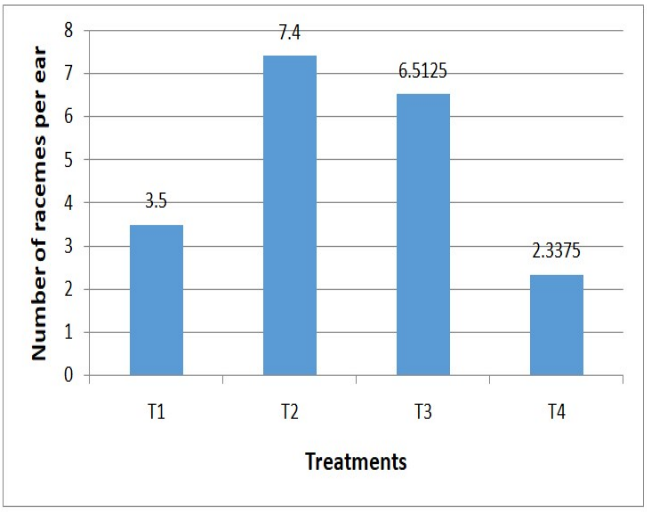

Figure 7. Average number of racemes per ear

Average straw yield (kg/ha): The average straw yield is shown in Figure 8. Treatment T2 (177.77 kg/ha ± 44.443) had the highest yield, followed by T1 (133.33 kg/ha ± 0.11) and T3 (133.33 kg/ha ± 33.335), which had the same yields. The lowest yield was observed in treatment T4 (110 kg/ha ± 22.225). Statistical analysis of the average treatment results revealed no significant difference in straw yield ($F = 2.37$; $P < 0.0001$). The observed differences are due to uncontrolled factors and not to the treatments themselves.

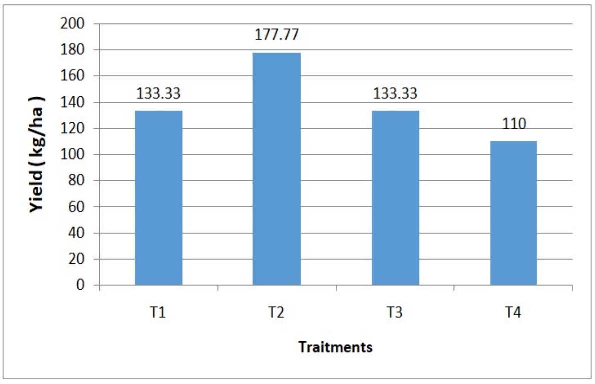

Figure 8. Average straw yield (kg/ha)

Estimation of genetic variability, heritability and selection gain

Genetic variability of the quantitative trait number of tillers, ears and racemes. Statistical data on the genetic variability of the quantitative trait number of tillers are shown in Table 2.

Table 2. Variability in the number of tillers of 15 JAR fonio varieties

Genotypes	Means and standard deviations
Ts Fon13 (T2)	$2,222 \pm 0,210^{a}$
Ts Fon24 (T3)	$1,557 \pm 0,141^{b}$
Ts Fon20 (T1)	$1,397 \pm 0,175^{b}$
Ts Fon23 (T4)	$1,34 \pm 0,431^{b}$
Average of varieties	**6,517± 0,239**
σ_I^2	**32,0214**
σ_i^2	**0,1477**
P	**< 0,00**
PPDS	**0,6556**

Analysis of variance of the number of tillers in four fonio varieties studied (15JAR) revealed that genotype effects are highly significant ($p<0.001$) (Table 2). The number of tillers varies overall from 1.34 (Ts Fon23 (T4)) to 2.222 (Ts Fon13 (T2)), with an average of 1.62. Of all the genotypes tested, the variety TsFon13 (T2) is considered the best variety in terms of the number of tillers per variety, followed by Ts Fon24 (T3) at the experimental site. The inter-varietal variance (32.0214) is greater than the intra-varietal variance (0.1477), and this difference could be explained by environmental factors and/or the growing season. Averages followed by the same letter in the same column are not significantly different at the 1% probability threshold. PPDS: Least Significant Difference,σ_I^2 inter-varietal variance,σ_i^2 intra-varietal variance, P: probability. The statistical data on the genetic variability of the quantitative trait number of tillers per variety are shown in Table 3. Analysis of variance of the number of tillers of four fonio varieties studied 60 JAR showed that the genotype effects are significant ($p=0.174$) (Table 3).

Table 3. Variability in the number of tillers of fonio varieties 60 JAR

Genotypes	Means and standard deviations
Ts Fon13 (T2)	$8,18 \pm 2,681^{a}$
Ts Fon24 (T3)	$6,38 \pm 0,219^{ab}$
Ts Fon20 (T1)	$4,31 \pm 0,487^{b}$
Ts Fon23 (T4)	$5,48 \pm 0, 393^{b}$
Average of varieties	**24,3525 ± 0,945**
σ_I^2	**447,444**
σ_i^2	**7,6663**
P	**0,174**
PPDS	**2,2077**

The number of tillers varies from 4.31 (TsFon20 (T1)) to 8.18 (TsFon13 (T2)), with an average of 6.088. Of all the genotypes tested, the TsFon13 (T2) variety is considered the best variety in terms of number of tillers per variety, followed by TsFon24 (T3) at the experimental site. The inter-varietal variance (447.444) is greater than the intra-varietal variance (7.6663), and this difference could be explained by environmental factors and/or the growing season. Means followed by the same letter in the same column are not significantly different at the 5% probability level. PPDS: Smallest Significant Difference, σI²: inter-varietal variance, σI²: intra-varietal variance, P: probability. The statistical data on the genetic variability of the quantitative trait of number of ears per plant at physiological maturity in fonio varieties are reported in Table 4.

Table 4. Variability in the number of ears per plant of mature fonio varieties

Genotypes	Means and standard deviations
Ts Fon13 (T2)	10,175 ± 4,3453[a]
Ts Fon24 (T3)	9,0625 ± 0,515[a]
Ts Fon20 (T1)	3,08 ± 0,1166[b]
Ts Fon23 (T4)	5,0125 ± 0,295[b]
Average of varieties	**27,28 ± 1,318**
σ_I^2	**568,6466**
σ_i^2	**12,5296**
P	**< 0,001**
PPDS	**4,8961**

Analysis of variance of the number of ears per plant in four studied fonio varieties revealed highly significant genotype effects ($P < 0.001$) (Table 4). The number of ears per plant ranged from 3.08 (TsFon20 (T1)) to 10.175 (TsFon13 (T2)), with a mean of 6.8325. Of all the genotypes tested, the TsFon13 (T2) variety was considered the best in terms of the number of ears per plant, followed by TsFon24 (T3) at the experimental site. The inter-varietal variance (568.6466) was greater than the intra-varietal variance (12.5296), and this difference could be explained by environmental factors and/or the growing season.

Means followed by the same letter in the same column are not significantly different at the 1% probability level. PPDS: Smallest Significant Difference, σI²: inter-varietal variance, σI²: intra-varietal variance, P: probability. The statistical data on the genetic variability of the quantitative trait number of racemes per ear at harvest for fonio varieties are reported in Table 5. Analysis of variance of the number of racemes per ear for four studied fonio varieties revealed highly significant genotype effects ($P = 0.254$) (Table 5).

Table 5: Variability in the number of racemes per ear of fonio varieties

Genotypes	Means and standard deviations
Ts Fon13 (T2)	7,4 ± 0,8602[a]
Ts Fon24 (T3)	6,5125 ± 0,2780[a]
Ts Fon20 (T1)	3,5 ± 1,3391[b]
Ts Fon23 (T4)	2,3375 ± 0,5218[b]
Average of varieties	**19,75 ± 0,7497**
σ_I^2	**298,3348**
σ_i^2	**5,37**
P	**0,254**
PPDS	**1,6466**

The number of racemes per ear ranged from 3.5 (TsFon20 (T1)) to 7.4 (TsFon13 (T2)), with a mean of 4.937. Of all the genotypes tested, the TsFon13 (T2) variety was considered the best in terms of the number of racemes per ear, followed by TsFon24 (T3) at the experimental site.

The inter-varietal variance (7319.4621) was greater than the intra-varietal variance (4686.0166), and this difference could be explained by environmental factors and/or the growing season. Averages followed by the same letter in the same column are not significantly different at the 1% probability threshold. LSD: Least Significant Difference, σI^2 inter-varietal variance, σi^2 intra-varietal variance, P: probability.

Heritability and selection gain for the parameters number of tillers, ears and racemes: The statistical data for heritability (h^2) and selection gain are shown in Table 6.

Table 6. Heritability and selection gain values

Paramters	Heritability (%)	Selection gain (%)
Number of tillers 15JAR	0,99	40,87
Number of tillers 60JAR	0,982	78,15
Number of ears/plant	0,97	87
Number of racemes/ear	0,982	80,66

The evaluation yielded a heritability value (h^2) of 0.99 with a selection gain percentage of 40.87% for the number of tillers 15JAR and (h^2) of 0.982 with a selection gain percentage of 78.15% for the number of tillers 60 JAR. Similarly, heritability and selection gain are 0.97 and 87 for the number of ears per plant and 0.98 and 80.66 for the number of racemes per ear. The high heritability coupled with the high selection gain indicates that additive genes contribute most to the genetic mechanism. This suggests a strong involvement of genetic variance compared to environmental variance.

DISCUSSION

In terms of stem height at harvest, the maximum height (25.66 cm) observed in our fonio varieties is lower than that (42.5 cm) recorded by Do *et al*. (2020). As for the number of tillers per plant, which is a varietal characteristic, our results do not match those obtained by Do *et al*. (2020). These authors recorded a high number of tillers per plant (10.90) compared to the results observed on our four fonio varieties (8.18). The results obtained for the number of ears (10.175) per plant on our varieties are not similar to those of Ndoye *et al*. (20I6), which were four (4) ears per plant. The number of ears varies depending on the variety, which is a varietal characteristic but is influenced by soil fertility and fertiliser inputs. The results for the number of racemes per panicle recorded (2.33 to 7.4) on our four varieties corroborate those obtained (2 to 5) by Amsana (2019) and Do *et al*. (2020). These results can be explained by the varietal characteristics and the soil and climate conditions at our experimental site. With regard to fonio grain and straw yields, our results do not agree with those obtained by Dième (2014) and Konaté *et al*. (2021). These authors recorded higher grain and straw yields than the grain and straw yields of the four fonio varieties used. However, our results are consistent with those obtained by Badiane *et al*. (2006). These authors recorded very low yields for fonio. It should be noted that varietal characteristics probably played a major role in the yields of fonio varieties. Similarly, the low yields obtained could be explained by the lack of fertiliser and the delay in planting the crop. The broad-sense heritability values (h^2) obtained are very high for the number of tillers 60 JAR ($h^2 = 0.982$), the number of ears per plant ($h^2 = 0.97$) and the number of racemes ($h^2 = 0.982$). All these heritability values are coupled with selection gain percentages of 78.15 (number of tillers), 87 (number of ears), and 80.66 (number of racemes). These values, combined with very high selection gains, demonstrate the superiority of genetic variance over environmental variance and pave the way for effective selection for these traits. Indeed, high heritability coupled with high selection gains indicates that additive genes contribute most to the genetic mechanism. These heritability values are comparable to those found by Noubissié *et al*. (2012) (h2= 0.99) in peanuts. However, they do not correspond to those obtained by Gollaou (2015) ($h^2 = 0.59$) in some accessions of *Voandzeia subterranea (L)* in the Sudano-Sahelian zone of Cameroon.

CONCLUSION

Fonio, a crop with many advantages, deserves special attention so that it can regain its place among the cereals that effectively contribute to the fight against food insecurity in the production area. The objective of this work is to identify, through the parameters observed and measured, the morpho-physiological characteristics and performance of the four fonio ecotypes. All varieties demonstrated their adaptability in terms of good vegetative development and completed their vegetation cycle normally. This was despite the lack of fertiliser, poor soil quality and rainfall disruptions. In terms of stem height, treatment T2 (25.66 cm) achieved the highest height, followed by T1 (25.13 cm). Low stem heights were noted in treatments T3 (21.8 cm) and T4 (22.8 cm). As for the number of ears, treatment T2 (10.175) recorded the highest number of ears, followed by treatments T3 (9.0625) and T4 (5.0125). The number of tillers ranged from (T1) 4.31 to (T2) 8.18. In terms of straw yields, treatment T2 (177.77 kg/ha) achieved the highest yield, followed by T1 (133.33 kg/ha) and T3 (133.33 kg/ha), which had the same yields. The lowest yield was observed in treatment T4 (110 kg/ha). The heritability values (h^2) obtained are very high for the number of tillers 60 JAR ($h^2 = 0.982$), the number of ears per plant ($h^2 = 0.97$) and the number of racemes ($h^2 = 0.982$). Thus, treatments T2 and T3 corresponded to Ts Fon13 and Ts Fon 24, which performed better. However, further studies conducted under the same experimental conditions are necessary to confirm the results obtained. In addition, the results obtained could serve as a basis for data for the fonio genetic improvement programme in Chad.

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