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Effect of Sowing Density on Voandzou Yield in the Sudanian Zone of Chad

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Abstract: *The cultivation of voandzou (Vignasubterranea) seems to be neglected, as it is still a traditional family crop. Yet it should be developed and intensified, given its contribution to food security and the maintenance of soil fertility. The aim of the present study is to investigate the effects of sowing density on the yield of the local voandzou ecotype in Chad. The plant material is the local ecotype "Tsvou 170". The trial was conducted using a Fisher block design with four treatments (T1, T2, T3, and T4) and four replications. The spacing adopted is 30 cm x 30 cm, 25 cm x 30 cm, 35 cm x 30 cm and 35 cm x 25 cm, corresponding to T1, T2, T3 and T4 respectively. T4 (31.50 ± 2.25) obtained the highest number of pods per plant, followed by T1 (30.25 ± 0.75). The lowest number of pods per plant was observed on T2 (13.75 ± 0.75). The highest shell yield was recorded on T1 (0.5887 t /ha ± 0.0017) followed by T4 (0.5872 t/ha ± 0.0012). Low shell yields were recorded on T3 (0.409.50 t/ha ± 0.002) and T2 (0.412, 25 t/ha ± 0.0008). T2 (0.368 kg ± 0.003) recorded the lowest seed weight. The best weights were obtained on T1 (0.4432 kg ± 0.0017), T4 (0.4422 kg ± 0.0018) and T3 (0.4415 kg ± 0.001).T1, corresponding to 111,556 plants /ha, increased production under the conditions of this trial. It could be recommended to growers in the Sudanian zone as part of the drive to boost food security.*

Keywords: *Vignasubterranea, local ecotype, sowing geometry, ecological zone, yield.*

1. Introduction

To meet the growing demand of the world's population by 2050, i.e. 9 billion people, and the expected changes in diet, it will be necessary to increase global agricultural production by 60 percent over the same period (FAO, 2014). Moreover, Chad's agricultural policy is to ensure the population's food security with quality, low-cost agricultural products on sustainable bases (Goalbaye *et al*., 2018) and to contribute to poverty reduction in rural areas. However, agricultural production is often in deficit due to climatic hazards and rudimentary means of production, among other factors (Nadjam and Goalbaye, 2014).Voandzou ranks 3rd among food legumes consumed in Africa, after groundnuts and cowpeas. Despite its high nutritional value, worldwide production of voandzou is estimated at just 300000 tonnes. Because voandzou (Vignasubterranea) cultivation seems to be neglected, it has remained a traditional family crop. Yet it should be promoted, intensified and popularized, given its contribution to food security and soil fertility. To this end, voandzou is grown in rotations and crop associations. Voandzou is also a plant that adapts more easily to difficult climatic conditions. As a result, particular attention needs to be paid to this crop in view of current climate change. Research should focus more on developing appropriate cultivation techniques to increase crop yields (Taffoua *et al*., 2008). Various studies have been carried out on the crop density of various speculations (Enyi, 1967; Widdicombe and Thelen, 2002; Nankinga *et al*., 2005; Madakadze *et al*., 2007; Nzietchueng, 1985; Kisic *et al*., 2010; Goalbaye *et al*., 2017).Furthermore, isn't the failure to determine sowing geometry one of the reasons for the neglect of voandzou cultivation in Chad? What is the voandzou cultivation technique that increases yields in the Sudanian zone of Chad? Identifying the best sowing density for voandzou cultivation will help increase productivity in the Sudanian zone of Chad. Similarly, the development of a voandzou cultivation data sheet will help increase yields in the Sudanian zone of Chad. The aim of the present work is to determine the best sowing density for the local voandzou ecotype in Chad, and also to draw up a technical data sheet for growers.

2. Materials And Methods

2.1. Experimentation Site

The experiment was carried out in July 2022 at the University of Sarh (UDS), Doyaba site (09'081"89°N, 18'42"947°E, Altitude: 360 m), Moyen Chari Province, where the climate is east Sudanian (average rainfall: 1100 mm/year; Temperature: 24 - 38°C). The soils are ferruginous, leached and red in color, with a uniformly sandy-clay to clay texture and a pH that is slightly acidic at the surface and very acidic at depth (Naïtormbaïdé, 2012).

2.2. Material

The plant material consists of the local ecotype Tsvou 170 from voandzou, with a cycle of 85 to 90 days. The average yield obtained on the farm is 300 to 400 kg ha-1. The level of intensification is low (ploughing, weeding, no phytosanitary products or fertilizers).

2.3. Methods

The trial was conducted using a Fisher block design with four treatments (T1, T2, T3 and T4) and four replications. The spacings adopted were 30 cm x 30 cm, 25 cm x 30 cm, 35 cm x 30 cm, 35 cm x 25 cm, corresponding respectively to densities T1 (111,556 plants per ha), T2 (133,934 plants per ha), T3 (95,524 plants per ha), T4 (114,686 plants per ha). Only one factor is studied: best density.

2.4. Cultivation Methods

The individual plots were ploughed to a depth of 15-20 cm. They were then harrowed to prepare the seedbed. Sowing is carried out after a useful rainfall of at least 20 mm. Sowing is carried out on one (1) seed, placed at a depth of about 5 cm. A first weeding is carried out 12 days after emergence and a second weeding 22 days after emergence. Four replicates were set up, i.e. 4 x 4 = 16 plots in all. The surface area of each plot is: 8 m x 5 m = 40 m2, i.e. an area of 40 m² x 16 = 640 m² for the total experimental plots. A 50 cm border is chosen for the passage and a 25 cm space between plots.

2.5. Calculated Parameters

Agronomic parameters are based on the number of pods per plant, hull yield and 1000-seed weight.

2.6. Statistical Analysis

The data collected were analyzed using SPSS software (Statistical Package for Social Sciences version 20.0). The means of the various parameters were separated by the Student-Newman-Keuls (SNK) multiple arrangement test.

3. Results

The number of pods per plant is shown in figure 1.

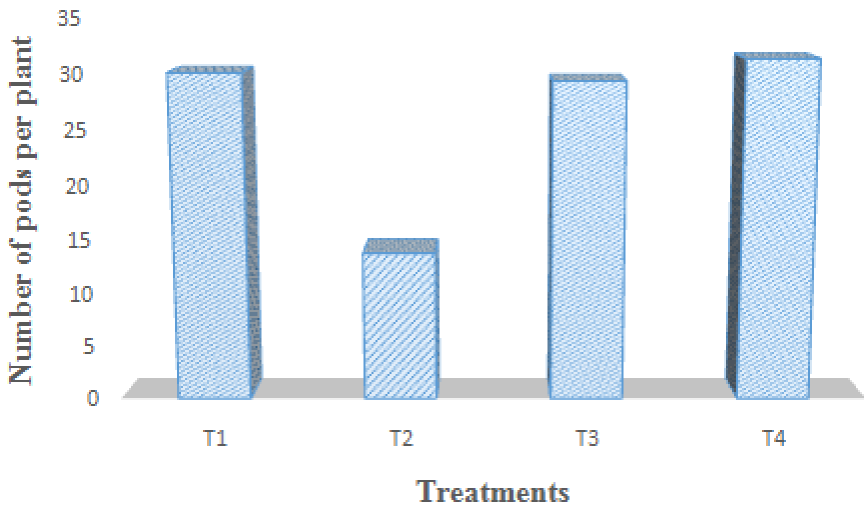

Figure1. *Number of pods per plant*

Treatment T4 (31.5 ± 2.25) obtained the highest number of pods per plant, followed by treatment T1 (30.25 ± 0.75) and treatment T3 (29.50 ± 1.75). The lowest number of pods per plant was observed in treatment T2 (13.75 ± 0.75). Statistical analysis of the results showed that there was a highly significant difference in the number of pods per plant at the 1% threshold (F = 50.49; P= 0.018).

Hull yield is shown in figure 2.

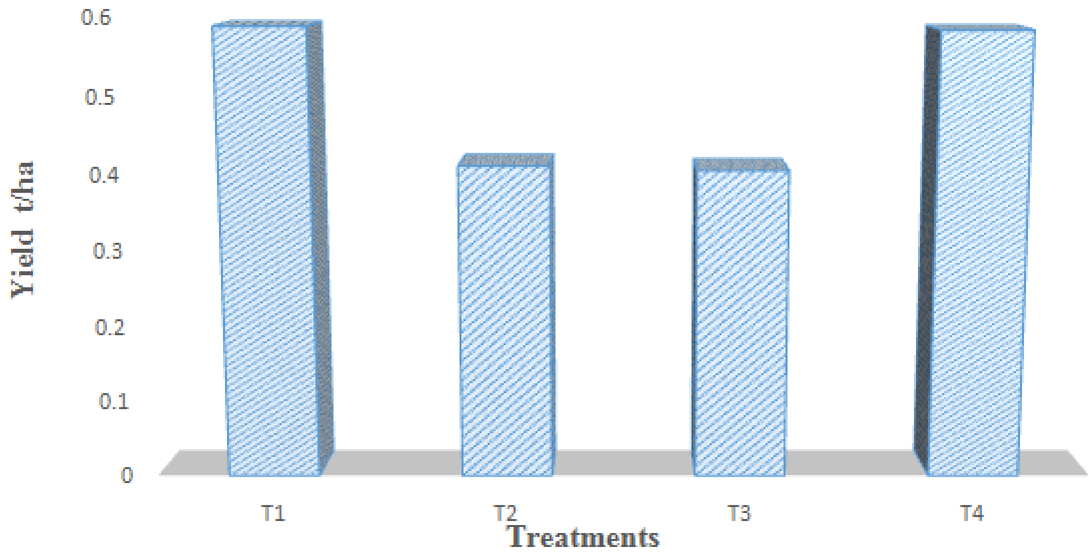

Figure2. *Hull yield*

Treatment T1 (0.591 t/ha ± 0.0017) recorded the highest yield, followed by treatment T4 (0.586 t/ha ± 0.0012). Low yields were observed in treatments T2 (0.412 t/ha ± 0.0008) and T3 (0.406 t/ha ± 0.002). Statistical analysis of the results revealed a highly significant difference in yield at the 1% level (F= 77.54; P= 0.056).

The weight of 1000 seeds is shown in figure 3.

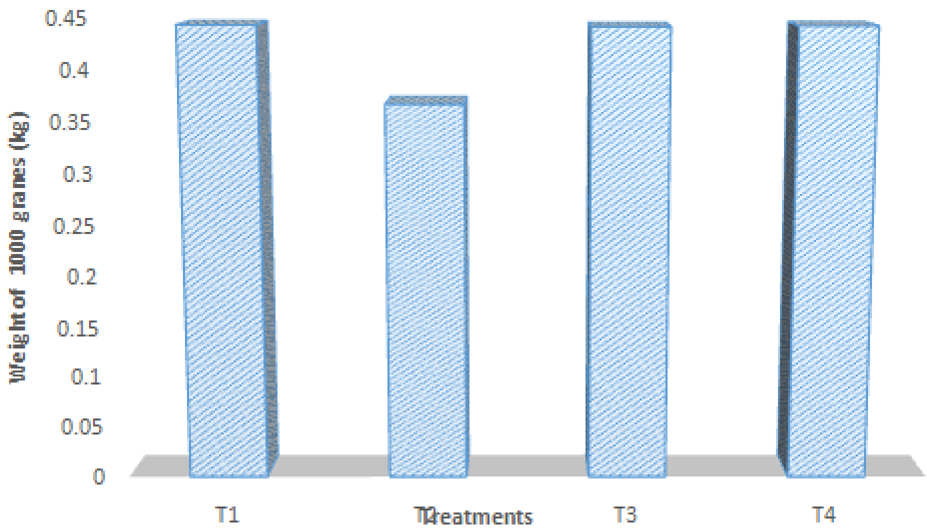

Figure3. *Seed weight*

Treatment T1 (0.4432 kg ± 0.0017) obtained the highest seed weight, followed by treatments T4 (0.4422 kg ± 0.0018) and T3 (0.4415 kg ± 0.001). The lowest seed weight was observed in treatment T2 (0.368 kg ± 0.003). Statistical analysis of the results revealed that there was a significant difference in seed weight at the 5% level (F= 9.128; P= 0.076).

Table1. *Number of pods per plant, shell yield and seed weight*

Treatments	Number of pods per plant	shell yield (t/ha)	Weight of 1000 seeds (kg)
T1	30,25 ± 0,75[a]	0,591 ± 0,0017[a]	0,4432 ± 0,0017[a]
T2	13,75 ± 0,75[b]	0,412 ± 0,0008[b]	0,368 ± 0,003[b]
T3	29, 50 ± 1,75[a]	0,406 ± 0,002[b]	0,4415 ± 0,001[a]
T4	31,5 ± 2,25[a]	0,586 ± 0,0012[a]	0,4422 ± 0,0018[a]

Values in the same column followed by the same letter are not significantly different at the 5% or 1% threshold according to the Student Newman and Keuls test.

4. Discussion

Analysis of the trial results revealed highly significant differences between treatments in terms of number of pods per plant. Voandzou at low sowing densities produced more pods per plant than those at high sowing densities. These results are in line with those reported by (Goalbaye *et al*., 2017; Awal and LijaAktar, 2015), who obtained the best number of pods per plant at low peanut sowing densities. However, these results do not corroborate those obtained by (Konlan *et al*., 2013; Ahmad *et al*., 2007). The latter recorded a higher number of pods per plant at high peanut seeding densities. Analysis of the results showed that there was a highly significant difference between treatments in terms of pod yield. In fact, voandzou with low or high densities recorded low yields, while those with densities intermediate to these two achieved better yields.These results do not agree with those obtained by Goalbaye *et al*. (2017) who carried out similar work on groundnuts. These authors observed low hull yields with high peanut seeding densities. Nor do these results match those obtained by Virender and Kandhola (2007); Abdullah *et al*. (2007) who obtained better yields with high seeding densities. Statistical analysis of the results showed that there were significant differences between treatments in terms of seed weight. The voandzou with high sowing densities obtained low seed weights. On the other hand, voandzou with low sowing densities recorded high seed weights. These results do not corroborate those obtained by Goalbaye *et al*. (2017). Indeed, these authors observed no significant difference between peanut seed weights whatever the sowing densities adopted.

5. Conclusion

The aim of this study was to determine the best sowing density for voandzou cultivation in the Sudanian zone of Chad. Based on the results obtained, the spacing of 30 cm between the rows and 30 cm on the row corresponding to treatment T1, i.e. 111,556 plants/ha , increased voandzou production under the conditions of this trial. It could be recommended to growers in the study area as part of the drive to improve food security.

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