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Research Article

EFFECT OF NITROGEN DOSES ON THE SENSITIVITY OF STEMS TO THE BORERS OF SUGAR CANE IN THE CULTURE OF VIRGIN CANE AT THE CST-BANDA OF CHAD

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ABSTRACT

A study was conducted to evaluate the agronomic performances of the sugar cane variety in relation to the nitrogenous manure and to the sensitivity of attack of the stems by the borers. The plant material is composed of the variety SP 70-1284. The test was conducted in the blocks of Fisher with 9 treatments to 4 repetitions. The total doses of N of three contributions for the cycle of harvest (35, 70, 105, 140, 175, 210, 245, 280, 0 kg ha⁻¹) correspond to treatments T1, T2, T3, T4, T5, T6, T7, T8 and T0. The treatments T1 (0.92% ± 1.12), T0 (1.20% ± 1.54), T4 (1.58% ± 0.34) and T8 (2.14 ± 0.90) recorded the weakest rates of attack of the stems by the borers. The treatments T2 (2.37% ± 2.18), T7 (3.88% ± 1.82) T5 (3.92% ± 2.33), T6 (4.22% ± 2.02) and T3 (4.80% ± 2.01) noted the most elevated rates of attack. The weakest diameters of the stems are observed on the T0 treatments (2.14 cm ± 0.07), T2 (2.21 cm ± 0.19), T6 (2.22 cm ± 0.11), T3 (2.22 cm ± 0.15), T1 (2.23 cm ± 0.14) and T5 (2.29 cm ± 0.24). The T4 treatments (2.30 cm ± 0.20), T7 (2.32 cm ± 0.13) and T8 (2.42 cm ± 0.14) got the most elevated rates of attack of stems. A weak sensitivity of attacks of the stems to the Boers of the variety SP 70-1284 are observed with the N doses of 0 ha kg⁻¹, 35 kg ha⁻¹, 140 kg ha⁻¹, 280 kg ha⁻¹. These levels of nitrogen can be retained for the profitability of the variety SP 70-1280 in the culture of virgin cane at the complex Agro Industrial of CST-Banda in Chad

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INTRODUCTION

One observes since some times in the industrial parcels of the Complex Agro Industrial of the CST Banda an average output of 80,7 t ha⁻¹ of canes in relation to other cultures of irrigated canes that can pass 120 t ha⁻¹. This output is weaker than the one of most countries producers of sugar cane like Guatemala (107.33 t ha⁻¹), Egypt (90.24 t ha⁻¹), Australia (86,.66 t ha⁻¹), FAO (2009). In addition, production fluctuates from one year to the next. Several factors are responsible of the weak output of sugar cane at Banda CST, including the scarcity of irrigation water, the weak plant density by unit of surface and the presence of stem borers as well as the use Inadequate fertilizers. In addition, sugar cane is a long-lasting culture that requires a great deal of nutrients. In these conditions, it would be interesting to test the different increasing doses of nitrogen on cane yield and the sensitivity to drillers. Otherwise, several studies have evaluated the effects of the inorganic fertilization

on the cultures (Diallo *et al.*, 2016; Ndikumana and Lumpungu, 1987; Korndörfer *et al.*, 2002; Fillols and Chabaliér, 2007; Franco *et al.*, 2010; Strong *et al.*, 2013a, 2013b; Useni and al., 2014a, 2014b; Bekeko, 2014; Bidzakim *et al.*, 2014; Asaduzzaman *et al.*, 2014). So, the determination of the nitrogen level would permit to identify the doses of nitrogen that would induce at the sensitivity of attack of stems to the borers in the industrial parcels of the CST-Banda. To this effect, the use inadequate of the nitrogenous manures would not be it one of the reasons of the sensitivity of the attack of the borers of sugar cane stems recorded at CST-Banda? In the setting of this work, we evaluated the agronomic performances of the variety Sp 70-1284 in relation to the nitrogenous manure and to the sensitivity of attack of the stems by the borers. Indeed, it is necessary to determine the level of nitrogen (N) for this variety for a better development of the virgin canes at CST Banda.

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MATERIALS AND METHODS

Site of the survey

The experiment was conducted at CST-Banda in the agro-industrial complex at the south of Chad (latitude 09° 11' N, longitude 18° 28' E, and 365 m altitude). It shelters a tropical climate of the type Sudano-Guinean with a dry season marked by the harmattan (dry and warm wind) from November to March and a rainy season marked by the monsoon from April to October. The average rainfall is 1167.0 mm. an⁻¹, the maximum and minimum temperatures are 33.9 and 19.6 °C respectively. The duration of the sunshine is close to 2908.1 h. an⁻¹. The soils are ferruginous leached red in color, uniformly clay-sandy to clay texture with a slightly acidic pH on the surface and very acid at depth (Naitorbaidé, 2012). The vegetation is characterized by clear forests and savannah trees in the part south of Chad (DREM, 1998). However, the experimental field that sheltered the test is not a fallow.

MATERIAL

Plant material

The plant material is composed of the variety SP 70-1284. Its cycle of harvest is from 10 to 12 months. The variety is chosen for its interesting agronomic characters (rate of sugar, stem, tillering...) and occupies 21% of the total area of cane in sugar CST-Banda. The level of intensification is improved (ploughings, weeding, sanitary protection facility of burning, erected harvest manual and regularity of the height of the stems). The average yield obtained in industrial is 90 t ha⁻¹.

METHODS

Experimental design

The test was conducted with the randomized complete blocks with 9 treatments, with 4 repetitions. The experimental parcel is subdivided 36 fragmentary units measuring each 14.4 m on 10 m. The fragmentary unit is constituted of 8 furrows; therefore, each received 2 rows of cuttings. The distance between the furrows is of 1.40 m and the one enters the 2 rows is of 0.40 m is 8 x (1.40 m + 0.40) x 10 m = 144 m² for a fragmentary surface. The density to the plantation is 4 cuttings for 1 m what gives 640 cuttings by fragmentary unit. The different elementary parcels separated of the one meter alleys. The 6 central furrows of every elementary parcel (116 m²) made the object of observations.

Conduct of the culture

The elementary parcels underwent a deep ploughing to a depth of 50-70 cm, followed of a medium ploughing of 25-45 cm of depth and harrowing. The ridging has been made to a depth of 10-20 cm on the lines of plantation. The method of plantation adopted is to put flatbed the pieces of cane in the bottom of the furrows. To avoid the parasitic infections, the machetes serving to cut the cuttings have been disinfected to formalin. In the beginning of the plantation, the doses of nitrogen brought (16, 16, 16, 16, 16, 16, 16, 0 kg ha⁻¹) to the bottom of the furrows correspond respectively to the T1 treatments, T2, T3, T4, T5, T6, T7, T8 and T0 the used witness. Then, to two months after plantation, a second dose of nitrogen (19, 37, 37, 37, 37, 37, 37, 0 kg ha⁻¹) correspondent to the T1

treatments, T2, T3, T4, T5, T6, T7, T8 and T0, has been brought and a third dose of nitrogen (0, 17, 52, 87, 122, 157, 192, 227, 0 kg ha⁻¹) correspondent to the T1 treatments, T2, T3, T4, T5, T6, T7, T8 and T0, has been brought to 4 months. The total doses of N of three contributions for the cycle of harvest (35, 70, 105, 140, 175, 210, 245, 280, 0 kg ha⁻¹) correspond to the T1 treatments, T2, T3, T4, T5, T6, T7, T8 and T0. The manual weeding has been made to the stage young plants (beginning tillering) and shortly before the period of fast growth (4 months after emergence).

Sampling

The harvest has been done to the optimum of sugars to physiological maturity. Thus, the canes are burnt the evening at the eve of the harvest to eliminate the leaves of the canes. The following day morning, the stems of canes of six (6) central furrows of every elementary parcel were harvested by hand with the help of the machetes and piled in the field. Then, a sample of 10 canes was randomly taken on every heap of the elementary parcels and brought back to the laboratory for analysis (Kouamé et al., 2010). This sample is constituted of 3 small stems, 4 medium stems and 3 large stems. The diameter of the stems is measured and the between nodes attacked by the borers are counted.

The measured and registered parameters

The agronomic parameters are carried on the diameter of the stems and the rate of attack of the stems by the borers

Statistical analysis

Data have been analyzed with the software SPSS (Statistical Package Heart Social Sciences, version 16.0). The averages of the different parameters were separated by the test of multiple arrangement of Student - Newman - Keuls (SNK).

RESULTS

The rate of attack of between nodes of the sugar cane stems by the borers follows the different doses of nitrogen. One the figure 1, the T1 treatment recorded the weakest rate of attack (0.92% ± 1.12).

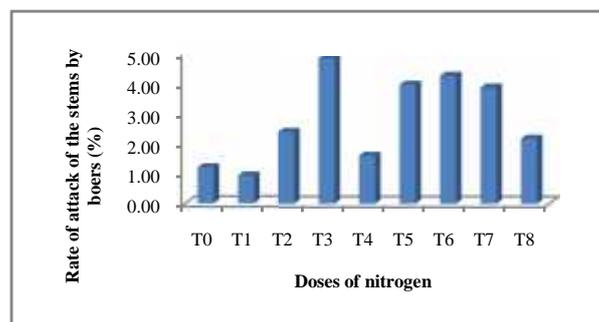


Figure 1 rate of attack of the borers

On the other hand, the T5 treatments (3.92% ± 2.33), T6 (4.22% ± 2.02) and T3 (4.80% ± 2.01) recorded the most elevated rates. The comparison of the averages of rate of attack of between nodes of the stems showed that it exists a significant difference between the treatments. On the figure, the effect of nitrogen does not follow the linear evolution; it evolves in teeth of saws. But the rate of attack of the borers

evolves following the increasing doses of nitrogen. It grows from T2 ($2.37\% \pm 2.18$) for to reach its maximum to the level of the T3 treatment ($4.80\% \pm 2.01$) and decreases to the level of the T4 treatment ($1.58\% \pm 0.34$).

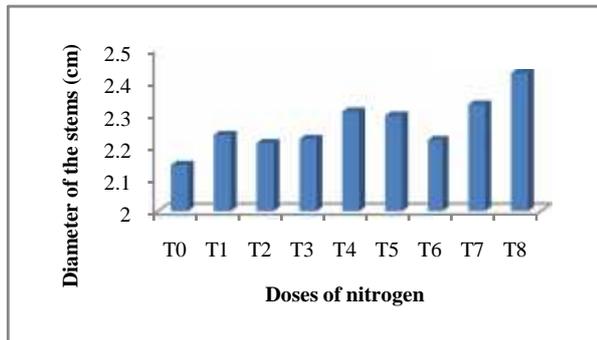


Figure 2 diameter of the cane stems

It takes to grow with the T3 treatment to decrease to the level of the T8 treatment ($2.14\% \pm 0.90$). The variance analysis revealed that a meaningful difference exists between the treatments at the doorstep of 5% ($F=2.609$; $P=0.033$). The diameter of the stems is represented on the figure 2. The weakest diameters of the stems are observed on the T0 treatments ($2.14 \text{ cm} \pm 0.07$), T2 ($2.21 \text{ cm} \pm 0.19$), T6 ($2.22 \text{ cm} \pm 0.11$), T3 ($2.22 \text{ cm} \pm 0.15$), T1 ($2.23 \text{ cm} \pm 0.14$) and T5 ($2.29 \text{ cm} \pm 0.24$), on the other hand they are raised for the T4 treatments ($2.30 \text{ cm} \pm 0.20$), T7 ($2.33 \text{ cm} \pm 0.13$) and T8 ($2.42 \text{ cm} \pm 0.14$) (table 1).

Table 1 effect of nitrogen on the diameter of the stems and the sensitivity of attack of the stems to the borers

Treatments	Diameter of the stems (cm)	Rate of attack of the stems by Boers (%)
T0	2.14 ± 0.07^a	1.20 ± 1.54^{cd}
T1	2.23 ± 0.14^a	0.92 ± 1.12^d
T2	2.21 ± 0.19^a	2.37 ± 2.18^{abc}
T3	2.22 ± 0.15^a	4.80 ± 2.01^a
T4	2.30 ± 0.20^a	1.58 ± 0.34^{cd}
T5	2.29 ± 0.24^a	3.92 ± 2.33^a
T6	2.22 ± 0.11^a	4.22 ± 2.02^a
T7	2.33 ± 0.13^a	3.83 ± 1.82^a
T8	2.42 ± 0.14^a	2.14 ± 0.90^{abc}

The values of a same column followed of a same letter are not meaningfully different at the doorstep of 5% according to the test of Student Newman – Keuls

The variance analysis of the averages of diameters showed that it doesn't exist differences significant between the treatments of the viewpoint of diameter of stems at the doorstep of 5% ($F=1.12$; $P=0.404$).

DISCUSSION

For the studied agronomic parameters, the variance analysis showed that it exists a meaningful difference between the rates of attack of the stems by the borers at the doorstep of 5%. Attacks by stems borers are the most important factors that limit the productivity of sugarcane in parcels by their damage (Meyer and Keeping, 2005). It is demonstrated amply in the literature that nitrogen plays an important role in the sensitivity of the cultures to the attacks of the borers of the stems. Our results join the findings of Meyer and Keeping (2005), these authors showed the meaningful effect of the nitrogen increasing doses N ($60, 120$ and 180 kg ha^{-1}) on the sensitivity of the stems of canes to the borers. Of the similar studies led by

Atkinson and Nuss (1989) and Meyer and Keeping (2005) have shown that the elevated use of nitrogen in the conditions of water stress increases the survival of larvae and the infestation of the sugar cane considerably by *Eldana saccharina*, the most widespread species in Africa, especially at the company CST Banda Chad (Brenière, 1970). These results corroborate with Meyer and Wood (2001) who have shown that with a level of the active nitrogen of 50 to 200 kg, the sensitivity of the sugar cane to the borers has increased from 11.8 to 41.8% on the stems. These results do not correspond to those obtained by our work, indeed, with a dose N of 280 kg ha^{-1} , we noted a weak attack of rate of 2.14% by the borers. The variance analysis revealed that there is not a meaningful difference between the different treatments in relation to the average of the diameters of stems at the doorstep of 5%. The averages of sugar cane diameters are statistically the same for all treatments. The diameters of stems of the SP 70-1284 variety are small compared to the diameters of stems of the other varieties that can reach six (6) cm (Fillols and Chabaliere, 2007). However, one note an interrelationship between the rates raised of attack of the borers of the stems and the weak diameters of the stems. Indeed, the T5 treatments, T6, T3, and T2 recorded a rate raised of attack of the borers of stems with the weak diameters of stems of these same treatments. This drives to saying that the attack of the borers affected the development of the stems weakly. On the other hand, the treatment corresponding T8 at a dose N 280 kg ha^{-1} has generated a weak rate of attack of the stems with a very weak growth of diameter of stems.

CONCLUSION

In view of the results obtained, one notes a weak sensitivity of attacks of the stems to the Boers of the variety SP 70-1284 on the T0 treatments, T1, T4 and T8 with the increasing doses of nitrogen. This weak sensitivity of attack is sometimes accompanied with a weak growth of diameter of the sugarcane stems. Therefore, these levels of nitrogen can be retained for the profitability of the variety SP 70-1280 of the virgin cane at the CST-Banda Agro Industrial complex in Chad

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