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Comparative Analysis of the Technical and Technical Performance of Two Types of Soil Preparation Techniques (Complete and Simplified) In Saris – Congo

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Abstract

This article has the results of a study led to Sari-Congo whose objective was to make a comparative analysis of the technico-economic performances between the complete technical routes of preparation of ground and the simplified technical routes (suppression of the pulvérisage).The study was based on the exploitation of the data bases of tillage and on the cost accounting of the pieces, that is to say 40 industrial pieces selected by taking account of the technical routes of tillage. The results show that the technical route of tillage do not have an influence on the parameters of production of the cane with sugar (output, a number of cycle of production) and on simplified the Hugo output (RHS).However, the study revealed the existence of the significant differences for average Brix, but more especially on the economic parameters (fuel consumption).The simplified technical routes of preparation of ground are thus more advantageous insofar as they make it possible to obtain good results at lower costs.

Keywords: simplified farming technical route, complete farming technical route, tillage, canes at sugar, output, cost.

RESUME

Cet article présente les résultats d'une étude menée à la Société Agricole de Raffinage Industriel du Sucre SARIS Congo dont l'objectif était de faire une analyse comparative des performances technico-économiques entre les itinéraires techniques complets de préparation de sol et les itinéraires techniques simplifiés (suppression du pulvérisage). L'étude s'est basée sur l'exploitation des bases de données de préparation des sols et sur la comptabilité analytique des parcelles, soit 40 parcelles industrielles choisie en tenant compte des itinéraires techniques de préparation des sols. Les résultats montrent que l'itinéraire technique de préparation des sols n'as pas d'influence sur les paramètres de production de la canne à sucre (rendement, nombre de cycle de production) et sur le rendementhugosimplifié (RHS). Cependant, l'étude a révélé l'existence des différencessignificatives pour le Brix moyen, maisaussi et surtout sur les paramètres économiques (consommation de carburant). Les itinéraires techniques simplifiés de préparation de sol sontdonc plus avantageuxdans la mesureoùilspermettentd'obtenir de bons résultats à moindre coûts.

Mots clés: itinéraire technique cultural simplifié, itinéraire technique cultural complet, préparation des sols, canne à sucre, rendement, coût.

INTRODUCTION

Modern agriculture is challenged by its degradation effect on the environment: widespread pollution of the environment (pesticides and nitrates), rapid decline in soil fertility, massive consumption of fossil energy and high costs of mechanized work soil preparation, degradation of biodiversity, rapid soil degradation and yield reduction, etc. Faced with these numerous problems in terms of environmental protection and the sustainability of agricultural systems, generated by conventional farming, several alternatives are proposed. These include organic agriculture, sustainable agriculture, soil conservation agriculture, agroecology integrated agriculture, etc. (Hervieu and Purseigle, 2012, Hervieu and Purseigle, 2013). Conservation agriculture is a set of farming techniques that cover a large number of agricultural practices and implement a wide variety of tools; it is based on the non-inversion of the soil; the common denominator is the suppression of plowing (Chevrier and Barbier, 2002).
Examples of soil conservation agriculture include non-tillage or semi-direct tillage, surface tillage (5 to 10 cm without soil compaction), direct seeding system with vegetative cover (Scopel et al. , 2005), etc.These techniques increase the biological activity of the soil, reduce nitrogen leaching, curb erosion and reduce fuel consumption (Anonymous, 2011).
The company SARIS Congo is the leader in terms of agricultural production in the Republic of Congo, its operating area covers more than 13 000 ha of sugar cane cultivation for a production of up to 70 000 tonnes of sugar per year, which is huge for the Republic of Congo where only subsistence agriculture is developed. SARIS Congo is a subsidiary of the Organization, Management and Development Company of Food and Agricultural Industries SOMDIAA, French group.
SARIS Congo has included in its diversity of soil preparation processes, a simplified soil preparation technique that eliminates heavy spraying (MialoundamaBakouetila, 2010, MialoundamaBakouetila et al., 2010, Bacquois, 2015). This technical itinerary of soil preparation is therefore an integral part of the forms of soil conservation agriculture.It would be more techno - economic compared to plots that have undergone a complete technical itinerary (heavy spraying or pseudo - plowing requirement, deep working of the soil to ± 30 cm).It is therefore in this context that this study conducted at SARIS Congo aims to test the hypothesis that the simplification of tillage has significant technical and economic benefits.

METHODOLOGY

Location of the study

The study was carried out on SARIS Congo exploitation sites, which are located in the south of the Republic of Congo, in the Department of Bouenza, 15 km from the town of Nkayi, in the agro-ecological zone, known as Niari valley.This zone is characterized by a Sudano-Guinean semi-humid tropical climate (Anonymous, 2012).The soils are of highly desaturatedferralitic types and moderately desaturatedferralitic soils, the texture is clay (Brugière, 1953, Djondo, 1994), ie 40 to 65%.In case of rain this very high rate of clay renders the soil preparation and harvesting work impracticable.The concession of SARIS Congo presents anSadéquate topography, a low relief terrain, making mechanized agriculture possible on large areas.Soils have an acidic pH (<4-5.5), hence the importance of limestone amendments (Anonymous, 2015).

Sampling and data collection

Forty (40) industrial parcels selected for the study were selected from the internal databases of the SARIS Congo Cultures Department:the database of mechanized soil preparation works, the database summarizing the plots harvested from 2010 to 2015, the cost accounting database.We took into account only plots that had exhausted their production cycles, that is to say the plots in renewal.Of the forty (40) plots selected, 17 were prepared in simplified soil preparation (TS) technical itineraries and 23 plots were prepared in complete technical itineraries (TC).The area of the plots varies between 19.76 ha and 99.84 ha.
Data on the technical performance of sugar cane production (sugar parameters, yields, production cycles) were retrieved from the SARIS Congo crop management database.
However information on economic performance (fuel quantity, fuel consumption costs) was retrieved from the parcel cost accounting database

Data analysis

The technical and economic information of the selected plots made it possible to build a database on the Excel 2007 software. This database has been imported to R version 2.11.0 software. The processing and analysis of the data was done by the same software and allowed to determine the descriptive statistics (mean, standard deviation, confidence interval).

One-way analysis of variance (ANOVA) supplemented by a student test was used to compare the results obtained by the two technical soil preparation routes. The probability threshold used to determine significant differences is P <0.05.

RESULTS

SARIS Congo soil preparation techniques description

Four technical soil preparation routes are observed at SARIS Congo (Figure 1), two complete technical crop routes (ITK1 and ITK2) and two simplified technical crop routes (ITK3 and ITK4).The complete itinerary is characterized by the presence of light and heavy spraying. Heavy spraying is a form of pseudo plowing with depths of up to 30 cm, it allows loosening and aeration of the soil.The simplified routes are characterized by the elimination of pseudo plowing (heavy spraying), in the case of ITK3 the 1st and 2nd weeding are not mandatory.In the case of the 40 parcels selected for our

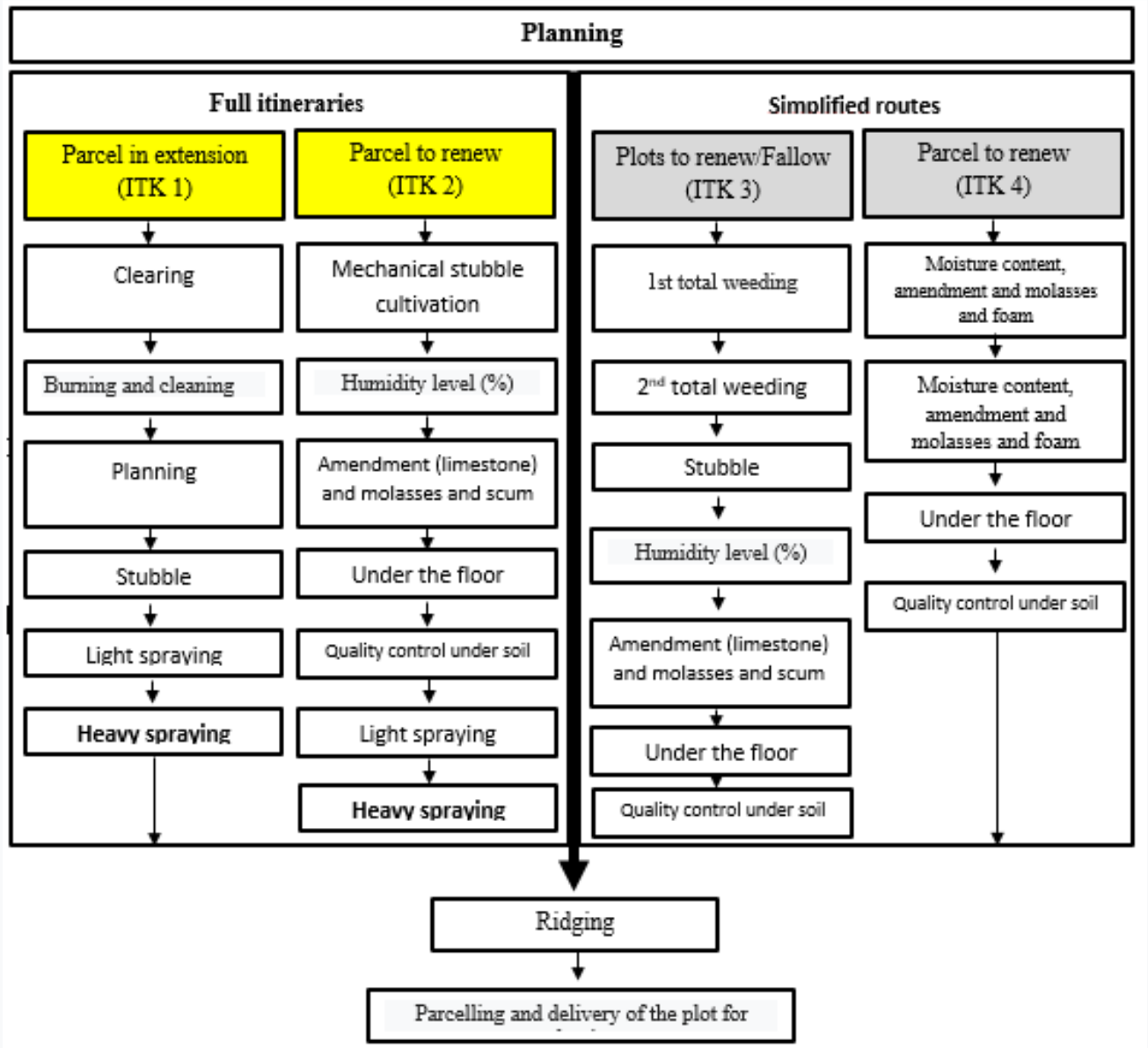

Figure 1: Soil Preparation Technical Routes at SARIS Congo

Table 1. Comparison of average yield (t / ha) of sugarcane

	Complete Itinerary (TC)	Simplified Itinerary (TS)
Average yield (t / ha)	54,43 ± 8,10a	52,72 ± 6,71a
Coefficient of variation	0,33	0,29

Average values followed by the same letter are not significantly different according to the student test

study, it is essentially the parcels to be renewed (parcels having exhausted their production cycle) resulting from the cultural technical itinerary 2 and 3.Plots from ITK 4, qualified as minimum tillage, were excluded from our sampling.

Production parameters of sugar cane

Yield of sugar cane

The yield is equal to the weight per unit area of the amount of sugar cane harvested per hectare. Table 1 shows the average yield obtained from two technical soil preparation routes. From this table, the average yield obtained by the complete route (TC) is 54.43 t / ha ± 8.10 and for the simplified technical route (TS) 52.72 t / ha ± 6, 71, a difference of 1.71 ± 1.39 t / ha.

Table 2. Comparison of the number of average cycles of sugar cane production

	Complete Itinerary (TC)	Simplified Itinerary (TS)
Number of average cycles	4,35 ± 0,40 a	4,61 ± 0,20 a
Coefficient of variation	0,20	0,10

Average values followed by the same letter are not significantly different according to the student test

Table 3. Comparison of Mean Brix (%) Sugarcane

	Complete Itinerary (TC)	Simplified Itinerary (TS)
Medium Brix	19,3 ± 0,62 % a	20,32 ± 0,46 % b
Coefficient of variation	0,05	0,06

Average values followed by the same letter are not significantly different according to the student test

Table 4. Comparaison du RHS moyen (%) de canne à sucre

	Complete Itinerary (TC)	Simplified Itinerary (TS)
Average HRH	11,63 ± 0,44 % a	11,91 ± 0,33 % a
Coefficient of variation	0,04	0,08

Average values followed by the same letter are not significantly different according to the student test

The results of the analysis of variance as well as those of the student test, show no significant differences (t = 0.33, p = 0.74). The type of technical soil preparation route has no influence on the yield of sugar cane.

Production cycle

The production cycle refers to an uninterrupted succession of cane crops in a given plot.
Table 2 shows the average production cycles resulting from two technical soil preparation routes. This figure shows that the complete route (TC) has an average production number of 4.35 ± 0.40 cycles and for the simplified technical route

(TS) 4.61 ± 0.20 production cycles
Analysis of variance and the student test carried out on the two technical soil preparation routes show a non-significant effect for the number of production cycles (t = 1.13, p = 0.266).

Sugar settings of sugar cane

Two sugar parameters were compared to evaluate the richness of sugarcane between the two types of technical soil preparation routes, namely Brix and RHS.
Brix is an indicator of the richness of sugarcane, represented by the percentage of dissolved solids (including sucrose) contained in a sugar solution. The results obtained show that the simplified route has a higher mean Brix, ie 20.32 ± 0.46% compared to 19.3 ± 0.62% for the complete technical route (Table 3).
The analysis of variance and the student test carried out on the Brix from the two types of technical route of soil preparation shows a significant effect (t = 2.68, p = 0.011); the type of technical soil preparation route has an influence on the brix of the sugar cane harvested. The simplified technical route (TS) for soil preparation therefore has a higher average Brix compared to the complete technical route (TC).
The simplified Hugo yield (RHS) is also an indicator of the richness of sugarcane, it determines the maturity from the base and the top of the sugar cane.It includes the percentage of sucrose in the dry matter (juice).Table 4 shows the average RHS obtained from two technical soil preparation routes.This table shows that the complete route has an average HRR of 11.63 ± 0.44% compared to 11.91 ± 0.33% for the simplified technical route (TS).Analysis of variance and the student test performed on HRH from both types of soil preparation technique showed a non-significant effect (t = 1.04, p = 0.69); the average RHS is almost identical.

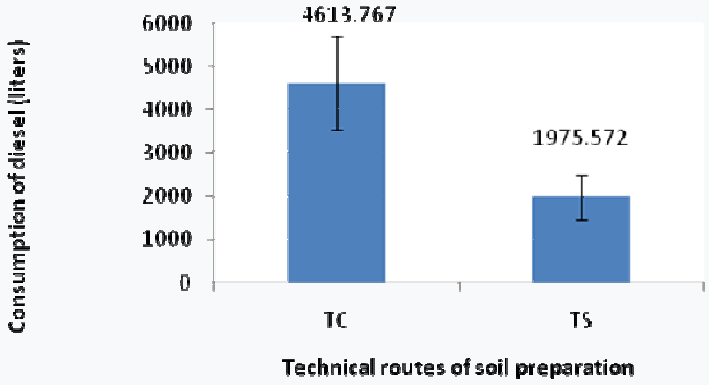

Figure 2. Fuel Consumption (GO) Between Land Preparation Routes

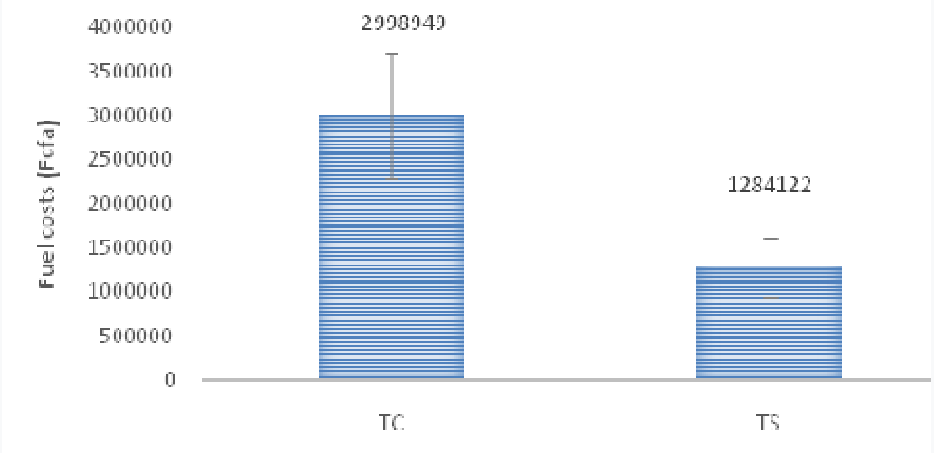

Figure 3. Fuel Consumption Costs Between Land Preparation Routes

Economic parameters of sugar cane

Two parameters were used to compare the economic performance of two land preparation routes: fuel consumption (GO) and consumption costs.Soil preparation uses manual work and mechanized work. The mechanized soil preparation (subsoiling, heavy spraying, light spraying, etc.) involves the consumption of fuel (GO), plus a technical soil preparation route involves mechanized farming operations, the more it consumes fuel. Simplification of tillage reduces fuel consumption (Figure 2).The results show that the complete technical route consumes more fuel (4613,767 liters) than the simplified technical route (1975,572 liters).

Analysis of variance and the student test on fuel consumption from both types of technical soil preparation route show a very significant effect ($t = 4.44$, $p = 0.0001$); the type of technical soil preparation route has an influence on fuel consumption.

Figure 3 shows the fuel consumption costs of two technical soil preparation routes (the TC full technical route and the TS simplified technical route).

This figure shows that the full itinerary has higher average costs (2,998,949 FCFA) than those resulting from the simplified technical itinerary (1,284,122 FCFA); a difference of 1714 827 FCFA.The analysis of variance and the student test carried out on the fuel consumption costs resulting from the two types of technical route of soil preparation confirms that the type of technical route of preparation of grounds has an influence on the expenses of consumption fuel.

DISCUSSION

The Simplified Route (TS) or Simplified Cultivation Technique (TCS) is a form of soil conservation agriculture, such as direct sowing (no tillage), under grassland system in SCV (Scopel et al., 2005). These farming techniques are based on the non-inversion of the soil, that is to say the removal of plowing (Chevrier and Barbier, 2002). Under the conditions of SARIS Congo, the complete soil preparation route involves heavy spraying, which is a pseudo plowing.

The results of the comparative study of the technical techniques of soil preparation (complete itinerary, simplified itinerary) of the sugar cane crop show that the type of technical itinerary of soil preparation has no influence on the yield, but on indicators of the richness of sugarcane like Brix and RHS.These results are similar to those obtained by Goalbaye et al. (2014) on maize cultivation in Chad. These authors note the absence of a significant difference in maize production (grain yield) between plowed and unplowed soil.

However, our results are different from those obtained by Kang et al., (1980) and Bitijula et al., (1984), who showed that the no-till system was superior in grain yield over the system. of plowing.According to De Tourdonet et al., (2013) the agronomic impacts of reduced tillage are very diverse in context and vary over time, particularly in the early years of implementation.Thomas (2011) finds that in some cases, the production performance of simplified crop techniques is far from favorable, yields are sometimes lower.

The results of the study showed that the type of technical soil preparation route has an influence on fuel consumption. These results are consistent with those obtained by Thomas (2006) who notes that the reduction of tillage decreases not only working time but also fuel consumption.The reduction of tillage mainly responds to an economic objective, that of increasing profitability through the reduction of working time and the use of fossil energy, see mechanization costs (De Tourdonnet et al., 2013). Working on the evaluation of no-till technique on maize, Goalbaye et al. (2014) also obtain similar results. The latter note that the overall cost of cultivation operations on unplowed soil is lower (11.76%) compared to plowed soil (88.24%).

Our results showed that the overall cost of producing sugar cane in a simplified technical route was relatively lower (1,284,122 FCFA/60ha) with less fuel consumption (1975,572 liters/60ha) than the full technical itinerary soil preparation (2.998 .949 FCFA for 4613.767 liters/60ha).

These results are in line with those obtained by Skora (1993) cited by Goalbaye et al., (2014) who notes that no-till provides significant savings in time and money. Removing heavy spraying will save fuel economy while achieving technical performance similar to that achieved during the complete technical soil preparation routes

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CONCLUSION

The study compared the technical and economic performance of two technical soil preparation routes at SARIS Congo, the simplified route and the complete itinerary.From this study, it appears that the type of technical soil preparation routes has no influence on the agronomic performance of sugar cane, that is to say the yield and the number of production cycles. The study also revealed that the type of technical soil preparation route has a significant influence on sugar parameters of sugar cane BRIX, but negligible on the RHS.However, this type of route has a very significant effect on economic parameters, including fuel consumption. The simplified technical soil preparation route has significant

economic advantages over the entire route.
The introduction of simplified soil preparation routes to SARIS Congo is therefore part of a soil conservation strategy.All plots cultivated in the company's concession are subject to cost accounting (working time, farming costs, receipts, etc.), the data of which serve to feed a database.It would be interesting to deepen this study, taking into account more economic parameters in order to allow the crop management of the company to make a final choice on the best technical soil preparation route.

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