

"Comparative study of the agronomic performance of *Desmodium kenyas* and *Stylosathes gracilis* under the ecological conditions of Nioka, DRC"

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Abstract: The present study focused on a comparison of productivity between *Desmodium kenyas* and *Stylosanthes gracilis* under the ecological conditions of Nioka, Democratic Republic of Congo. The experimental methodology adopted involved the cultivation of these two species on arable soil plots, both amended and unamended, evaluating parameters such as germination, crown diameter, plant height and biomass per plot.

This research is of scientific, socio-economic and environmental importance. The introduction of permanent legumes, in combination with grasses, could improve pasture management. The results, summarized in tables, revealed differentiated performances: the amended *Desmodium kenyas* produced 1.952 t/ha, while the unamended *Desmodium* produced 1.385 t/ha. Similarly, the amended *Stylosanthes gracilis* produced 1.278 t/ha, compared to 1.075 t/ha for the unamended *Stylosanthes gracilis*. Soil amendment promoted better productivity for both species studied.

Keywords: Agronomic performance, *Desmodium kenyas*, *Stylosathes gracilis*, Nioka ecology, DRC.

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1. Introduction

The problem of domestic animal husbandry in tropical and subtropical regions, such as the Democratic Republic of Congo, lies in pathological and nutritional constraints that compromise the zootechnical performance of livestock, thus reducing the sustainability of these activities. Despite the vast pastoral areas available, these regions face increasing limitations, aggravated by the population explosion, intense anthropogenic activities and global warming. These challenges make it difficult for animals to feed on a daily basis, especially in a context of fratricidal wars and foreign aggressions, resulting in low productivity of the grassland flora.

In this context, the search for solutions to improve the productivity of forage crops is of crucial importance. Previous work has

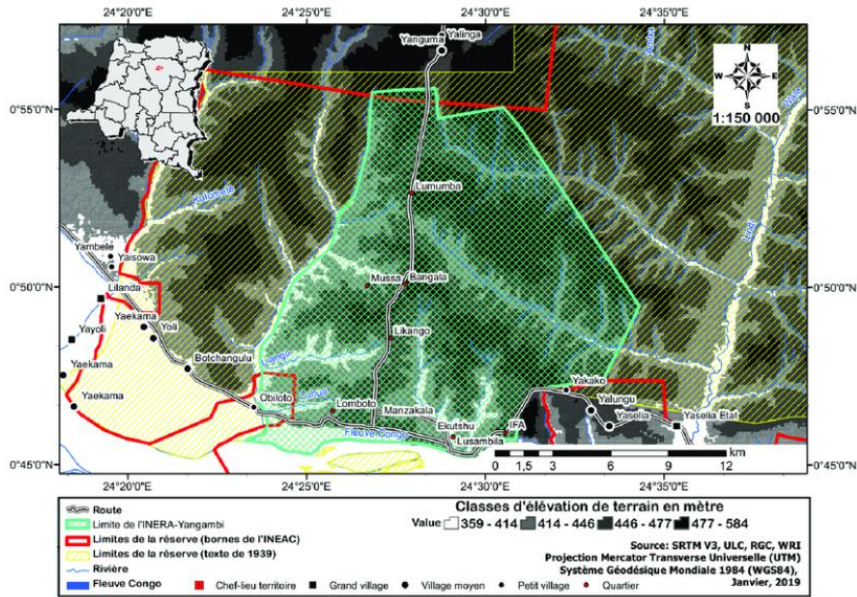
explored various approaches, including the use of *Desmodium kenyas* and *Stylosanthes gracilis* in pet nutrition. However, their effectiveness under specific ecological conditions, such as those of Nioka in the DRC, remains to be determined. By comparing the results obtained in this study with previous data, it is possible to assess the potential impact of these crops on livestock productivity in a local context.

Thus, the question of how to improve the productivity of fodder crops, such as *Desmodium kenyas* and *Stylosanthes gracilis*, under the ecological conditions of Nioka, DRC, is acute. This research aims to contribute to solving the challenges faced by pastoralists by identifying the most effective agricultural practices to overcome pathological and nutritional constraints, while taking into account local realities and environmental pressures.



2. Materials and Methods,

2.1. Localization



2.2. Description of the study environment

The present research is carried out as part of the national livestock research program at the National Institute for Agronomy Study and Research at the Nioka Center, located at 02°09' north latitude and 30°39' east longitude, at an altitude of 1,800 meters. Administratively, this site is located in the north-east of the Democratic Republic of Congo, in the chiefdom of the Panduru, Mahagi Territory, Ituri Province. It is 125 km from the city of Bunia, capital of Ituri province, and 54 km from Mahagi, capital of the territory.

As far as ecological considerations are concerned, the study area has a Köppen-like climate characterized by an annual rainfall of 1600 to 1700 mm. Precipitation is distributed over two main

periods, with maximums in August (193 mm) and May (163 mm), and secondary maximums in March (52 mm) and November (120 mm). Average monthly temperatures vary between 24°C and 25.5°C, with daily lows between 19°C and 20.5°C and a low temperature range.

Air humidity remains high throughout the year, with monthly relative sunshine generally between 30% and 55%. Winds on the ground are weak and of variable direction. More specifically, the climate of the Nioka experimental site corresponds to type A of the Köppen classification, characterized by average daytime temperatures above 18°C and an annual precipitation amount exceeding twice this average temperature, in accordance with the criteria established by Ruwet and Sengele in 1985

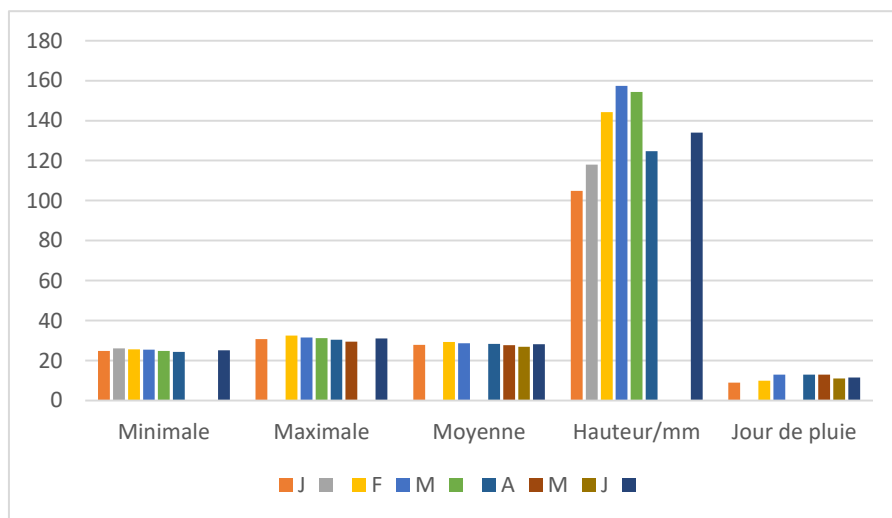


Figure 1 : pluviométrie dans la région de l'INERA NIOKA

3. Hardware

The equipment used for this experiment includes seeds of *Desmodium kenyasis* and *Stylosanthes gracilis* from the INERA-Nioka agrostological park. As far as technical equipment is concerned, we used agricultural tools such as hoe, machete, knife, tape measure, rope, as well as ballpoint pens of different brands, a 50 cm graduated slat, calipers and a food table

The genus *Desmodium*, native to Southeast Asia, spread to the Americas, starting with Mexico, and then colonizing tropical and subtropical regions around the world, with the exception of Europe according to Ohashi in 1983. The different species of this genus are found in various geographical areas, such as Asia, Africa, Central and South America, and India, depending on their specific climatic and ecological adaptations. Indeed, their distribution is closely linked to humid and hot climatic conditions, with high rainfall and consequent evaporation throughout the year, thus favouring equatorial and humid regions. These plants prefer a soil pH below 6.5 and are often found in wooded areas or open forests, although they are less common in savannahs.

However, their ecology can vary greatly depending on the species, with some preferring marshy habitats while others thrive in isolated soils. Morphologically, *Desmodium* species exhibit diverse growth habits, ranging from trees to bushes to grasses, with internal uniformity but species-to-species variation. Genetically, most *Desmodium* species have a chromosome number of $2n=22$, although exceptions exist, such as the African and American *Desmodium* with $2n=20$ chromosomes. These genetic characteristics also influence the behavior of the inflorescence in response to light, varying between species.

According to Skerman (1970) and Pittier (1944), *Stylosanthes* comprises relatively a small genus of tropical legumes and most of these species are native to southern and central America and the

Caribbean. In their local areas, many of these plants had been used by local pastoralists. Only recently have they been tried to make their domestications. The domestication of these legumes in tropical pastures is a recent matter.

4. Methodological approach

Preparatory work

For our experiment, the work began with the collection of technical equipment and the consultation of specialized books to develop our study protocol. At the same time, we gathered the necessary tillage material, such as hoe and nylon wire, for the subsequent preparation of the experimental set-up.

Subsequently, we opted to collect the seeds of *Desmodium kenyasis* and *Stylosanthes gracilis* at the INERA-Nioka Station, two weeks before sowing, in order to guarantee their quality and germination. These seeds were then sorted and packaged to ensure homogeneous growth of the plants in the experimental field.

The preparation of the land required a careful choice of a suitable site, characterized by a non-hilly topography and pre-established vegetation including *Imperata cylindrica* and *Pennisetum purpureum*. After a month of post-ploughing rest, the land was disturbed and divided into plots, with particular attention paid to the amended plots where cow dung was used as organic matter.

The experimental setup was set up with six plots of equal size, each housing different combinations of *Desmodium kenyasis* and *Stylosanthes gracilis*, amended or not, with a uniform seeding density. This system made it possible to compare the results obtained and to carry out a methodical analysis of the data collected.

The diagram below illustrates the special layout of our experimental set-up.

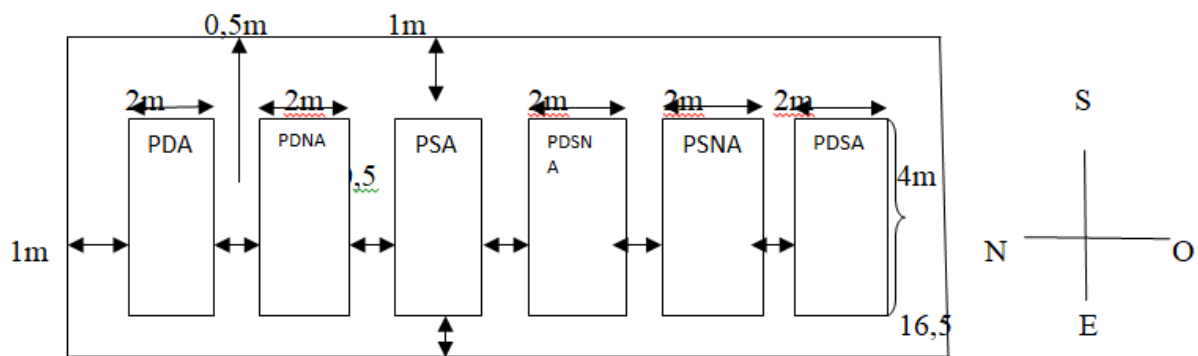


Figure 2. Experimental device used

Legend: P1, P2, P3, P4, P5, P6: The plots.

P1: PDA: *Desmodium kenyasis*; amended plot

P2: PDNA: *Desmodium kenyasis*; unamended parcel

P3: PSA: *Stylosanthes gracilis*; parcel amended

P4: PDSNA: *Desmodium and Stylosanthes*; Unamended parcel

P5: ANSP: *Stylosanthes gracilis*; unamended archella

P6: PDSA: *Desmodium and Stylosanthes*; amended plot

Maintenance work: During sowing until germination, copious watering was observed. After germination, we reduced the frequency, to resume only during the dry season. Of paramount importance is the experience of rational maintenance methods in

these cultivars: *Desmodium kanyasis* and *Stylosanthes gracilis*. However, as experience has shown in the trial, it is not possible to make a fair assessment of a given method in the course of a week following sowing

5. Results and Discussion

Outcome 1. Evaluation of the germination of *D. kanyasis* and *Stylosanthes gracilis*

Table 1.below elucidates the germination of *Desmodium kanyasis* and *Stylosanthes gracilis*. This observation was made 30 days after sowing.

Rehearsals	Amended parcels			Unamended parcels		
	N.G.S	N.G.G	N.G.N.G	N.G.S	N.G.G	N.G.N.G
1	32	28	4	32	87,5%	12,5%
2	32	30	2	32	93,75%	6,25%
3	32	27	3	32	84,3%	15,6%
4	32	28	4	32	87,5%	12,5%
5	32	29	3	32	90,62%	9,25%
6	32	30	2	32	93,75%	6,25%

Source: Sprouting experiment at NIOKA

Legend:

1. NGS: Number of seeds sown
2. NGG: Number of seeds sprouted in numbers and percentage
3. NGNG: Number of unsprouted seeds

By these results, the *Desmodium kanyasis*, a remarkable germination was observed in the unamended plot, where 30 seeds, or 93.75%, germinated, while only 2 seeds, or 6.25%, failed to germinate. On the other hand, in the amended plot, 28 seeds, representing 87.5%, germinated, while 4 seeds, or 12.5%, did not germinate.

In addition, *Stylosanthes gracilis*, a good germination was also observed in the unamended plot, with 29 seeds, or 90.62%, having germinated, and only 3 seeds, or 9.25%, having not germinated. In contrast, in the amended plot, 27 seeds, or 84.3%, germinated, while 5 seeds, or 15.6%, failed to germinate.

Result 2: Evaluation of the height of the plants

In the table below, we elucidate the heights of the plants of two grassland species observed in cultivation on amended plots and those not amended for 90 days.

Table 2: Height results of *Desmodium kenyaensis* and *Stylosanthes gracilis* grown on two types of substrates

Repetitions or plots	Amended plots	Unamended parcels
1	20,00cm	-
2	-	18,00 cm
3	58,16 cm	-
4	-	60,10 cm
5	-	45,00 cm
6	78,50 cm	-
Sum	156.66	123.1
Average	26.11	20.516667
Variance	1170.8886	687.08167
Standard deviation	34.2182495	26.212243
CV	131.054192	127.76073

The table shown shows that *Desmodium kenyaensis* shows more vigorous growth on amended soils (20.0 cm) than on unamended soils (18.0 cm), all else being equal. This difference is particularly noticeable between the treated seed in the first amended plot and the second unamended plot. In addition, it appears that the effect of the amendment persists even when the same seeds are used in both treatments. A similar conclusion can be drawn for *Stylosanthes*

gracilis, with favored growth on amended soils (58.16 cm) compared to unamended soils (45.00 cm) after a 90-day crop. This disparity in growth between the two soil types can be attributed to the beneficial effect of the amendment on fertilized soils, thus confirming the earlier observations reported by Bondombe (2018) on the importance of fertilization for Obtain satisfactory agricultural yields.

	Amended plots	Unamended parcels
Average	26.11	20.5166667
Variance	1170.8886	687.081667
Observations	6	6
Pearson correlation coefficient	-0.7166927	-
Hypothetical difference in means	0	-
Degree of freedom	5	-
Statistics	0.24436041	-
P(T<=t) unilateral	0.40833129	-
Critical value of t (one-sided)	2.01504837	-
P(T<=t) bilateral	0.81666258	-
Critical value of t (bilateral)	2.57058184	-

Analysis of the table reveals differences in crown diameter for *Desmodium kenyas* between the amended and unamended plots, respectively in the first and second plots. This observation highlights the preponderant role of the first treatment compared to the second for this species, with a larger diameter in the amended plot. Similarly, for the species *Stylosanthes gracilis*, the diameter at the collar is favoured in the amended plot compared to the

unamended plot, without any adverse effect on the physiology of the plants. Detailed analyses confirm this trend, with a record diameter observed in the amended plot. This comparison of the cultivars under the different experimental conditions allows for in-depth observation, highlighting the significant impact of the amendment on the crown diameter of the plants.

Result 3: Student's T result (equal expectation test)

	Amended plots	Unamended parcels
Moyenne	0.15	0.1125
Variance	0.03475	0.0199375
Observations	6	6
Pearson correlation coefficient	-0.7693293	-
Hypothetical difference in mean	0	-
Degree of freedom	5	-
Statistique t	0.297726117	-
P(T<=t) unilateral	0.388943048	-
Critical value of t (one-sided)	2.015048373	-
P(T<=t) bilateral	0.777886096	-
Critical value of t (bilateral)	2.570581836	-

Result 4: Biomass per plot

The results, recorded after 130 days of experiments on biomass per plot, are carefully given in Table 6 according to the cultivars.

Table: The biomass of *Desmodium kenyas* and *Stylosanthes gracilis* is amended and unamended for 130 days.

Repetitions or plots	Amended plots	Unamended parcels
1	1,56 kg	-
2	-	1,108 kg
3	1,023	-
4	-	1,517 kg
5	-	0,856 kg
6	2,524 kg	-
Sum	5.107	3.481
Average	0.851166667	0.580166667
Variance	1.100759367	0.448425767
Standard deviation	1.0491708	0.669646
CV	123.262675	115.423039

The statistical data show no significant difference between the amended and unamended plots for this parameter, thus confirming the absence of rejection of the null hypothesis. Looking at the results of the experiment, it can be seen that *Desmodium kenyas* has a better yield in the amended plot compared to the unamended one, with average weights of 1.562 kg and 1.108 kg, respectively. Similarly, for *Stylosanthes gracilis*, the amended plot shows a

favourable response, with an average weight of 1.023 kg, while the unamended plot shows an average of 0.856 kg. This comparative study therefore reveals significant differences in the yields obtained: the amended *Desmodium kenyas* shows a higher production than the unamended one, while for the *Stylosanthes gracilis*, it is the amendment that leads to a clear improvement in efficiency, unlike *Desmodium*.

Result 5: Student's T result (equal expectation test) observed on biomass

	Amended plots	Unamended parcels
Average	0.851166667	0.580166667
Variance	1.100759367	0.448425767
Observations	6	6
Pearson correlation coefficient	-0.843445746	-
Hypothetical difference in means	0	-
Degree of freedom	5	-
Statistique t	0.40143746	-
P(T<=t) unilatéral	0.352340256	-
Critical value of t (one-sided)	2.015048373	-
P(T<=t) bilatéral	0.704680513	-
Critical value of t (bilateral)	2.570581836	-

Conclusion

This study aims to contribute to a comparative analysis of the productivity of *Desmodium kenyasis* and *Stylosanthes gracilis* under the ecological conditions of Nioka in the DRC. Increasing the use of *Desmodium* for grazing or land cover could undoubtedly promote livestock growth and agricultural production in tropical and subtropical regions. However, information on increased productivity remains limited, as these species may be hampered by factors such as insect pests and foliage loss, which would affect their ability to bind nitrogen, which is essential for their functioning. Despite this, the variability inherent in any biological organism obscures the results obtained.

We consider our results on *Desmodium*, for which we used 32 seeds, as well as those on *Stylosanthes*, as a first indication to guide further more in-depth research. The diversity of results, both between species and within the same species, highlights the preponderant influence of internal factors. The study of the impact of external conditions on the success of seeds revealed their crucial importance. The methodology for this study was to place seeds of *Desmodium kenyasis* and *Stylosanthes gracilis* in plots with or without soil amendments, and then to record the observations in experimental tables over time. The results obtained indicate variable yields: in the amended plot of *Desmodium*, we observed an average of 1.562 kg, or 1.952 t/ha, while in the unamended plot, the yield was 1.108 kg, or 1.385 t/ha. For *Stylosanthes*, the amended plot produced an average of 1.023 kg, or 1.278 t/ha, while in the unamended plot, the average yield was 0.856 kg, or 1.07 t/ha.

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