Comparative Analysis of Different Treatments Effects on *Stylosanthes Guianensis* Production Parameters in Imbo, Natural region of Burundi

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ABSTRACT

In Burundi, the major problem for livestock is the lack of sufficient nutrients needed for its growth and development due to Burundi higher population growth rate which put a pressure on arable lands and pastures leading to grass pastures reduction. However the concentrates that can be used alternatively are not only insufficient, but also very expensive under the local farmer conditions. In the Burundi, livestock reduction was recorded while it occupies an important place in Burundian life, especially for smallholders to whom it plays a major role in terms of social life, health and income generation. Fortunately, stylosanthes Guianensis has been identified as an herbaceous forage legume with potential protein supplements of better impacts on livestock growth, development and production. It is more accessible to smallholder, whence this study has been carried out to improve stylosanthes production for better livestock feeding. The experiment has considered six seedling spacing as treatments to analyze the treatment which could effectively improve the stylosanthes production parameters in Imbo natural region. These treatments (T1 (40cm X 5 cm); T2 (40cm X 10 cm), T3 (50cm X 5 cm), T4 (50cm X 10 cm), T5 (60cm X 5 cm), T6 (60cm X 10 cm)) were ranged in three blocs completely randomized with three replications. Data were sampled at the 8th, 10th, 12th, 14th, 16th, 18th, and the 21st weeks after germination by recording as parameters: plant height, ramifications number, plant water content, green and dry matters. All data were analyzed through SPSS at $P<0.05$ for significative difference. The results showed no significant difference among treatments for plant height but highlighted treatments T2 as the effective treatments in increasing plant growth especially in developing period. This treatment T2 also showed positively effects on ramifications number comparatively to others. Moreover, T2 treatment significantly improved plant water content, green matter and dry matter. This study suggested treatment T2 (40cm X 10 cm) as the effective treatment which could be used for improving stylosanthes production parameters and productivity as well in the Imbo region.

Keywords: Stylosanthes Guianensis, Different treatments, Production parameters, Imbo region.

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1. INTRODUCTION

In Burundi, the major problem for livestock is the lack of sufficient nutrients needed for its growth and development due Burundi higher population growth rate [1] which put a pressure on arable lands and pastures leading to grass pastures reduction. Furthermore, the concentrates that can be used alternatively are not only insufficient, but also very expensive under the local farmer conditions. Although livestock has the ability to select and consume a wide range of forages, tree leaves and crop residues, there still a feed shortage, due to seasonal effect with abondant forages only during the wet season and dry out in the dry season [2], whence deficiency in energy, protein and essential minerals and vitamins for livestock leading to its reduction while it occupies an important place in Burundian life especially for smallholders by playing a major role in terms of social life and income generation. However herbaceous forage legumes Stylosanthes species have been identified as potential protein supplements for livestock since they contain high crude protein (150 -300 g/kg DM), minerals and vitamins that are needed for livestock growth and development [3]. *Stylosanthes guianensis* is a leguminous perennial herb with an erect form, many branches and trifoliate leaves [4-5]. It is native to South America and adapts to a wide range of soil and very resistant to various weather conditions.

Stylosanthes is a short-lived perennial legume, very tolerant of low fertility and acid soils [3]. Usually grown as a cover crop, *Stylosanthes* is self-fertile and effectively suppresses weeds. Moreover, it can help prevent soil erosion by 70 % and enhance soil nutrients [6]. Stylosanthes has assumed a very important position as a pasture legume for grassland but also for degraded forest area and waste lands [7]. It has been found promising and combines both disease resistances with other favorable agro-forestry characteristics. Based on foregoing research, Stylosanthes guianensis is among several legumes which produced good biomass [8]. It is a good feed supplement for most animals and can be used fresh or dried for hay and leaf meal [3]. *Stylosanthes* is fairly palatable to livestock and improves its growth and development [2]. It contains 33–40 % crude fibre, 0.1–0.2 % P, 0.8–1 % Ca, 1.2–1.8 %K, 0.3–0.8 %Mg, a trace 0.02 %Na and 0.1–0.8 % Cl in the dry matter [9]. Considering stylosanthes' impact on the livestock growth, development and production, as well as its accessibility to smallholder farmers compared to the concentrates, the improvement of *Stylosanthes* productivity is needed especially in Burundi where the effectiveness of legumes use in the animals ration remains low due to grass dominance in the grazing land and Burundian habit of using *Pennissetum purpureum* and *Setaria sphacelata* grasses as supplement, while livestock nutrient deficiency was reported by relying on these grasses feed only. This study aimed to analyses the effects of different treatment on *Stylosanthes* production parameters in Imbo natural region conditions to find a treatment which can effectively improve stylosanthes growth, development and production whence enhancement of livestock productivity through better feeding leading to improved households food security and livelihood.

2. MATERIALS AND METHODS

2.1 Site description and soil properties
The experimentation site was located in the Imbo region displayed in this following map [10]
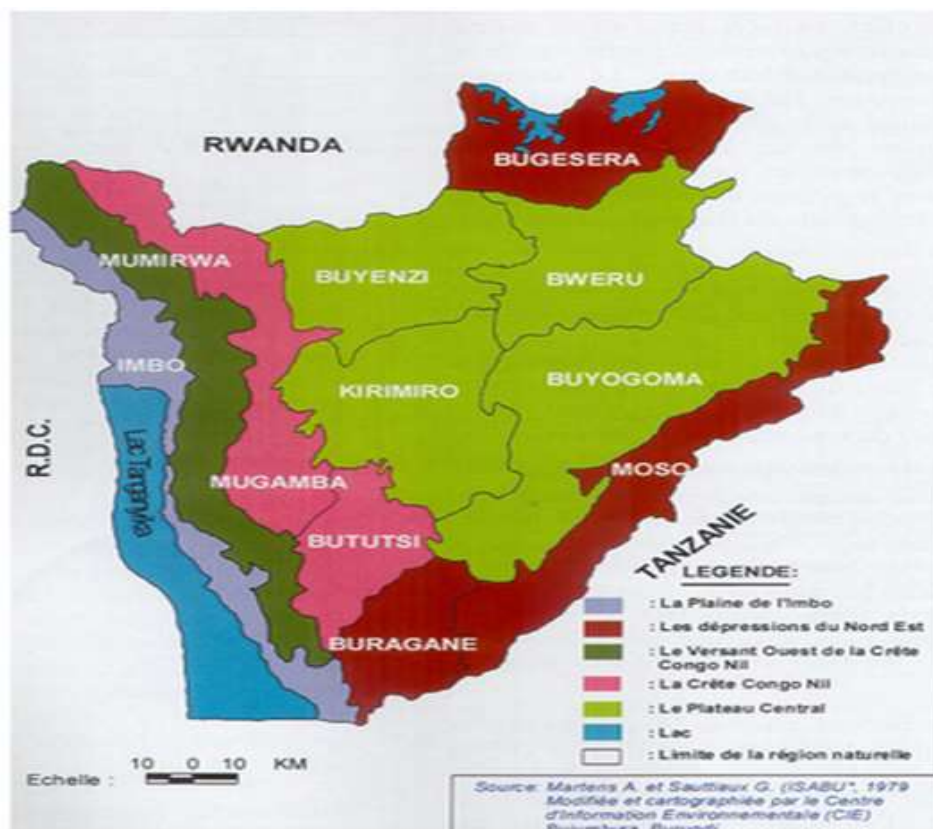

Photo 1 : Burundi natural regions map

Specifically, the experiment was carried out at Burundi University in the faculty of Agronomy. The recorded average precipitation was 106.73 mm with 25°C as mean temperature and an altitude of 883.44 m. The soil texture was characterized by 30.84 % of clay and C of 1.36%.

2.2. Experiment design

The experiments has considered six seedling spacing considered as treatments (T): T1 (40cm X 5 cm); T2 (40cm X 10 cm), T3 (50cm X 5 cm), T4 (50cm X 10 cm), T5 (60cm X 5 cm), and T6 (60cm X 10 cm), ranged in three blocs completely randomized with three replications for each as shown below.
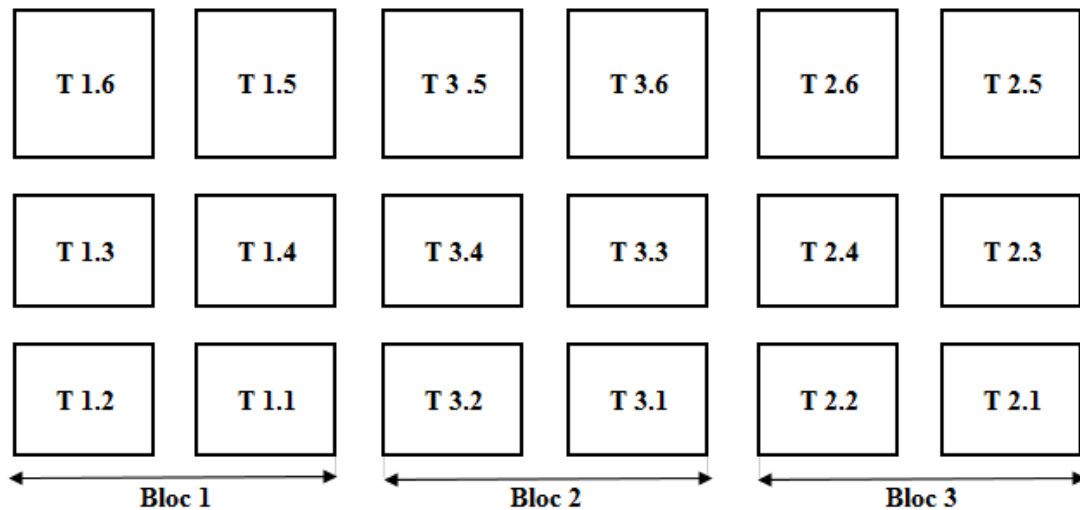
Figure 1. Experiment design

For each treatment, the first and the second numbers show the replication and the treatment number respectively.
Before sowing, the fertilizers were applied as recommended by Burundi Agricultural Sciences Institute (ISABU), while during the growth period, diseases and pests were normally controlled.

2.3. Sampling and data collection:

Data were sampled at the 8th, 10th, 12th, 14th, 16th, 18th, and the 21st week after germination. The recorded parameters were plant height, ramifications number, water content, green matter and dry matter.

2.4. Statistical analysis:

All data were processed with applied Excel 2007 and SPSS. Figures were made by using Excel, while comparison between treatments were conducted through LSD (least significant difference) and SPSS at $P<0.05$.

3. RESULTS

3.1. Effects of different treatments on plant height (PH)

The results on plant height (PH) were summarized in Figure 2. Plant height increase with data record date with a linear growth rate. In the first days (8th week), there was no significance difference between treatments.
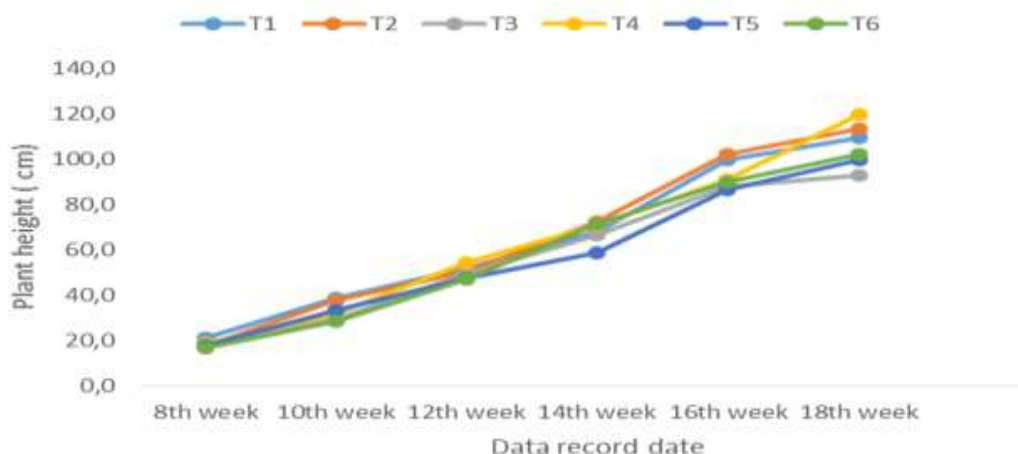

Figure 2. Effects of different treatments on plant height (PH)

The highest PH of 21.3 cm was recorded for the T1 method and minimum for T6 with 17 cm. The same trend was observed on 10st and 12th week, the maximum PH was recorded for T1 with 39 cm and 52 cm respectively, while the minim of 28 and 47.3 cm was obtained by T6. At the 14th week, the trend changes, the highest plant height was recorded for T2 (72 cm) and minimum for T3 (66.7 cm). Similarly, on 16th, the tallest plant was still recorded by T2 and minimum T5 (86 cm). However in the last days the maximum was recorded by T4 with 120 cm and did not significantly differed to the following treatment T2 of 113 cm but both significantly differed to T3 treatment with shortest plant of 93 cm.

3.2 Influences of different treatments on ramifications number (RL)

Branch ramification is a notable trait that varies both within and among species. It serve for hydraulic and biomechanical functions as reported but foregoing researchers [11-12-13-14-15]. Furthermore, branch ramification may be linked to reproductive characters [15-16], whence this studies has assessed its evolution as summed up in the figure 3

Figure 3. Response of ramifications number to different treatments

The outcomes on ramifications number shows no significant difference between treatments. Specifically, on the 8th week, the ramifications maximum value was recorded for treatments T1 and T2 with 8 and 7 ramifications respectively. The minimum of 5 ramifications was observed for both T3 and T6. In the following days (12th week), ramifications highest number of 11 ramifications was observed for T2, followed by T1 and T3 with both 10 ramifications and minimum for T6 with 7 ramification. The same trend was observed on the 14th week where the optimum ramifications number was observed for T2 with 22 ramifications as well as for T3 and T4 which got the said value, while the minimum of 20 ramifications was observed for T5. The same pattern was observed on the 18th and 21th where treatment T2 still in the first place without no significance difference observed between treatments and minimum for treatment T5.

3.3. Effects of different treatment on plant water content (PWC)

Plant water content is one of the most common physiological parameters limiting efficiency of photosynthesis and biomass productivity [16-17]. It is a very important parameter in determination of plant drought and salinity tolerance due to water stress which restricts transpiration including closure of stomata and water evaporation from leaf surface. Whence it has been recorded in this study as displayed in figure 4.
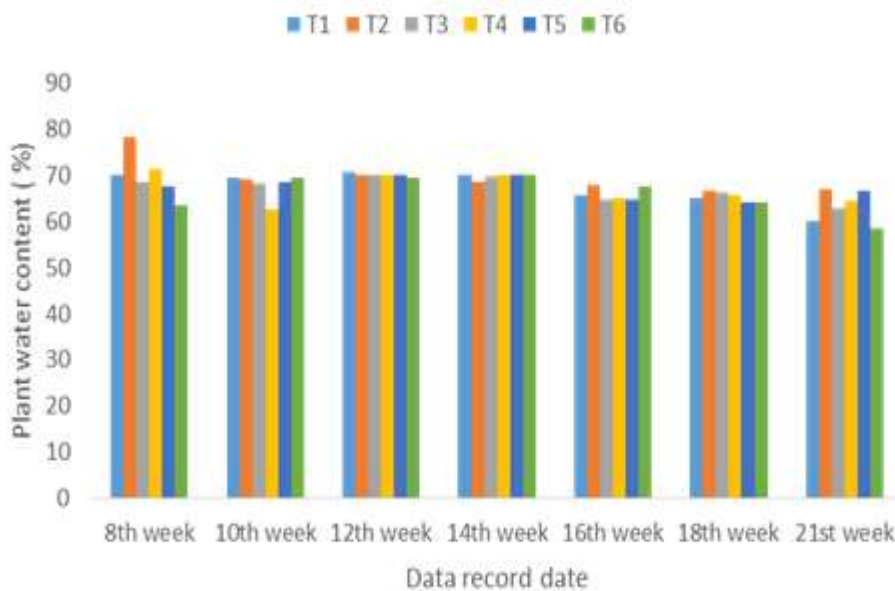
Figure 4. Effects of different treatments on plant water content (PWC)

Considering this figure, the plant water content (PWC) was effectively influenced by the applied treatment. Specifically, considering the 8th week, the highest value was recorded for T2 treatment with 78.4 %, while the minimum was observed for T6 treatment of 63.6 %. Regarding to the 10th week, the maximum PWC value of about 69% was observed for both treatments T2 and T6, whereas T4 got the minimum by 62.5%. On 12th, treatment T2 still in the first place with70.2% of water content. The same trend was observed in the last weeks 16th, 18th and 21th where treatment T2 got the maximum water content of 67.8%, 66.6% and 67% respectively comparatively to others. However the minimum of 64.6% and 64% was observed for T5 on the 16th and 18th respectively, while on the 21th the minimum value of 58% was observed for treatment T6.

3.4. Different treatment effects of on green matter (GM)

Green matter evolution is summed up in the following Figure 5. It increase with data registration date following the relation GM 8th < GM 10th < GM 12th < GM 14th < GM 16th < GM 18th < GM 21st. Clearly, on the 8th week, there was no significance difference between treatments, highest value of 14 g was observed for T2 and T3 with 13 g for both treatments, while the lowest of 7 g was recorded for T6 treatment.
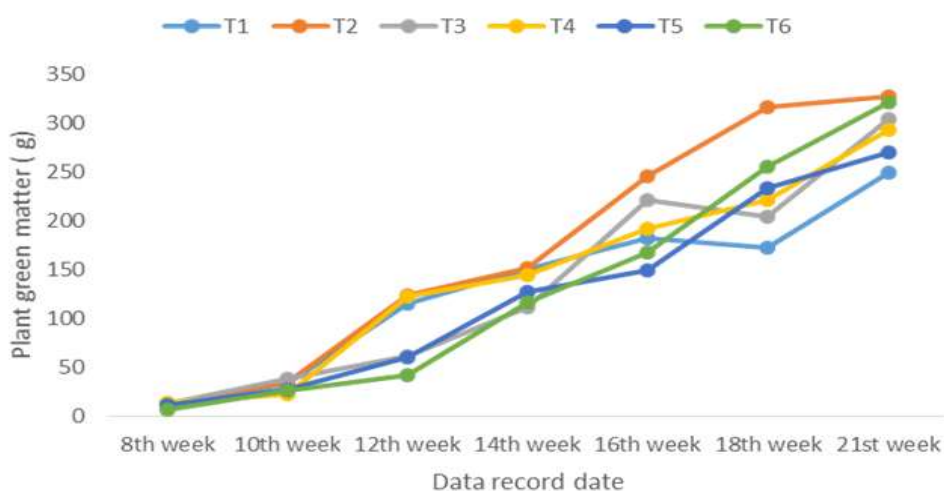

Figure 5. Effects of different treatments on green matter content

On the 10th week, treatment T3 (39g) and T2 (35 g) occupied the first and the second place, while treatment T4 (23 g) was the last one. On the 12th week, green matter maximum value was observed for T2 treatment with 124 g, followed by T3 of 123 g, while the minimum of 42 g was recorded for T6. The same trend was observed on the 14th week where the first highest value of 152g was observed for T2, the second for T1 with 151 g, and the lowest of 111 g for T3 treatment. On the 16th week, higher significant difference was observed between treatments. Specifically, the optimum value was still recorded for T2 treatment with 246 g which

significantly differed to others with P< 0.05. It was followed by T3 of 222 g, and minimum for treatment T5 of 149 g. On the 18th week, as it can be seen from figure 5, the same evolution pattern was observed, with a maximum green matter value for T2 (317g) and minimum for T1 (173 g). The same trend was also observed on the 21st weeks where highest value of 327 g was observed for T2 which significantly differed (p<0.05) from other treatments. The following was T6 with 321 g and minimum treatment T1 of 250 g.

3.5 Effects of different treatments on dry matter (DM)

The outcomes on dry matter were shown in figure 6. As for the green matter, dry matter increase with data registration date following the relation DM 8th < DM 10th < DM 12th < DM 14th < DM 16th < DM 18th < DM 21st.
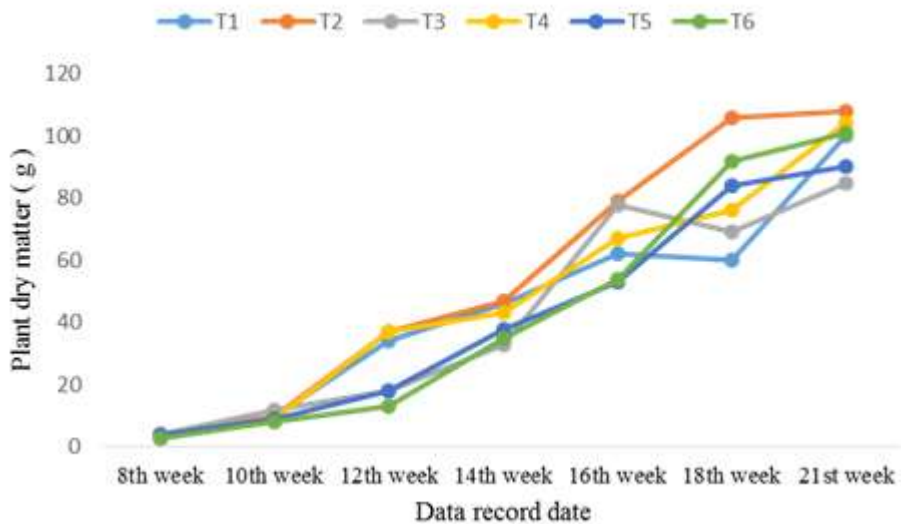

Figure 6. Dry matter evolution as influenced by different treatments

On the first weeks, no significance difference was observed, the value of dry matter per plant oscillates between 4 and 3 g on the 8th, while on the 10th week, it value between 8 and 12 g. However, on the 12th week a little discrepancy was observed with highest value for T2 and T4 treatments with both 37 g. The following was treatment T1 of 34 g and minimum for T6 with 13 g. On the 14th week, dry matter highest value was recorded for T2 (47g) followed by T1 of 46 g, while T3 treatment got the minimum with 33 g. On the 16th week, the same trend was observed with highest value for T2 (79 g) and presented significant difference from T5 (53 g) and T6 (54 g), treatments with minimum value. Similarly, on the 18th week, maximum value was still recorded for T2 (106 g) which significantly differed from others with p<0.05. The minimum was observed for T1 treatment with a dry matter 60 g. The same dry matter evolution pattern was observed on the 21st week, where the highest value was observed for T2, 108 g, followed by T4, 104 g, and the minimum for T3 of 85 g.

4. DISCUSSION

The assessed parameters were effectively influenced by the used treatments. Regarding the plant height, although there was no significant difference among treatments in the first weeks, significant difference was observed later during development growth period with treatment T2 as the effective treatment in increasing plant growth. This may be attributed to the adequate seedling spacing, whence assimilation of more nutrients that plant need for growth. This support the results of Zubeldia and Gases (1977) who reported optimum plant growth through different spacing [18]. They endorse the result of Olivares et al. (2015) [19] who highlight *Stylosanthes guianensis* plant height Increments with applied treatments. Moreover, this treatment T2 significantly improved dry matter, leading to adequate crude protein enhancement as reported by foregoing researchers [20], whence a greater positive effect on livestock health, leading to a little improvement of households food security and life to whom livestock is an integral part of many subsistence by providing: income, milk, meat, and manure. Furthermore, treatment T2 significantly increased plant water content. However better plant water content allows to maintain favorable photosynthesis rates even with small stomatal opening [21], whence synthesis of many nutrient that the plant needs for its growth and development leading to green matter increment as has been found in this study. Thereby a very nutritious production for livestock. Considering all these, treatment T2 could be considered as an effective treatment which could improve stylosanthes production parameters and

productivity as well in the region.

5. CONCLUSION

The outcomes highlighted better effects of T2 treatment (40cm X 10 cm). It has played an important role in plant growth by increasing a little bit the average plant height and ramifications number. Furthermore, this treatment has significantly improved plant water content, green matter and plant dry matter. This study suggested T2 treatment as the effective treatment which can be used to improve stylosanthes production parameters in the region whence enhancement of livestock health leading to improved households food security and life.

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