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Effects of Cutting Height on the Recovery of Some Forage Grasses under Cultivation in Kindu, DRC

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ABSTRACT

This article analyzes the effects of cutting height on the recovery of some forage grasses under cultivation in Kindu, (DRC). The few forage grasses concerned are *Pennisetum purpureum, Panicum maximum, Hyparrhenia diplandra* and *Paspalum chevalierii*. The effects of cutting height on the regrowth of several grasses were studied in a separate experimental setup, randomized complete blocks comprising four treatments and four replicates. Each 4m x 2.5m plot, i.e. an area of 10 m^2, received 40 stumps and cuttings installed at 0.5m x 0.5m spacing, i.e. 0.25 m^2. These plots were separated by paths 2 m wide each. Thus, overall, the system consisted of 640 stump fragments, cuttings and the total field area was 1612 m^2. The results obtained can be summarized as follows. Better recovery was observed in the forage species *Paspalum chevalierii*, which recovered well at all cutting heights, followed by *Panicum* maximum for cutting heights of 5, 10 and 15 cm; *Hypparhenia diplandra* comes in third, while *Pennisetum purpureum* closes the way. Regarding the regrowth rate, 10 and 15 cm heights proved more effective for species of *Panicum maximum, Paspalum chevalierii* and *Hypparhenia diplandra*, which behaved well.

Keywords: effects of cutting height, grass, recovery, forage, crop

INTRODUCTION

The productivity of forage grasses depends on several factors, including cutting height, which influences regrowth, biomass, nutritional quality, and plant longevity. For this reason, Audru et al. (1987) state that in humid tropical zones, optimal mowing management is crucial for improving year-round forage availability, particularly during the dry season. Farmers must strive to mitigate seasonal feed deficits by providing a regular supply of high-quality supplementary feed in sufficient quantity, such as harvested forage (Limbourg, 1997). Natural pastures play an important role in feeding livestock in tropical regions (Yameogo et al., 2013). Peri-urban livestock farming is increasingly flourishing. However, the constraints of urbanization continue to encroach upon grassland areas used as natural pastures for livestock (Mosimann et al., 2017). As a result, there is a low availability of food in quantity and quality,

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particularly in the dry season, negatively affecting the health of the animal and its production (Suittie, 2004; Tshibangu et al., 2014). Forage crops are of paramount importance in the sustainable development of livestock farming (César et al., 2004). Seasonal fluctuations in plant growth and maturity make harvesting and storing forage essential in order to maximize quality and productivity (Decruyenaere et al., 2005). In Maniema Province in general, and in Kindu in particular, certain grassland forage species are becoming increasingly rare due to shifting cultivation, over-logging and burning, and the rapid urbanization of the city (Pamo et al., 2007; Kiema et al., 2012). Faced with these major problems, which are constantly worsening and linked to the rapid destruction of peri-urban forest ecosystems and traditional grasslands, it is imperative to consider selecting more productive and resilient grassland species for grassland, in response to the effects of global warming, human activity, grazing, and mowing (Pamo et al., 2006; Babatounde et al., 2011).

How does the cutting height influence the recovery and speed of regrowth of grasses in particular: *Panicum maximum, Pennisetum purpureum, Paspalum chevalierii* and *Hypparhenia diplandra*?

1) Under the effects of repeated cutting, do these herbaceous species have the same recovery capacity under the aforementioned conditions?
2) At what cutting height does it best promote regrowth?

To address these concerns, the following provisional solutions are proposed:

The high cutting height between 10 and 15 cm promotes better recovery and faster regrowth.

a) Under the effects of repeated cutting, these grassland species do not have the same capacity to recover under the aforementioned conditions;

b) Cutting too low weakens the plant and slows regrowth.

The objective of this investigation is to evaluate the effect of different cutting heights on the recovery and regrowth rate of some forage grass species in Kindu, including *Pennisetum purpureum, Panicum maximum, Hypparhenia diplandra* and *Paspalum chevalierii*.

Specifically, this work pursues the following three objectives:

a) Determine the recovery rate of these forage species under the aforementioned conditions and treatment;
b) Evaluate the regrowth rate according to the cutting height.

MATERIALS AND METHODS

Study Environment

Site Location

The study was carried out in the province of Maniema, specifically in the city of Kindu, at the experimental site of the Faculty of Agronomic Sciences of the University of Kindu located at the Lwama I camp. Maniema province is located in the northeastern region of the central Congo basin. The GPS coordinates of the experimental site are as follows: S 02°56.525°; E 025°53.118°; Altitude 469 m).

Geolocation of the experimental field and duration of the study

This investigation took place in the province of Maniema, city of Kindu, commune Mikelenge, district of Tokolote, more precisely on the grounds of the University of Kindu, Lwama1. The experimental setup in this site is located at 2°56'31.48692" South latitude, 25°53'5.73252" East longitude and 497 m altitude as visualized in the map below, from the period from June 15 to September 30, 2024.

Climate

The Democratic Republic of Congo comprises several distinct climatic zones. Unlike regions far from the equator where variations in average temperature distinguish the seasons,

rainfall is the primary factor creating seasonal differentiation across most of the country (Ngongo et al., 2009; Solia, 2016). The average monthly temperature ranges from 22.5 to 29.3 °C, with an annual average close to 25 °C.

Vegetation

The vegetation on the Kindu University grounds consists of heavily degraded secondary forests, mostly composed of young grassy fallow land interspersed with small wooded areas and spontaneous palm trees. It should be noted that savanna vegetation dominates the entire city of Kindu. This forest gave way to secondary forest, then wooded savannas, and finally, grassy savanna. The latter is dominated by *Panicum maximum, Imperata cylindica, Pennisetum purpureum, Pueraria javanica, Synedrella nodiflora*, and *Bidens pilosa*.

Soil and relief

In the Democratic Republic of Congo, there are two main soil types: recent soils (or Fluvisols) and Ferralitic soils or Ferralsols in the INEAC and/or WRB classification (Solia, 2016). The study sites are all Ferralitic soils, which include:

Hydrography

The city of Kindu is very rich in waterways. It is crossed from South to North by the Congo River, which drains the waters of several tributaries, the most important of which are: Mikelenge, Canon, Kapondjo, Lwanonga (www.congovirtuel.com, 2023).

Equipment

The study material consists of four herbaceous forage species, namely *Panicum maximum, Paspalum chevalierii, Hypparhenia diplandra* and *Pennisetum purpureum*.

Methods

Experimental setup

The design consisted of a bifactorial randomized complete block design with elongated plots. These plots were 4 m long and 2.5 m wide, for a total area of 10 m² each. They were separated by 2 m wide alleys, as illustrated in the diagram below. The two factors in the design comprised a total of four blocks, and each block contained four plots as primary treatments. These primary plots were randomly assigned to one of the forage species using the cardboard box technique. Labeled slips of paper (A, B, C, and D) were placed in the box, and after shaking the box, the selected slips were placed in each experimental unit (*Panicum maximum, Paspalum chevalierii, Hypparhenia diplandra*, and *Pennisetum purpureum*). An experimental field with an area of 1612 m² was established.

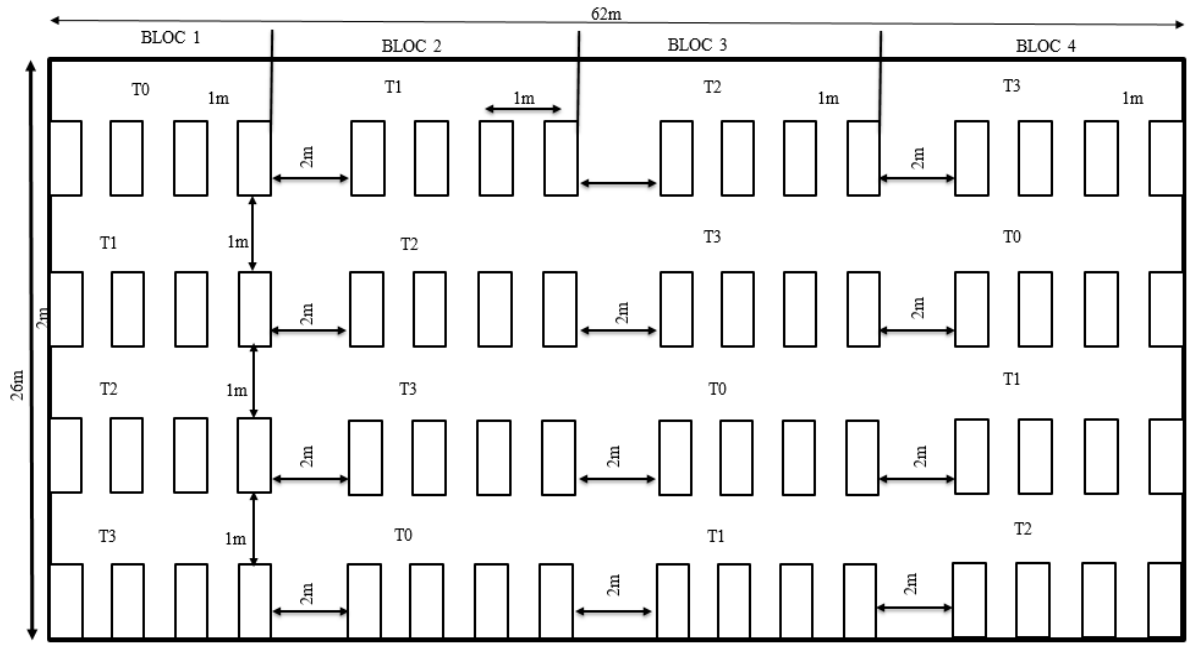

Figure 1. Experimental setup

Legend: T0: Control treatment at 7cm 2m Area: 62cm x 26 cm = 1621 m^2

T1: Mowing at 5 cm
T2: Mowing at 10 cm
T3: Mowing at 15 cm

A: *Pennisetum purpureum*
B: *Hypparhenia diplandra*
C: *Paspalum chevalierii*
D: *Panicum maximum*

Testing

a) Site selection

Our experimental setup was established on the outskirts of the University of Kindu. The Lwama1 site is in its more or less natural state, with a diverse range of plant species. The site is very secure, and animals rarely visit it, except by accident.

b) Ground preparation

It covered the activities described below, with the exception of incineration:

1) Delimitation

When delimiting our land, we used the Pythagorean theorem which states that the sum of the hypotenuse is also the sum of the squares of two other sides (32+42 = 52).

The land was divided into four blocks with elongated plots, each 4 m long and 2.5 m wide. These four blocks were separated by two 2 m walkways and the plots by 1 m walkways.

2) Land clearing

The grasses, shrubs, and trees on the site were cleared with machetes and felled with axes respectively. The total area was 1612 m^2.

3) Skidding of felled shrubs and trees

The trees and shrubs were cut down and removed from the field to allow the fallow land to dry out and be used as organic fertilizer.

4) Stump removal

Using a hoe and spade, an axe and a machete, the stumps of shrubs and trees were uprooted to better sow the land and lay out our crops.

5) Labor

Using hoes, the land was cut and turned over by this operation, while the dried organic matter was buried to improve the fertility and structure of the soils to some extent.

6) Harrowing

After the rain and/or watering, this operation had followed the plowing and consisted of breaking up and crumbling the clods of earth resulting from plowing in order to better flatten the ground and bury the organic matter more or less perfectly.

7) Development of plots by block

After leveling and staking out the terrain according to the desired map, the 64 plots, each measuring 4 m x 2.5 m, were laid out and separated by 1 m wide paths. These equally sized plots were separated by 1 m wide boundary lines, as illustrated in Figure 2 below. Four plots were grouped together to form a block, resulting in four blocks, each containing four plots, representing the proposed treatments. Finally, four blocks with four treatments were laid out to create four replicates.

8) Conditioning materials

The propagation material was first conditioned under shade and then watered to prevent drying out and to encourage root formation before final placement.

9) Planting of cuttings or root division

Several species of tropical grasses are propagated vegetatively, using three techniques.

A crop can be established from seeds (grains, cuttings, root divisions, suckers) or seedlings. However, for this investigation, planting was carried out by cuttings for *Pennisetum* and by root division for other grasses using a machete, at spacings of 0.5 m x 0.5 m. Each plot had an area of 10 m², with 40 seedlings per plot.

10) Filling the gaps

This cultivation operation consisted of replacing the plants that did not take root using a machete after 14 days of planting.

11) Watering

Watering took place three days after planting in the absence of rain throughout this experiment.

12) Weeding

Weeding took place every 15 days after planting using a hoe.

13) Mowing

One method of pasture improvement involves cutting with a machete or a mower. However, in this study, according to Boonen (2010), the ideal cutting height for some tropical grasses is between 6 and 7 cm. The cut will be made at heights of 5 cm, 7 cm, 10 cm, and 15 cm from the ground at mowing frequencies of 30 days, 45 days, and 60 days after planting.

Production determination

To estimate productivity, regrowth was cut with a machete plot by plot and species by species to approximately 5 cm, 7 cm, 10 cm, and 15 cm from the ground. It should be noted that a uniform cutting was first carried out on the same day as planting, after conditioning, to restore the plants to the same growing conditions. Then, each species was cut three times at 15-day intervals to study the evolution of productivity. Finally, productivity was analyzed by examining the weight of the grass harvested at each cutting in each plot.

Mowing height and frequency

Four secondary treatments based on mowing height were carried out at: 5 cm, 7 cm, 10 cm and 15 cm, depending on the mowing frequency at 30, 45 and 60 days, and four replicates. The harvested forage will be immediately weighed using the aforementioned electronic scale to determine the fresh biomass. All plants were then cut on the same day each time to allow for the assessment of biomass productivity.

Parameters to observe

- ✓ The survival rate of each herbaceous species after 14 days of planting;
- ✓ The relative speed of regrowth after each successive mowing;

Data processing and results analysis

The data from this investigation were grouped according to their nature (variables) and compiled in a table using Microsoft Excel. The means of the different parameters were subjected to a two-way analysis of variance (ANOVA) at a significance level of 5%. using GraphPadPrism5 software. And in case of significant difference, the Bonferroni post hoc test was applied to detect treatments that differ from each other.

Results

The expected results of this investigation will be the knowledge of:

- ✓ The success rate will be determined 15 days after planting;
- ✓ The rate of regrowth will be known after repeated mowing;

RESULTS

Presentation of Results

The results are presented in the form of graphs relating to the production of each forage species after cutting, and the recovery rate during the dry season.

Dry Season

a. Recovery rate

The following figure shows the recovery rate of the different forage species during the dry season after successive cuts.

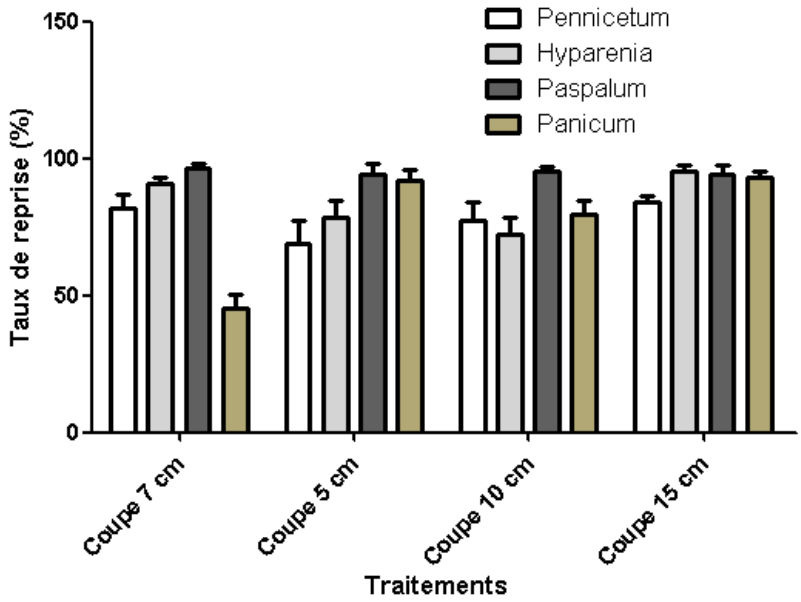

Figure 2. Evolution of the recovery rate (%) of different forage species

Figure 2 above shows that after cutting, the forage species behaved differently. It shows that *Paspalum chevalierii* regenerated well at all cutting heights, followed by *Panicum maximum* at cutting heights of 5, 10, and 15 cm, and *Hyparrhenia diplandra* in third place, while *Pennisetum purpureum* came in last. The two-way ANOVA (forage species and cutting height) showed differences in regeneration between the forage species with respect to cutting height (P=0.0001). However, the Bonferroni post-hoc multiple test showed highly significant differences between *Pennisetum purpureum* and *Panicum maximum, Hypparhenia diplandra* and *Panicum maximum*, *Paspalum chevalierii* and *Panicum maximum* at a cutting height of 7 cm (P=0.0001); highly significant differences between *Pennisetum purpureum* and *Paspalum chevalierii, Pennisetum purpureum* and *Panicum maximum* at a cutting height of 5 cm, as well

as between *Hypparhenia diplandra* and *Paspalum chevalierii* at a cutting height of 10 cm (P=0.001); significant differences between *Pennisetum purpureum* and *Paspalum chevalierii* at a cutting height of 10 cm (P=0.01). However, for the remaining plants, no differences were found between the forage plants at any cutting height (P>0.05).

b. Regrowth rate between 30-45 days

The growth rate of forage species between 30 and 45 days is shown in Figure 3 below.

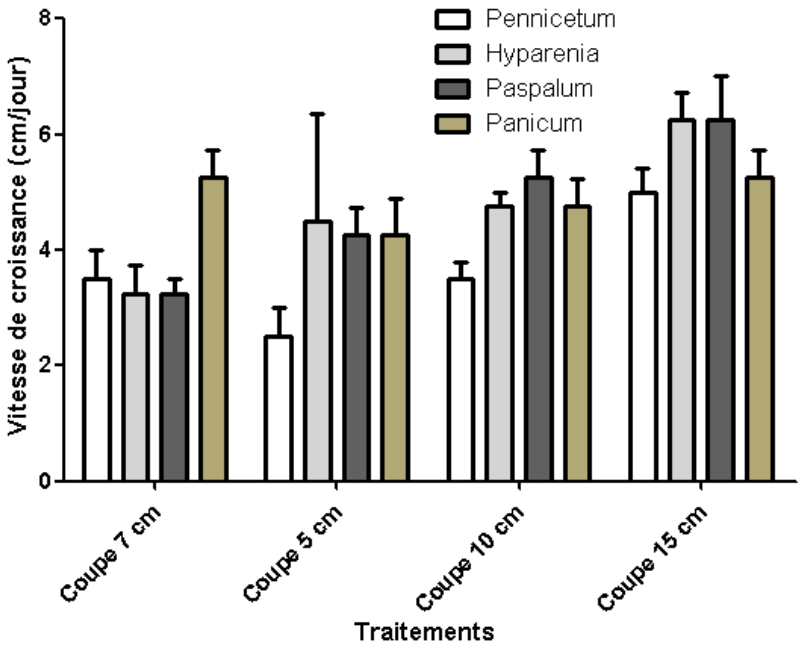

Figure 3. Growth rate of forage species between 30 and 45 days (cm/day)

Figure 3 shows that *Panicum maximum, Paspalum chevalierii*, and *Hypparhenia diplandra* performed better at cutting heights of 10 and 15 cm than the others, exhibiting a slightly higher growth rate. However, these numerical differences were not confirmed by statistical analysis (P>0.05).

Discussion

Effect of the survival rate of forage species 14 days after planting

Better recovery was observed in the forage species *Paspalum chevalierii*, which recovered well at all cutting heights. It was followed by *Panicum maximum*. at cutting heights of 5, 10, and 15 cm, and *Hypparhenia diplandra* came in third, while *Pennisetum purpureum*. brought up the rear. During the rainy period, the recovery rate was almost identical among the different species tested, although there were numerical differences between them. However, statistical analysis only confirmed differences between species. *Pennisetum purpureum* and *Hypparhenia diplandra*, too, between *Pennisetum purpureum* and *Panicum maximum* for the cutting height of 15 cm (P=0.01).

Effect of clipping on the regrowth rate of observed species

Regarding regrowth rate, heights of 10 and 15 cm proved more effective for species of *Panicum maximum, Paspalum chevalierii* and *Hypparhenia diplandra*, which behaved well.

The regrowth rate is faster at 10-15 cm than at 5-7 cm.

CONCLUSION AND SUGGESTIONS

This study aims to evaluate the effect of different cutting heights on the recovery and regrowth rate of some forage grass species in Kindu, including *Pennisetum purpureum, Panicum maximum, Hyparrhenia diplandra* and *Paspalum chevalierii*. Cutting height has a significant effect on recovery and regrowth rate of forage grasses.

The results obtained can be summarized as follows:

- Better recovery was observed in the forage species *Paspalum chevalierii* which recovered well at all cutting heights, followed by *Panicum maximum* for cutting heights of 5, 10 and 15 cm and *Hypparhenia diplandra* comes in third position, while *Pennisetum purpureum* closes the way.
- Regarding regrowth rate, heights of 10 and 15 cm proved more effective for species of *Panicum maximum, Paspalum chevalierii* and *Hypparhenia diplandra*, which behaved well.

In light of the above, we suggest:

- ✓ Researchers should continue their research on other forage species and over a longer period to strengthen these results;
- ✓ Raising awareness among livestock farmers about responsible pasture management;
- ✓ Adopt a cutting height of 10-15 cm for the grasses studied in Kindu.

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