Open Access Library Journal
2021, Volume 8, e8042
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Evaluation of Improved and Selected Brachiaria Grass Cultivars in DRC

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How to cite this paper: Katunga, M.M.D., Tshikoly, M., Bofunga, L.M., Ngona, D., Balemirwe, K.F., Mushagalusa, B., Nshokano, M.P. and Mugisho, N.P. (2021) Evaluation of Improved and Selected Brachiaria Grass Cultivars in DRC. *Open Access Library Journal*, **8**: e8042.
https://doi.org/10.4236/oalib.1108042

Received: October 2, 2021
Accepted: December 27, 2021
Published: December 30, 2021

Abstract

Food security has become a major concern in DRC. Animal production decreases dramatically due to wars while still managed in an extensive system. Productivity is low due especially to low diseases control, lack of animal feed and low extension services. Meanwhile, the DRC has a huge agricultural potential characterized by sufficient rainfall, a major river system, a high diversity of soils and broad sunshine. To contribute to face this malnutrion, three Brachiaria varieties: *B. decumbens* CV. Basilisk, *B. brizantha* (CVs. Xaraes, Piatã) and two controls: *Pennisetum purpureum* and *Brachiaria ruziziensis* were evaluated in the multi-location trials in Nioka and Mulungu in Randomized Complete Block Design with 4 replications. Space between replication was 1m. Basal manure was applied at 8 t/ha in both sites. After land preparation, each hole received one plantlet of forages evaluated. Parameters observed every 4 weeks in the plot randomly placed over the 2 central rows during one year were: pests and diseases attacks; number of tillers; plant height. To assess the dry matter yield, cutting was randomly placed over the 2 central rows of the herbage every 8 weeks. Harvested fresh material was weighed and sub-sample (400 g) collected and dried at 105˚C for 48 hours for dry weight determination. Data were analyzed by Statistix 0.8 software. Results showed that pests and diseases attacks were not significantly important for all the forage species and cultivars. Brachiaria Cultivars' evaluation showed successively that the two best forages based on a number of tillers were *B. decumbens* CV. Basilisk 78.4 and *B. ruziziensis* 54.5, on the height there were *P. purpureum* 279.7 cm and *B. brizantha* CV. Piata, 100.9 cm and

on weight biomass *B. decumbens* CV. Basilisk 3320.3 Kg DM ha^{-1} and *P. purpureum* 3175.5 Kg DM ha^{-1}. The two other Brachiaria Cultivars introduced can be also recommended to the farmers according to their good yield.

Subject Areas

Agricultural Science

Keywords

Forages, Brachiaria, Adaptation, Growth, Yield

1. Introduction

Located in Central Africa, the Democratic Republic of the Congo (DRC) has 2.345.409 km^2 of national territory, 71.712.867 inhabitants with 65% in the rural area. Rate of population increasing is 3.5% per year. Contribution of agriculture to GDP is 43% in 2009 [1] and as proportion of livestock GDP 9.2% [2]. Major livestock species and their numbers are: cattle 755,500, sheep 900,470, goats 4,027,950, swine 961,090 chickens and 19,080,437 [3].

Mulungu soils are from recent volcanic eruption with pH (water) 5.2, K (EXK100G) 0.4, Ca (EXK100G) 7.5 [4] when in Nioka, soils origin is from granite [5]. Food security has become a major concern for the entire population in DRC. This is particularly the case of animal proteins and crops which are not enough to nourish people. Animal production decreases considerably due to recent wars while it remains managed in an extensive system [4]. Productivity is low due especially to low diseases control, lack of animal feed and low extension services [6]. Meanwhile, the Democratic Republic of the Congo has a huge agricultural potential characterized by sufficient rainfall, a major river system, a high diversity of soils and broad sunshine [7]. Despite this importance, in South Kivu, consumption of red meat, pork and chicken was low in all Mandate Areas with an exception of Ruzizi plains where the average consumption frequency of red meat was 4 times a month [8].

To contribute to facing the problems of lack of animal proteins in DRC, Bec'A-ILRI decided in this work to reintroduce in Sud-Kivu and Ituri provinces, some cultivars of improved brachiaria from CIAT in South America.

2. Materials and Methods

Treatments: The Brachiaria in this evaluation included three varieties: *B. decumbens* CV. Basilisk, *B. brizantha* (CVs. Xaraes, Piatã) and two controls; Napier grass *Pennisetum purpureum* (*P. purpureum*) and *Brachiaria ruziziensis* (*B. ruziziensis*) were evaluated in the multi-location trials in Nioka, Mahagi territory, Ituri province and at Mulungu in Kabare territory, Sud-Kivu province. Nioka is located in North Hemisphere while Mulungu is in South Hemisphere of DRC.

Design: Randomized Complete Block Design with 4 replications.

Plot size: 4 m × 5 m = 20 m^2 (10 rows per plot), the space between replication was 1 m.

Basal fertilizer: Manure was applied at 8 ton/ha in both sites.

Land preparation: Plough and harrow the land twice to a fine tilth. All other grasses were eliminated by weeding using hand hoe.

2.1. Forages Establishment Phase

Sowing/transplanting: was done with more than 4 seeds per hole. In Mulungu site, sowing was done in June, 2017, the seedling emergence was observed in August, 2017. In Nioka, sowing was done in December, 2018, seedling emergence observed in January, 2018. After the seedling's emergence was observed, all the holes were planted and only one plantlet per hole was kept in all the sites. Following parameters were observed every 4 weeks in the plot randomly placed over the 2 central rows during one year:

Pests and diseases: Assess pests and diseases incidences;

Number of tillers: Number of tillers was counted per plant from 4 plants within the 1 × 1 m;

Plant height: Height of 4 plants within the 1 × 1 m frame.

2.2. Forages Production Phase

Dry matter yield: Cutting was randomly placed over the 2 central rows every 8 weeks the herbage from 1 × 1 m^2 net harvest area. Cutting regulation in Nioka was done in May 2019 and harvest times from November 2019 to September 2020. In Mulungu the cutting regulation was done in November 2019 and harvest times were from January 2020 to November 2020. In both two sites, cuttings were done every 8 weeks for one year. Harvested fresh material was weighed and sub-sample (400 - 500 g) collected and dried at 105˚C for 48 hours for dry weight determination. Data were analyzed by Statistix 0.8 software.

3. Results

3.1. Seedling Emergence

The rates of seedlings emergence were generally good in Mulungu than in Nioka. At all, 100% of holes were planted with one plantlet per hole (Table 1).

Table 1. Rates of seedling emergence.

Species and Cultivars	Repetitions/Nioka					Repetitions/Mulungu				
	1st rep.	2nd rep.	3rd rep.	4th rep.	Mean rate	1st rep.	2nd rep.	3rd rep.	4th rep.	Mean rate
B. decumbens CV Basilisk	69	52	72	72	66	100	100	100	100	100
B. brizantha CV Piata	96	90	78	84	87	85	100	89	85	90
B. brizantha CV Xaraes	75	96	95	95	90	100	100	82	100	96
P. purpureum	97	97	91	98	96	100	100	100	100	100
B. ruziziensis	75	46	74	80	69	100	100	100	100	100

3.2. Insects and Diseases Attacks

The means of insect and diseases attacks were not important for all the forage species and Cultivars (Table 2).

3.3. Number of Tillers

The number of tillers was respectively in ascendant order *B. decumbes* CV. Basilisk (BdecBasili) 78.4, *B. ruziziensis* (Br) 54.5, *B. brizantha* CV. Xaraes (BbrizXarae) 38.4, *B. brizantha* CV. Piata (BbrizPiata) 38.2, and *P. purpureum* (Pp) 35.9 (Figure 1).

There was significant difference ($P < 0.001$) between the means of forage species and Brachiaria Cultivars tiller numbers.

According to the sites, Mulungu realized a mean of 60.4 tillers when Nioka had only 29.2 tillers (Figure 2). There was significant difference ($P < 0.001$) between the means of the number of tillers in the sites. Mulungu counted many tillers than Nioka.

Table 2. Insects and diseases.

	Nioka				Mulungu			
	Insect inci*1	Ext insect d*2	Dise inci*3	Ext disease*4	Insect inci*1	Ext insect d*2	Dise inci*3	Ext disease*4
B. decumbens CV Basilisk	0	0	0	0	0	0	0	0
B. brizantha CV. Piata	0	0	0	0	0	0	0	0
B. brizantha CV. Xaraes	0	0	0	0	0	0	0	0
P. purpureum	0	0	0	0	0	0	0	0
B. ruziziensis	0	0	0	0	0	0	0	0

Insect inci*1 = insect incidence, Ext insect d*2 = extent of insect damage, Dise inci*3 = disease incidence and Ext disease*4 = extent of disease.

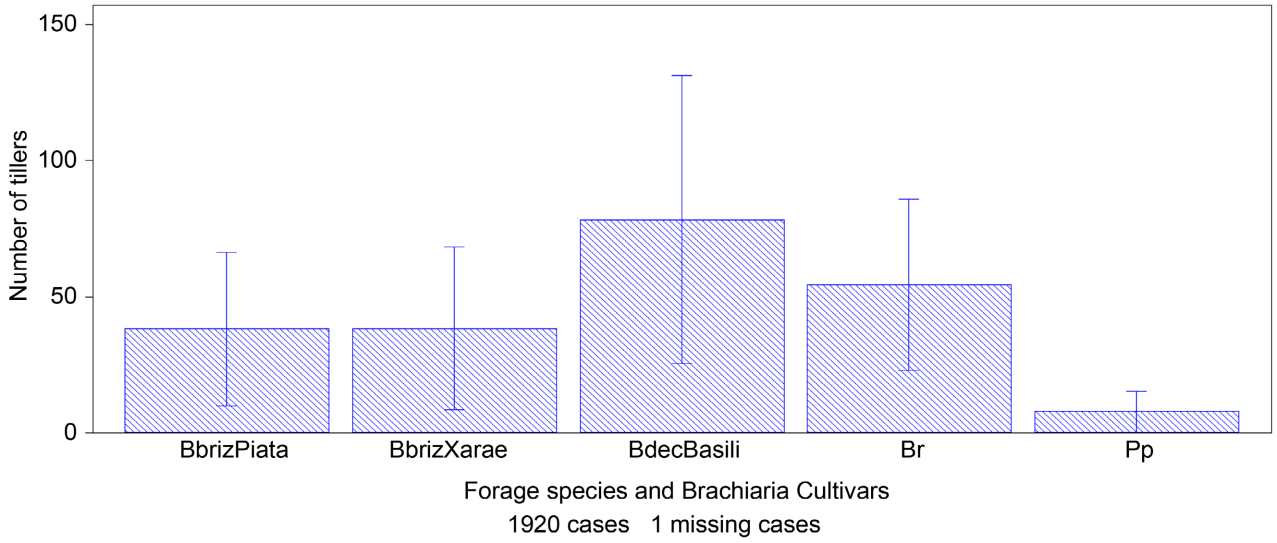

Figure 1. Forages species and brachiaria cultivars number of tillers.

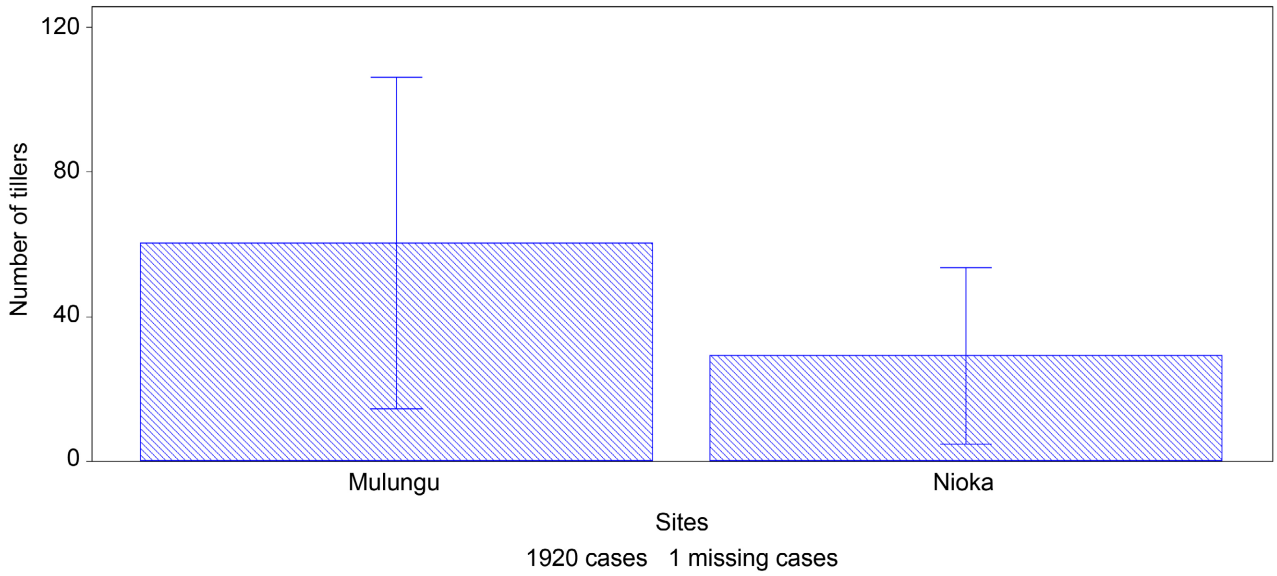

Figure 2. Number of tillers per site.

3.4. Forages Height

Heights presented in ascending order were for the tallest *P. purpureum* 279.7 cm followed by *B. brizantha* CV. Piata 100.9 cm, *B. decumbens* Basilisk 96.7 cm, *B. brizantha* CV. Xaraes 92.8 cm and *B. ruziziensis* 54.5 cm (**Figure 3**).

There was significant difference ($P < 0.001$) between the height means of the forage species and Brachiaria Cultivars in Nioka than in Mulungu site, *Pennisetum purpureum* was the tallest.

There was no significant difference between the means heights ($P > 0.05$) by the Student's t-test of heights forage species and Cultivars between the two sites.

3.5. Dry Matter Yield

Means dry matter of the forage species and Brachiaria Cultivars were significantly different $P < 0.0001$ between the means of forages and Brachiaria Cultivars respectively in ascendant order for *B.* CV. *decumbens* Basilisk 3320.3 Kg DM ha^{-1}, *P. purpureum* 3175.5 Kg DM ha^{-1}, *B.* CV. *brizantha* Piata 2914.5 Kg DM ha^{-1}, *B. brizantha* CV. Xaraes 2837.5 Kg DM ha^{-1} and *B. ruziziensis* 1677.7 Kg DM ha^{-1} (**Figure 4**). These results showed that the high weight of biomass was recorded by *B. decumbens* CV. Basilisk followed by *P. purpureum*.

Compare to the sites, there was a highly significant difference $P < 0.0001$ between the means of dry matter yield of forages and Brachiaria Cultivars in the sites. Mulungu site recorded to produce more biomass 3064.8 Kg DM ha^{-1} than Nioka with 2505.4 Kg DM ha^{-1} (**Figure 5**).

4. Discussion

4.1. Insects and Diseases Attacks

Pests and diseases attack don't have a negative influence on the development of

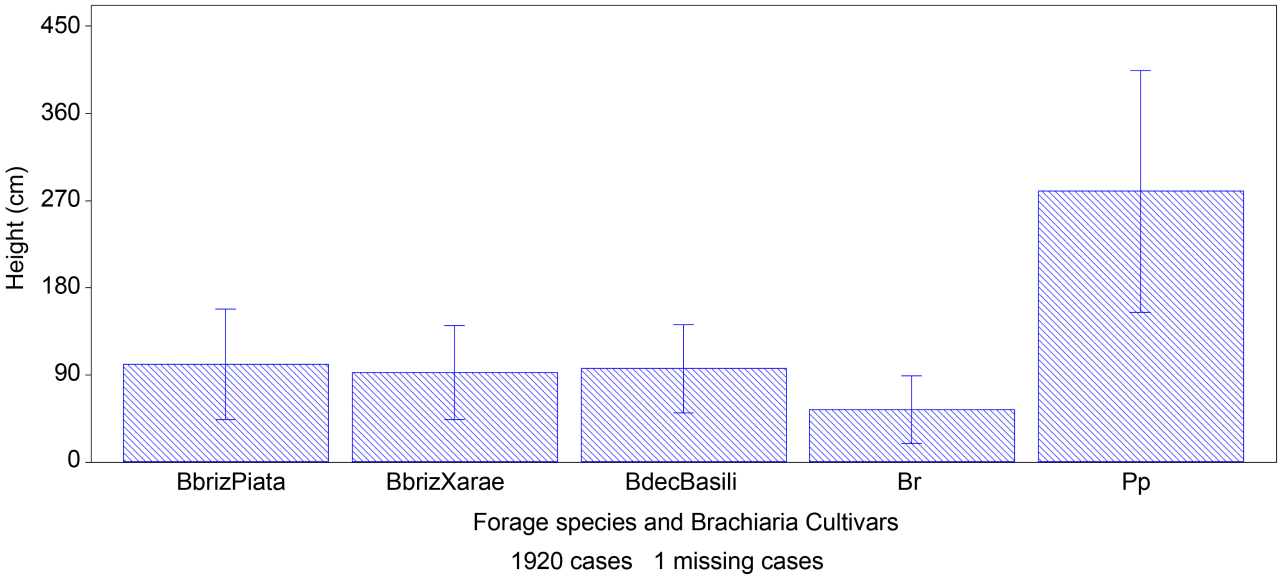

Figure 3. Forages height.

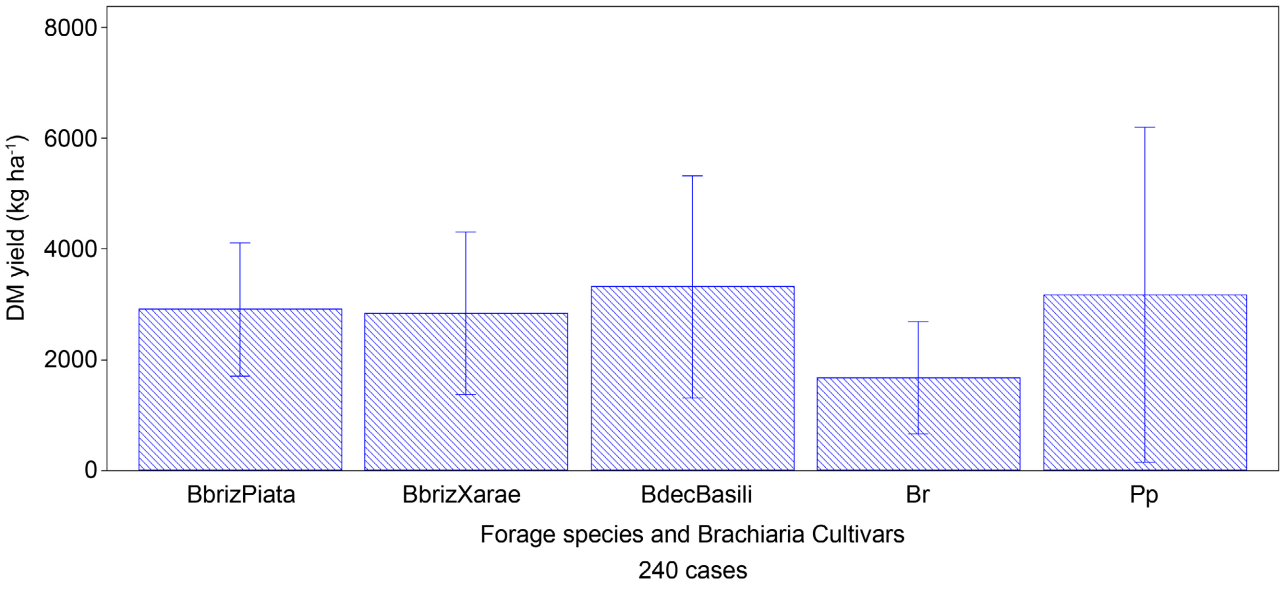

Figure 4. Forages dry matter yield.

the forages observed. However, according to the monthly observations some nematodes attacked especially the leaves of *Brachiaria ruziziensis* and in certain conditions *B. decumbens* CV. Basilisk, *B. brizantha* CV. Piata, *B. brizanha* CV. Xaraes. Only *P. purpreum* resisted to these attacks. [9] observed that red spider mites attacked the underside of the leaves while the grass midge and shoot fly attacked the young growing tillers.

4.2. Number of Tillers

B. decumbens CV. Basilisk had the big number of tillers, 78.4 followed by *B. ruziziensis* with 54.5. In Brazil, *B. decumbens* CV. Xaraes had 41.5, *B. brizantha*

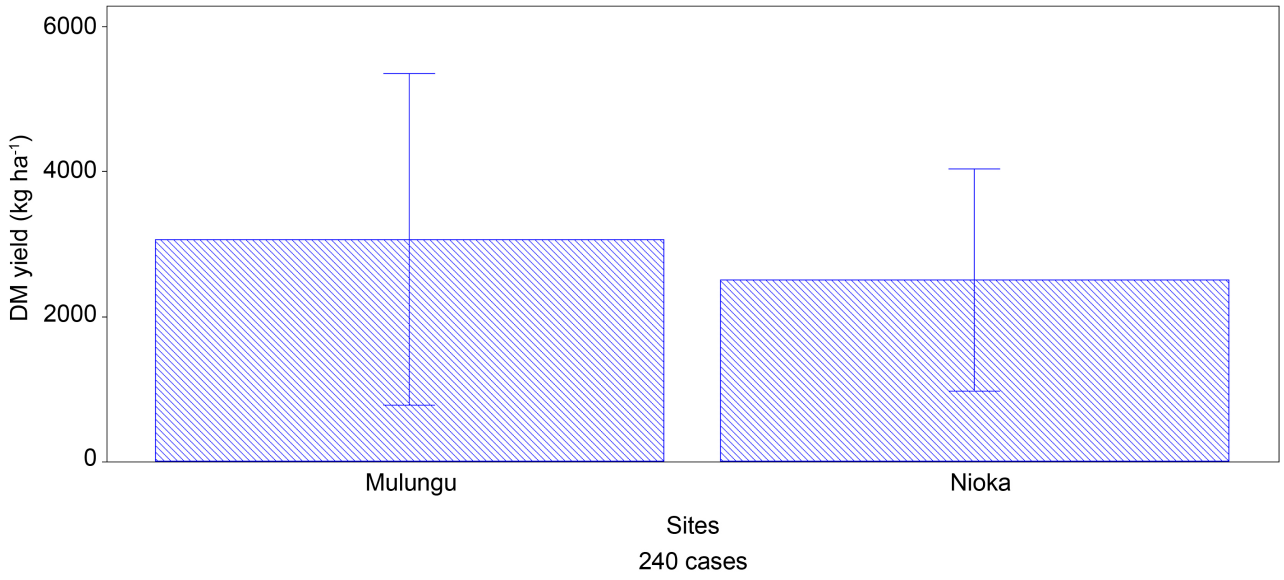

Figure 5. Forages dry matter per site.

CV. Piata 48.7 and *B. ruziziensis* had 46.5 [10]. The number of tillers compared to the sites, Mulungu had the big number than Nioka.

4.3. Height

The tallest forage was *P. purpureum* in both the two sites even if there were any differences of heights between the sites. At 8 weeks after emergence, [11] observed that *P. purpureum* 9.2 cm was tallest followed in ascendant order by *B. brizantha* CV. Xaraes 5.3 cm, *B. decumbens* CV. Basilisk 4 cm and *B. brizantha* CV. Piata 3.5 cm.

4.4. Dry Matter Yield

B. decumbens CV. Basilisk produced more dry matter yield in all the sites and was followed by one of the control *P. purpureum*. In Rwanda *P. purpureum* produced 17.2 t DM ha^{-1} under legume intercropping and mulch on yield [12] which is so high than in DRC where we observed 3.2 t DM ha^{-1}. [10] observed that the dry matter yield after mineral fertilizer application on *B. decumbens* CV. Xaraes was 11,636 kg DM ha^{-1}, *B. brizantha* CV. Piata 6708 kg DM ha^{-1}, *B. ruziziensis* 8940 kg DM ha^{-1}. Various dry matters yields were observed in Msabaha (Kenya) on *B. decumbens* CV. Basilisk 3700 kg DM ha^{-1}, Brazil, *B. decumbens* CV. Xaraes 2000 kg DM ha^{-1}, *B. brizantha* CV. Piata 2600 kg DM ha^{-1}, they were rather less than those implemented in DRC [13].

5. Conclusions

Results of Brachiaria Cultivars evaluation in DRC showed that based on number of tillers *B. decumbens* CV. Basilisk was the first. According to the height, the three cultivars introduced followed *P. purpureum*. The high weight of biomass was recorded on *B. decumbens* CV. Basilisk followed by the control *P. purpu-*

reum.

The two other Brachiaria Cultivars can also be recommended to the farmers according to their good yield.

Acknowledgements

We thank the Swedish International Development Cooperation Agency (SIDA) who funded this research via Bec'A-ILRI Hub. Special thanks are also addressed to Dr Sita Ghimire who chose INERA to implement this research in DRC. As a leader of the project, he monitored and evaluated all activities and revised the manuscript of this paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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