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Evaluation of the performance of the three bean varieties (d6, mu mwema and mlb oo7) at bushman, western coast of lake kivu.

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ABSTRACT

The main objective is to evaluate the productivity performance of these three varieties of common beans in bushumba, north kabare. The results show that: these three varieties d6, mlb007 and muke mwema have same collar diameter and same plant height. Concerning pods, d6 and mlb007 bean varieties have a hight of number of pod per plant (6) than muke mwema bean variety (5). The bio fortified bean mlb007 has highly weight than d6 and muke mwema beans varieties. The number of seeds per pod is the same for these three varieties (d6, mlb007 and muke mwema), as the hundred grain weight, the plot weight and the grain yield. The number of seeds per pod is the same for these three varieties (d6, mlb007 and muke mwema), as the hundred grain weight, the plot weight and the grain yield.

KEYWORDS: fortified organic beans, malnutrition, Kabare, legume and bean varieties.

1 INTRODUCTION

More than 2 billion people in the world, one in three, have a deficiency of essential vitamins and minerals (micronutrients) vitamin A, zinc and iron in their diets. This situation is called "invisible hunger" because those who suffer from this form of malnutrition often seem healthy, but are still more vulnerable to diseases and infections. In the most severe cases, invisible hunger can cause blindness, stunting, or IQ drop, and can increase the risk of a woman dying during childbirth (HaverstPlus, 2015).

Legumes are very important from a dietary point of view because they have very high levels of protein and fat. These crops, including beans, peas, soybeans, cowpeas, etc., are a very important source of protein and fat for the less affluent populations who cannot easily obtain protein (Raemaeckers 2001, Nyabyenda 2005).

Common bean is the world's largest food legume, and is widely consumed in Africa where it can be an extremely productive crop. Millions of Africans suffer from iron deficiency or iron deficiency anemia. In infancy, during childhood and during adolescence, this deficiency hinders physical growth and endurance, mental development, as well as learning abilities. For more than 300 million people, beans play an important role in the diet, especially in the Mesoamerican and South American regions as well as in Africa. Improved varieties of high

iron beans can help reduce iron deficiency in African regions where daily bean consumption is high (HaverstPlus, 2009).

The bean, the oldest crop in the Tropical Regions of Altitude of Africa (RTA), is a typically high altitude plant. It is grown mainly in the highlands of Ethiopia, Democratic Republic of Congo, Burundi, Tanzania, Uganda and Rwanda. Although it is 88% produced in the region, beans do not have the same dietary importance as soybeans (Nyabyenda, 2005).

A varied diet consisting of nutritious foods such as vegetables, including green and leafy vegetables, fruits and animal foods is the ideal way to provide the micronutrients needed to maintain good health. The most nutritious foods are often expensive or simply unavailable. Biofortified crops developed by HarvestPlus and its partners, such as beans, are grown using traditional methods, are high yielding and are resistant to threats such as pests, diseases, heat and drought (HarvestPlus 2015).

According to HarvestPlus (2009), in the Great Lakes countries of Central Africa, on the one hand, more specifically in Rwanda, the daily consumption of beans is lower with 200 g per habitant, and the prevalence of anemia among preschool children is almost as high (33%), half of which is caused by iron deficiency in the diet. And on the other hand, in the Democratic Republic of Congo (DR Congo), in the eastern provinces of North and South Kivu that is consumed mainly beans. This consumption is estimated at 300 g per inhabitant per day. The prevalence of anemia among preschool children is 36% in North Kivu and 47% in South Kivu. In addition, Raemeakers (2001) shows that the bean in its culture, it is usually subject of a leaf stripping, intensified practice in the Great Lakes region of Central Africa in general and in South Kivu precisely in Kabare. The purpose of this leaf stripping is mainly to get salads, but also under certain growing conditions, to improve the yield. Common beans are one of the most widely grown legumes and their importance in human nutrition is well established.

However, Nyabyenda (2005) shows that research on beans is advanced compared to other crops. Indeed, this research focuses mainly on varietal selection, the study of diseases and pests and their control, as well as in the study of cultural techniques. Research on cultivation techniques focuses mainly on sowing patterns and densities, crop combinations, fertilization, biological nitrogen fixation, sowing techniques, and varietal production.

Zaharia (2002) shows that a good knowledge of the varieties is necessary: the hardiness compared to the diseases, the precocity and the height of the plants, the behavior with respect to the climatic hazards, the bakery value, the taste aspects, etc. To obtain this knowledge, farmers rely as much on their practical experience as on the information they have at their disposal about varieties. However, there are various approaches to choice of varieties: the choice of varieties from a farm trial, the cultivation of mixed or pure varieties, the random sowing of the follow-up of an evaluation and the selection on the farm and the directed crossing between varieties considered interesting.

The production of beans in the study area in Bushumba, North Kabare often faces several constraints. Farmers without training and an agricultural social regrouping use ancestral cultural methods: no protection of the soil; no improved seeds; no management by

agronomists. Based on these constraints, it is important to mention the lack of improved genetic material. However, several varieties of "fortified organic" beans are being introduced, but their studies are still rare in this area in Bushumba, North Kabare and surroundings as the case of the *MLB OO7* fortified organic bean variety. Indeed, these varieties *D6* and *Muke mwema* are the most cultivated by smallholders in the Bushumba environment and its surroundings, but the comparison of their productivity has never been studied.

Indeed, what is the yield of these three varieties of beans? Which of these three varieties will provide high production in the study environment? The three varieties of beans would provide high production in the Bushumba environment. There would be one of these three varieties that will have high production in the study environment.

The main objective is to evaluate the productivity performance of these three varieties of common beans in Bushumba, North Kabare by determining their grain yields and also, by identifying which one provides high production in the study area environment.

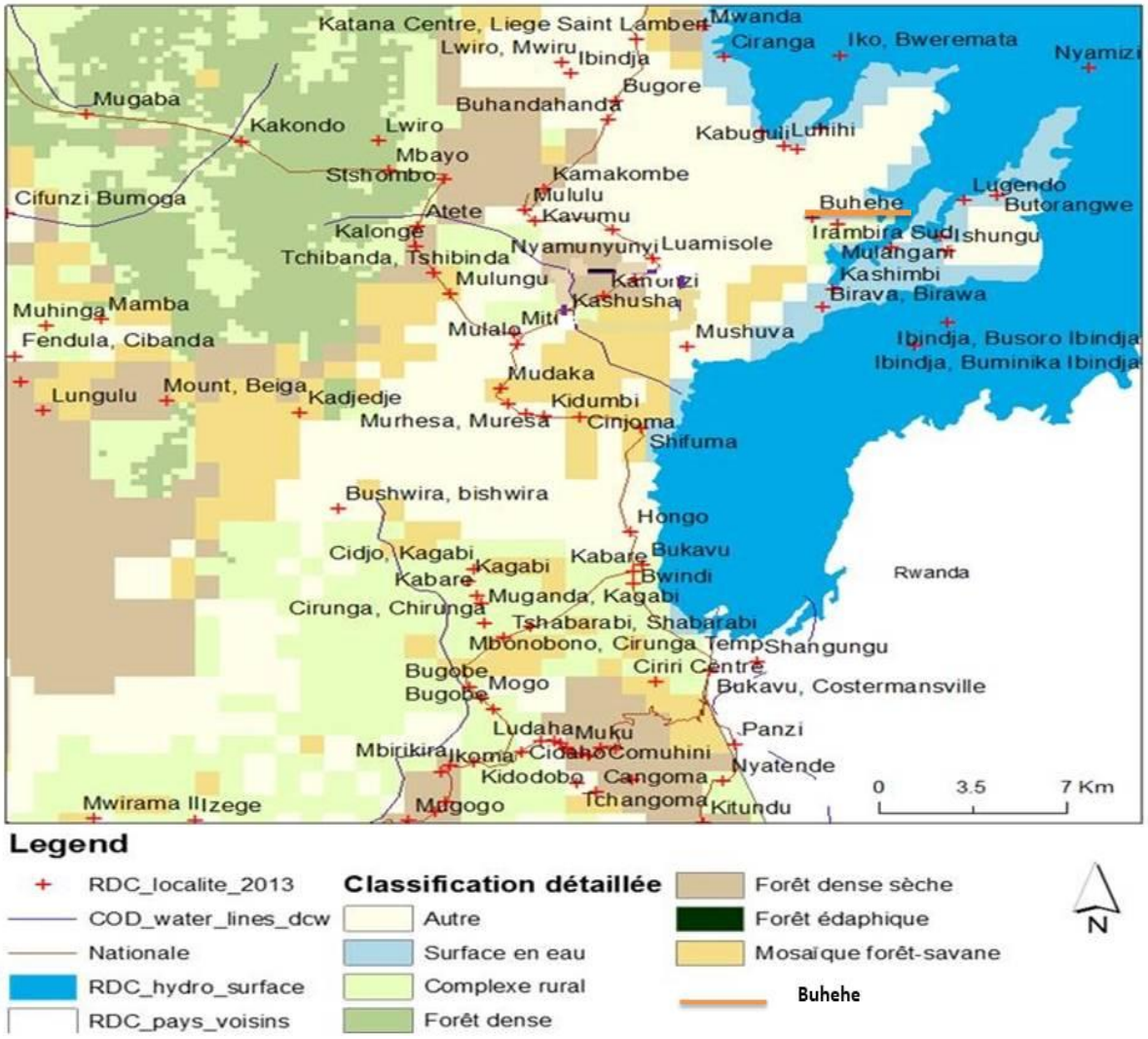
2 MATERIAL AND METHODS

2.1. STUDY ENVIRONMENT

The study concerns Bushumba (97 Km^2) which is part of 14 groupings that counts the territory of Kabare, and is located about 30 km from Bukavu, province of South Kivu. Bashumba is administratively constituted of 6 localities officially recognized by hierarchy: Bushumba centre, Murama-muganzo, Buhehe, Cishoke I, Cishoke II and Lwangoma.

The experiment was conducted in the area of Mushweshwe, located at 28 ° 33 '32" East longitude and 2 ° 18' 58 " South latitude, at 1534 m altitude, in the locality of Buhehe, Bushumba, territory of Kabare. The Mushweshwe estate is 15 km from Katana and 7 km from Birava. It is bordered with Luhihi on the North, the village of Nyabulongwe on the West and South and the village of Buhehe on the East. The Figure 1, below illustrates the study environment area, Buhehe pointed out.

Figure 1. Map of Kabare territory: Area of Study Buhehe (Atlas Forestier de la RDC, 2013)



2.2. MATERIAL

The common bean (Phaseolus vulgaris) is the biological material of the work. The varieties used in this study are D6, Muke mwema and MLB OO7. The characteristics of the varieties are presented in Table 2.

Table 2. Characteristics of the bean varieties *D6, Muke mwema* and *MLB OO7* (INERA, 2006)

Parameters	**Varieties of beans**		
	Muke mwema	***D6***	***MLB OO7***
	Main morphological characters		
Plant port	IIIa	-	-
Type of growth	Indeterminate	-	-
Leaf color	Green very light	-	-
Redness of the trifoliate leaf	average	-	-
Terminal leaflet shape	Rounded	-	-
Ripe pod color	Purple	-	-
Color of the seed	Red	-	-
Duration semi-flowering (days)	40-42	-	-
Duration semi-mature (days)	85-90	-	-
Parameters	**Main agronomic traits**		
Weight of 100 seeds (g)	222-300	-	-
Mineral content	Fe (75 ppm) ; Zn (31 ppm)	-	Fe (72 ppm)
Yield (Kg/ha): • In a controlled environment • In real life	 1000-1400 500-1000	-	 1200-1500
Resistance to diseases	Ascoschytosis, Antrachnosis, Rust, BCMV	-	-
Resistance to insects	User appreciation	-	-
Good color of the seed, productivity, cooking and good taste		-	-

3. METHODS

The experimental method Random Block was used during the cultivation season A, from September 29, 2017 to December 27, 2017 for the realization of the present research.

2.3.1. Experimental device

The Random Block device was used and the ground divided into 3 plots (treatments) for each repetition. This experimental device has 6 repetitions and each of its repetitions having 3 plots. The experimental device has 18 plots. Each plot has a dimension of 2 x 1.5 m or 3 m^2 distant of 40 cm between the lines and in the lines. Each block and each column contains all the treatments. The useful surface is 12, 80 x 10.4 m is 133.12 m^2 and the total area is 14.80 x 12.4 m or 183.52 m^2.

2.3.2. Conduct of the experimental

The sowing took place on September 30, 2017, when 97% of the seeds germinated in each plot. The diameter at the collar (cm) was taken from 1 month after sowing on October 30, 2017. Fifteen plants were measured using a caliper; inside the parcel without take into account the plants of the border. In addition, the plant height (cm) was taken from 1 month also. Fifteen plants were measured using a slat graduated in cm. These plants were chosen from the interior of the plot without considering the plants in the border. Harvesting occurred on December 27, 2017. The number of branching per plant was manually counted as the number of seeds per pod. The hundred grain weight (g) was measured using a precision balance (METTLER TELEDO) while the plot weight (Kg) was measured using a kitchen scale (Bron -Coucke BM20). The grain yield ($t.ha^{-1}$) was obtained by calculating the ratio of weight to plot area.

2.3.3. Data analysis

Data encoding was done on the laptop using Microsoft Office Excel 2010 and analysis by Sigma Plot 12.0 software. The analysis consisted of the one-way variance test (ANOVA I) and the Fisher LSD Method at p-value 5 % for the comparison of means.

3 RESULTS AND DISCUSSION

3.1.1. Results of vegetative parameters

The collar diameter and plant height are presented in table 3.

Table 3. Mean ± standard and summary of variance analysis mean ± standard deviation

Bean varieties	**Vegetative parameters**	
	Collar diameter (cm)	**Plant height (cm)**
	Means ± Standard deviation	
D6	0.3096 ± 0.015	21.15 ± 0.281
MLB007	0.335 ± 0.044	20.96 ± 0.577
Muke mwema	0.303 ± 0.015	21.26 ±0.341
DF	17	17
F	2.153	0.785
p	0.151	0.474
Power of performed test with alpha (5 %)	0.208	0.049
Signification	NS	NS

NS: Not Significant

Statistical analysis showed that plant height as the collar diameter respectively of the three varieties *D6, MLB007* and *Muke mwema* (Table 3) had not significantly (p 0.474 as p 0.151 respectively) affected at experimental site. However, these three varieties *D6, MLB007* and *Muke mwema* have same collar diameter and same plant height.

3.1.2. Results of production parameters

The results of number of pods per plant, number of seeds per pod, hundred grain weight, plot weight and grain yield are reported in table 4.

Table 4. Mean ± standard and summary of variance analysis mean ± standard deviation

Bean varieties	Vegetative parameters				
	Number of pod	Number of seeds per pod	Hundred grain weight (g)	Plot weight (Kg)	Grain yield ($t.ha^{-1}$)
	Means ± Standard deviation				
D6	6 ± 0.632	3 ± 0.516	27.0944±9.5397	1.661±0.069	0.1337 ±0.089
MLB007	6 ± 0.408	3 ± 0.516	30.202±9.9948	1.921±0.002	0.054 ±0.0470
Muke mwema	5 ± 0.408	3 ± 0.516	30.144±13.5238	1.639±0.196	0.05467± 0.0137
DF	17	17	17	17	17
F	8.193	0.000	0.152	10.255	3.663
p	0.004	1.000	0.860	0.002	0.051
Power of performed test with alpha (5 %)	0.883	0.049	0.049	0.952	0.440
Signification	S	NS	NS	S	NS

Pairwise Multiple Comparison Procedures (Fisher LSD Method)					
D6 vs. *Muke mwema*	S	-	-	NS	-
D6 vs. *MLB007*	NS	-	-	-	-
MLB007 vs. *Muke mwema*	S	-	-	S	-
MLB007 vs *D6*	-	-	-	S	-

S: Significant and NS: Not Significant\

Statistical analysis showed that *D6* and *MLB007* beans varieties were significantly (p 0.004) affected pods per plant. The maximum pods per plant were recorded from *D6* and *MLB007* (6 respectively) and 5 for *Muke mwema* bean variety. About the plot weight, statistical analysis showed that the bio fortified bean *MLB007* were significantly (p 0.002) affected weight. However, bio fortified bean *MLB007* has highly weight than *D6* and *Muke mwema* beans varieties.

In addition, statistical analysis showed that numbers of seeds per pod, as the weight of 100 bean seeds, the parcel weight and the yield respectively of the three varieties *D6, MLB007 and Muke mwema* (Table 4) had not significantly (p 0.049 as p 0.440 respectively) affected at experimental site. However, the number of seeds per pod is the same for these three varieties, as the hundred grain weight, the plot weight and the grain yield of beans of varieties (*D6, MLB007* and *Muke mwema*).

3.2. DISCUSSION

3.2.1. Discussion of vegetative parameters

These three varieties *D6, MLB007* and *Muke mwema* have same collar diameter and same plant height. These results are similar to those obtained by Sana (2011) who observed a significant relationship between growth parameters of beans varieties.

3.2.2. Discussion of production parameters

Concerning pods, *D6* and *MLB007* bean varieties have a hight of number of pod per plant (6) than *Muke mwema* bean variety (5). The result was in line with the work of Tafere et al. (2012) who reported that varieties had a higher number of pods per plant, while others varieties had the smallest number of pods per plant. Hassan and Ishaq (1972) found that genotypes varied in their pod number per plant. Pilbeam et al. (1992) also reported that there was a variation between bean varieties for pod number per plant.

The bio fortified bean *MLB007 has* highly weight than *D6* and *Muke mwema* beans varieties. The result was in line with the work of Ashenafi & Mekuria(2015) who reported that the beans varieties do not have the same production potentials

The number of seeds per pod is the same for these three varieties (*D6, MLB007* and *Muke mwema*), as the hundred grain weight, the plot weight and the grain yield. The result was in line with Tafere et al. (2012) who reported that low grain yield bean was harvested. The

causes of these low yields in South Kivu province are many, mainly inappropriate agricultural practices with the consequences of soil exhaustion, disease and climate change (Bouwmeester et al., 2009; Lunze et al, 2012; Kanyenga et al., 2016). Most farmers burn grass during the preparation of land for planting, which can result in the loss of 40 kg N and 10 kg S per hectare in each growing season (Sanginga & Woomer, 2009 ; Civava et al., 2012). This situation is aggravated, on the one hand, by the fact that cultivated lands, especially those on slopes, are increasingly affected by erosion due to massive runoff, which is the major source of degradation and loss of arable land in mountainous Kivu (Masi, 1982). On the other hand, the practice of repeated traditional plowing, on these sloping ground, and the low use of agricultural inputs favor the phenomenon of erosion and the decrease of the production (Razafindramanan et al., 2012). In addition, this continuous degradation of soils is correlated with the lack of effective peasant eco-agriculture technology packages in African peasant agriculture (Pyame, 2015). However, in bean-based agrosystems, the yields of bean seeds (400 to 800 Kg ha^{-1}) are still low (Bouwmeester et al., 2009). Yet research results have shown that more than 2,000 to 3,000 kg ha-1 of kidney beans and 4,000 to 6,000 kg ha^{-1} of twining beans can be produced (Kanyenga et al., 2016). Ecological intensification practices can be a response to the challenges of natural resource degradation and the decline of agricultural production, particularly the systems of no-till cultivation under permanent vegetative mats (AFD, 2006; Razafimbelo et al., 2006; FAO, 2012). This system allows the reduction of runoff due to the presence of dead or living. The high production of biomass, resulting from the return of crop residues left on the surface, allows enrichment in organic matter of the superficial horizon of the soil (Six et al., 2002). This organic material contributes to the maintenance of the soil structure and improves the penetration of water in depth (FAO, 2005; Jiao et al., 2006; Muriel, 2007; Fazle et al., 2010). This system therefore allows the restoration of soil fertility, and consequently the improvement of agricultural production (Razafindramanan et al., 2012). Thus, to increase production, it is important to apply good cultural practices and to use the improved variety (Sallah et al., 2009), because yield improvement can come from a number of plant biological characteristics or cultural practices (Dana, 1978). The introduction of better farming systems and technologies is a particularly important issue, since better productivity does not only mean increased food volume, but also higher compensation and nutrient richness of foods (FAO, 2003) hence a good social and sanitary organization of households thus, the development of the area.

4. CONCLUSION

The number of seeds per pod is the same for these three varieties (*D6*, *MLB007* and *Muke mwema*), as the hundred grain weight, the plot weight and the grain yield. The three varieties of beans provide the same production in the Bushumba environment. The grain yield of these three varieties(*D6*, *MLB007* and *Muke mwema*) is lower because of several constraints. Hoever, smallholder must introduce better farming systems and technologies to increase yield in the study area of Bushumba.

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