Improving Farmers' Profitability, Soil and Water Conservation through an Adapted Tillage Technique: Experiences from the Cultivation of Potatoes in Bamiléké's Hills, Cameroon

Henri Grisseur Djoukeng, Yves Brostaux, Christopher Mubeteneh Tankou, and Aurore Degré

Abstract— **On farms situated on slopes, such as those in the Western Highlands of Cameroon, the implementation of soil and water conservation techniques remains a major concern. The land preparation methods commonly practiced in the Western Highlands agro-ecological zone of Cameroon are ridging along the steepest slopes (RASS) and the flatbed (FB). Field observations showed FB and RASS promote erosion by runoff, thereby compromising some agriculture functions (environmental function, production function and even social function). In order to ensure soil stability and maintain good water quality for rivers, a new land preparation method, tied ridging (TR), was tested. Erosion by runoff tests were conducted with four blocks of three plots on each of the most commonly exploited slopes, namely 11% and 29% gradient. With the main crop in the area (potato, *Solanum tuberosum* L.), the performance of RASS, FB, and TR were compared during crop years 2013 and 2014. The water runoff and sediments were collected per plot and per block after every rainfall. The results showed a significant difference between the FB or RASS and TR in terms of soil loss ($F_{min}(2, 2) = 322.7$, $p = 0.003$), yields ($F(2, 2) = 287.7$, $p = 0.003$), and runoff water ($F_{min}(2, 12) = 2.4x106$, $p < 0.001$). The TR technique generated a 7% increase in seedlings density, a 41% increase in the workforce, and an 81% and 100% increase in yields compared to FB in 11% and 29% slopes, respectively. The TR increased farmer's profitability by 686 US\$.ha^{-1} and 1420 US\$.ha^{-1} over RASS in 11% and 29% slopes, respectively. The TR showed undeniable advantages: for the producer, the stress of additional work was offset by the gain in yields while creating additional job opportunities and improving the conservation of soil and water. Although the technique has several advantages, the provision of financial means for its implementation could be a negative point. Twelve farmers were involved in the experiment. The test results convinced the participants and other curious farmers who adopted the technology during the second experiment.**

Key Words—**Bamiléké, water, erosion, tied ridging**

I. INTRODUCTION

In the Western Highlands of Cameroon, erosion by runoff is a major cause of land and water degradation [1]. Bamiléké's hills cover an area of 3.1 million hectares [2] and according to [3], 51% of this area is occupied by steep slopes (> 25% gradient), where much cultivated land easily loses fertility due to lack of conservation practices. These steep slopes once reserved for grazing and forestry, are now intensively used for food crop production [2]. In this area, 85.4% of farmers remain committed to traditional methods of land preparation namely flatbed (FB) and ridging along the steepest slopes (RASS) that greatly threaten the conservation of soil. Therefore, there is a need to propose remedial guidelines that will enable farmers to adopt tillage methods able to sustainably support productivity of their land [4], [5] and [6]. These two practices promote erosion by runoff and lead to the following consequences: (1) gradual reduction of soil production capacity, (2) income losses to farmers, and (3) pollution and disturbance of rivers.

Until now, studies on erosion in the Bamiléké's hills of Cameroon have been limited and essentially descriptive [7], [8] and [9]. In 1998, [10] have conducted research on erosion from the cultivation of peas (*Pisium sativum* L.) on perpendicular ridging. In 1997, [11] performed tests on erosion by runoff on parallel ridging and discontinuous terraces planted with maize (*Zea mays* L.) on oxisol with 9% and 20% slopes. These tests demonstrated the effectiveness of discontinuous terraces on soil loss and crop yields but have limitations because of the high costs for constructing discontinuous terraces. Currently, the most exploited slopes are 11% and 29%. According to [12] maize and peas are no longer the primary crops found in the Bamiléké's hills. The most common crop in the area is potato (*Solanum tuberosum* L.). Cultivation of potato requires intensive land preparation [13]. Potatoes are a profitable crop for farmers in the Bamiléké's hills because of the high demand from urban populations for fresh tubers [14]. This demand for potato greater today because, in addition to the Cameroonian urban population there is added demand for potatoes from neighboring countries, primarily Gabon and Equatorial Guinea [12]. It is important to design inexpensive technology such as tied ridging (TR) [15] that can help to increase potato yields while reducing the risk of rapid land degradation in order to maintain the sustainability of production systems and rural income.

The overall aim of this study was to introduce TR and evaluate the effectiveness of the three land preparation methods (TR, FB, and RASS) on soil loss, water runoff, and potato yields on 11% and 29% slopes. To our knowledge, this experiment could be the first to assess the overall efficiency of these three soil preparation practices on the steepest slopes in the Cameroonian context. The research was conducted with two specific objectives:

1. Quantify water runoff and soil loss during two cropping seasons, and
2. Assess the economic acceptability of the TR, FB, and RASS techniques on the basis of labor, potato yields, earnings, efficiency, and global performance of each of the three land preparation methods.

II. Materials and Methods

A. Presentation of the Experimental Site

The experiment was conducted during crop years 2013 and 2014 in the village of Méloh in the Fongo-Tongo subdivision found between the geographical coordinates 5°27' to 5°37'N and 9°57' to 10°05'E [7]. This village is one of the largest sites of potato production in the Western Highlands of Cameroon, which is the main food crop production area of the Central Africa sub-region [12].

B. Weather Data from the Experimental Site

A thermometer and a rain gauge were installed at the experimental site to collect climatic data (temperature and precipitation). Each year, these data were recorded every day during the growing season from March 1 to August 31.

During 2013 and 2014, 985.5 and 1057.3 mm (38.78 and 41.62 in) of rainfall were recorded respectively. In total there were 97 days and 109 days (for 2013 and 2014 respectively) in which there was at least one period of rain over the 24 h period (Fig. 1). Runoff was observed on 44 and 53 days (for 2013 and 2014, respectively) with rainfall. Over the two years, average temperatures varied very little and oscillated between 16.3°C (61.34°F) in August and 20.3°C (68.54°F) in April. The months of May and August received the most rain, with 239 and 234.6 mm (9.41 and 9.24 in) of rain for 2013 and 2014 respectively.

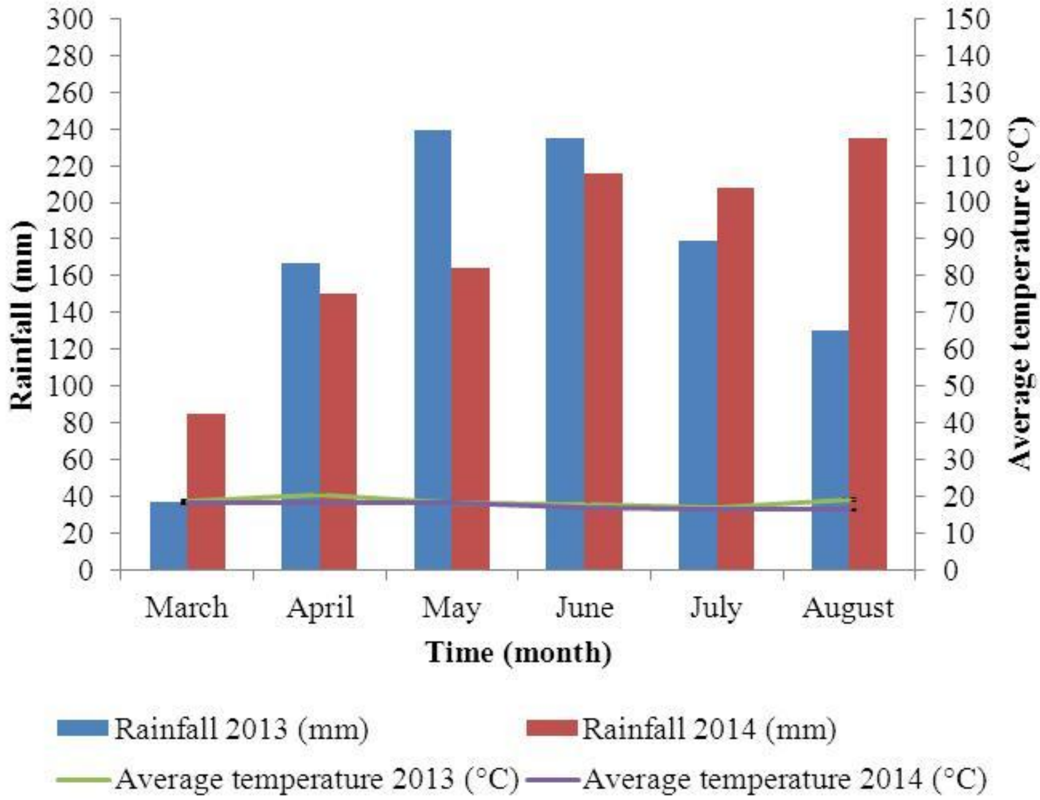


Fig.1 Precipitation and average temperature during 2013 and 2014 growing seasons at the study site

C. Physical and Chemical Characteristics of the Soil

Soil samples were collected in December 2012 at 30 cm (11.81’’) depth using an increment borer and according to the soil sampling standards. After pretreatment method derived from the ISO 11464 standards, characterization of these samples was carried out on dry matter. The FAO textural triangle was used to determine the soil types. For the 11% and 29% slopes, we measured hydraulic conductivity using a Minidisk infiltrometer (Decagon brand), and following the manufacturer’s procedure, with a succion rate of 2 cm (0.78 in), a value that fits with most soil [16].

D. Management of the Field Trial

This experiment was carried out on areas of potato cultivation on two different slopes (11% and 29%), which are representative of the most commonly exploited slopes in the area. Twelve farmers were involved in the experiment. There were four blocks of Weischmeier’s plots, for each slope, with each block divided into three plots. Three treatments (FB, RASS, and TR) were conducted on identical plots of 22.10 m (870.07 in) by 1.80 m (70.86 in) [17] and [18], occupying an area of approximately 40 m^2 (430.56 ft^2). Typical production methods of the farmers were practiced with respect to planting distances between plants, basal application, weed control, hilling-up, chemical fertilizer, and chemical treatments. The three treatments received the same quantities of fertilizers and pesticides.

E. Experimental Design

Each block was comprised of the three treatments (Fig. 2) with four replications on each slope. Hydrological isolation of plots and blocks was ensured by the use of corrugated galvanized steel sheets driven into the ground.

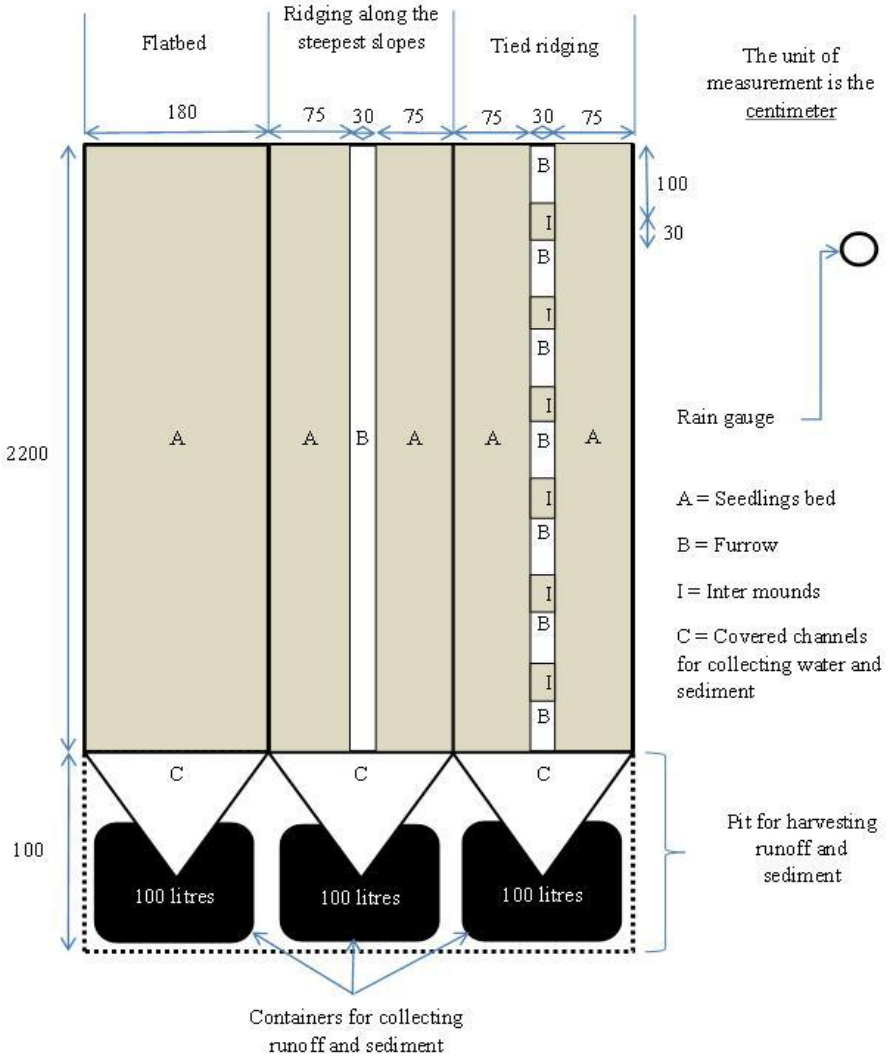


Fig.2 Graphical representation of an experimental block

F. Plowing, Demarcation, Planting and Basal Application

The land was tilled at 0.30 m (11.81 in) depth using a hoe in all treatments. In FB, the land was dug and any lumps were crushed to form a flat surface. Ridging along the steepest slopes involved forming two ridges running down-slope. The ridges had a trapezoidal shape with an 0.80 m (31.49 in) large base and 0.75 m (29.52 in) small base, and were separated by a groove of 0.20 m (7.87 in). Tied ridging were formed identically to RASS, with the exception that 16 inter mounds with a width of 0.30 m (11.81 in) were constructed in the furrow at regular 1 m intervals, thereby forming micro-dams between the ridges. Demarcation was carried out with cut twines and branches of *Eucalyptus saligna*. The variety "Spunta" that all farmers consider the most resistant to various attacks (insect, nematode, etc) was used in the experiment. Seedlings were selected by the producers themselves and no calibration was conducted. As per the farmers' typical practice, the seedlings were measured in a bucket of 15 liters capacity weighing approximately 25 kg. in RASS and TR, two lines of potato were planted, running up-down, on each ridging with a spacing of 0.25 m (9.84 in), and one potato was planted in each inter mound in TR. On the FB treatment, spacing was 0.25 m (9.84 in) and 0.45 m (17.71 in) respectively between seedlings and lines. In FB, lines were arranged along the length of the plot. Chicken manure (basal application) was spread at a rate of 1,600 $kg.ha^{-1}$ (647.77 $lb.ac^{-1}$) immediately after plowing and before planting in each treatment. Potatoes were planted approximately 0.15 m (5.90 in) from the surface into a hole dug with a metallic or wooden planter. The densities of seedlings differed across the three treatments: 86,000 plant.ha^{-1} (34,818 plant.ac^{-1}) FB; 88,250 plant.ha^{-1} (35,729 plant.ac^{-1}) RASS; and 92,250 plant.ha^{-1} (37,348 plant.ac^{-1}) TR. Operations of demarcation, plowing and basal fertilization application by hand, and hoeing and mounding required 50 man-day ha-1 (20 man-day ac-1) for FB and RASS, and required 60 man-day.ha^{-1} (24 man-day.ac^{-1}) for TR. Harvesting workforce differed across the three treatments and in the two slopes: 52, 50, and 91 man-day.ha^{-1} (21, 20 and 37 man-day.ac^{-1}) in the11% slope for RASS, FB, and TR respectively; and 34, 33, and 68 man-day.ha^{-1} (14, 13 and 28 man-day.ac^{-1}) in the 29% slope for RASS, FB, and TR respectively. These operations were conducted on March 26, 2013, and on March 18, 2014.

G. Pesticides and Chemical Fertilizers

Chemical fertilizers and pesticides used in the experiment were those available in the study area. Pesticide application was conducted using a 16 liter knapsack sprayer. Pesticides were sprayed using the farmer's method (i.e. above and below plant leaves). At 25 and 18 days after planting for 2013 and 2014 respectively, Gramoxone (a selective herbicide that does not burn potato leaves) at a rate of 2 l.ha^{-1} (0.81 l.ac^{-1}) with 10cc Gramoxone in 16 liters of water was applied for weed control. To fight nematodes each year, a single treatment of Cypercot 100 mg was applied at 3 days after planting at a rate of 400 ml.ha^{-1} (160.94 ml.ac^{-1}), with 20 ml Cypercot in 16 liters of water. Antifungal treatments using Plantizeb 80WP were applied at a rate of 2.5 kg.ha^{-1} (1.01 kg.ac^{-1}) with 100 g in 16 liters of water, at 28, 35, 42, 45, 48, 51, and 58 days after planting in 2013, and at 22, 29, 36, 43, 50, and 57 days after planting in 2014. At 47 and 44 days after planting in 2013 and 2014 respectively, chemical fertilization (NPK complex formulated 20-10-10) was manually applied at the same rate of 200 kg N.ha^{-1} (80.97 kg N.ac^{-1}), 100 kg P_2O_5.ha^{-1} (40.48 kg P_2O_5.ac^{-1}) and 100 kg K_2O.ha^{-1} (40.48 kg K_2O.ac^{-1}) for each treatment.

H. Hoeing and Mounding

At 47 and 44 days after planting in 2013 and 2014 respectively, hoeing and mounding were simultaneously conducted after the application of chemical fertilizers. These operations consisted of bringing up the land at the foot of potato plants to form furrows in the FB treatment and digging deeper into the furrows of the RASS and TR treatments. These two operations used a workforce of 60 man-day.ha^{-1} (24 man-day.ac^{-1}) for TR and 50 man-day.ha^{-1} (20 man-day.ac^{-1}) for each of the other two treatments.

I. Collecting Water and Sediments

Collection containers of 100 l capacity were installed on the outlets of each plot. These were positioned in a pit of 1 m (39.37 in) width and 0.50 m (19.68 in) deep dug downstream of each block. The containers were covered with a polyethylene film to prevent inflows of water and sediment not coming from the plot (Fig. 3).

Fig.3 Device for water and sediments collection

J. Harvesting

The eight blocks were harvested with a hoe on July 17, 2013 (114 days after planting) and on July 14, 2014 (119 days after planting). Tubers were weighed in 25 kg series using a spring scale of 50 kg maximum capacity.

K. Quantification of Water and Sediment

For both years the water and sediment collection containers were installed on the first day of planting. During the first 27 and 12 days after planting for 2013 and 2014 respectively, rainwater seeped fully into the ground and produced no runoff. The first water and sediment data were recorded at 28 and 13 days after planting for 2013 and 2014 respectively. Recordings were made during rainfall if runoff is beyond the capacity of collecting containers or after each rainfall if runoff does not across collecting containers. Recordings were made until soil is completely covered and unless there was no runoff containing sediment; it was 26 and 34 days after harvest for 2013 and 2014 respectively. After each collection, sediments were filtered and the amount of wet sediments and water were measured. Wet sediments were finely spread and dried on cotton fiber bags in the field room at ambient temperature for 48 h. A second weighing was conducted after drying and the difference in weight was added to the amount of water runoff. The amounts of water and sediment considered in this paper are those obtained after drying.

L. Assessment of Tillage Methods in Expenses and Revenue

Ridging along the steepest slopes data were considered as a baseline in calculating the rate of increase in expenses and revenue. The three treatments were evaluated in terms of farmer's profitability. Only the costs of labor and agricultural inputs were taken into account in these calculations, experimental material was excluded. As learned from the farmers, the calculations of expenses, revenue were made on the fee schedule of 200 XAF (0.33 US$).$kg^{-1}$ seedlings and 125 XAF (0.21 US$).$kg^{-1}$ potatoes for consumption. The cost of labor is 1,300 XAF (2.16 US$).man-$day^{-1}$ regardless task. Other inputs' prices are from market. Farmers' expenses and profits were calculated assuming that all potatoes are sold, as intended, for consumption (Appendix). Usually in this study area there is no difference between the potato for consumption and seedling. The calibration is almost inexistent; the difference observed in price is mainly due to the fact that potatoes harvested in July are planted in March of the following year. During the time spent in storage, tubers lose more water and therefore decrease in volume.

M. Data Analysis

Soil samples were analyzed by the Provincial Center of Agriculture and Rural Policy, La Hulpe, Belgium. The effects of treatments and slopes on the quantity of water runoff, sediments, and yield were tested through the adjustment of a partially nested analysis of variance model, with years and blocks as random factors. Normality and homogeneity of the variances assumptions were assessed on the residuals of the adjustments. Those assumptions were met for all the data for 2013 and 2014. The effects of treatments and slopes on the workforce, expenses, and profit were tested through descriptive statistics.

III. Results and Discussion

A. Physical and Chemical Characteristics of the Soil

Table I shows that the soil from both slopes had a silty texture. According to the FAO textural triangle, the soil in the 11% slope is a silt while the soil in the 29% slope is a fine silt. The rainsplash index of 0.32 and 0.37 respectively for 11% and 29% slopes explains why in both cases the soil was favorable for water infiltration and had no structural stability problems [16].

Calculated k_1 and k_2 (respectively) hydraulic conductivity of the soil on 11% slope and 29% slope, were in the typical range of values for hydraulic conductivity in silty soils [19] which means that the soil had not been affected by physicochemical transformations that could promote rainsplash [20].

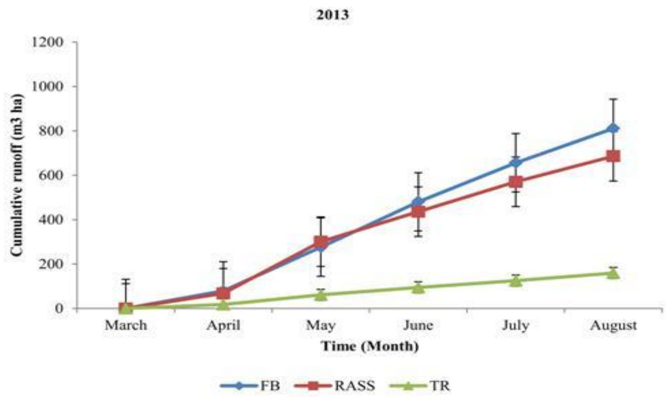
Table I: Soil characterization

Characteristic	Designation	11% slope	29% slope
Physical characterization	Clay (%) < 0.002 mm	25.2	21.7
	Fine silt (%) 0.002-0.02 mm	35.3	45.1
	Coarse silt (%) 0.02-0.05 mm	11.3	11.7
	Fine sand (%) 0.05-0.2 mm	14.4	13.2
	Coarsesand (%) 0.2-2 mm	13.7	8.3
Chemical characterization	pH_water	5.4	5.9
	Organic carbon (g/kg)	82	94
	Calculated rainsplash index	0.32	0.37
	Calculated hydraulic conductivity ($m.s^{-1}$)	$3.32*10^{-6}$	$3.44*10^{-6}$

Source: Field samples analyzed by the Provincial Center of Agriculture and Rural Policy, La Hulpe, Belgium, 2014. Hydraulic conductivity obtained by Minidisk.

B. Effects of Slope and Tillage on Quantity of Water Runoff

Data from 2013 experiment had higher water runoff variability than in 2014. Therefore, results are presented by year. Low variability in 2014 would be due to homogeneity, indicating mastery of the TR technique. Regardless of slope, cultivation on FB and RASS released highest runoff, while TR released the lowest ($F_{min}(2, 12) = 2.4x10^6$, $p < 0.001$, Fig. 4 and 5). Flatbed and RASS released six times more runoff than TR.



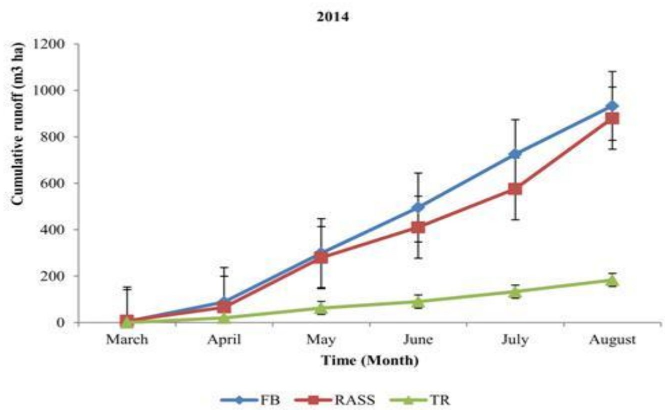


Fig.4 Chart of average cumulative runoff per hectare, per tillage method on 11% slope

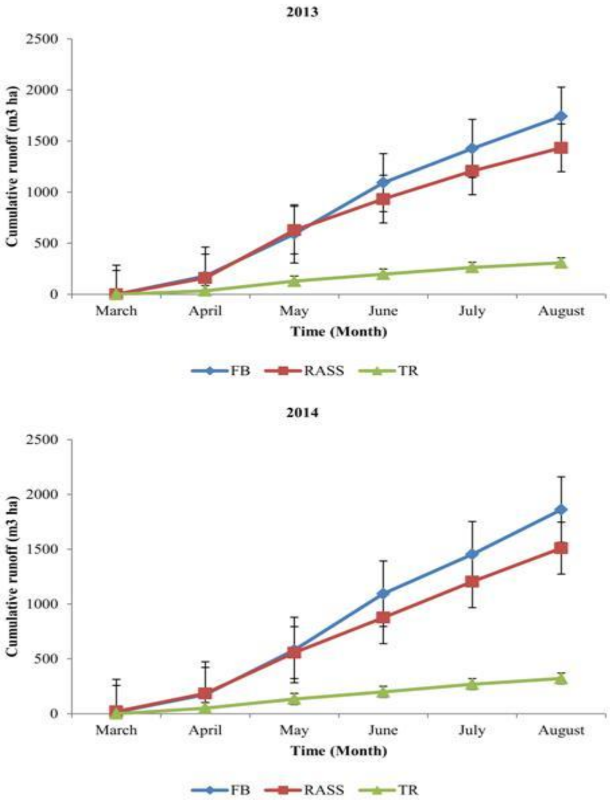


Fig.5 Chart of average cumulative runoff per hectare, per tillage method on 29% slope

C. Effects of Slope and Tillage on Quantity of Sediment

Considering all tillage methods, cumulated soil losses for the 11% slope (Fig. 6) were lower than the 29% slope (Fig. 7). Flatbed and RASS caused the highest soil loss, while TR caused the lowest soil loss. Considering average value of 2013 and 2014, TR retained five times more sediment than FB and RASS ($F_{min}(2, 2) = 322.7$, $p = 0.003$). In relation to soil loss and runoff for FB and RASS, it could be deduced that soil loss was not necessarily proportional to runoff; FB favored runoff over RASS, and the latter mode contributed to more soil loss than FB.

Everything being equal, the FB remained the method that generated the higher quantity of runoff (Fig. 6). Regarding soil loss, RASS was the method of land preparation that generated the higher quantity of soil loss (Fig. 6 and 7). In both cases, TR is the optimum conservation technique. In relation to soil loss, it could be deduced that the soil loss was not necessarily proportional to runoff; FB favored runoff more than RASS and the latter mode contributed to more soil loss than the FB.

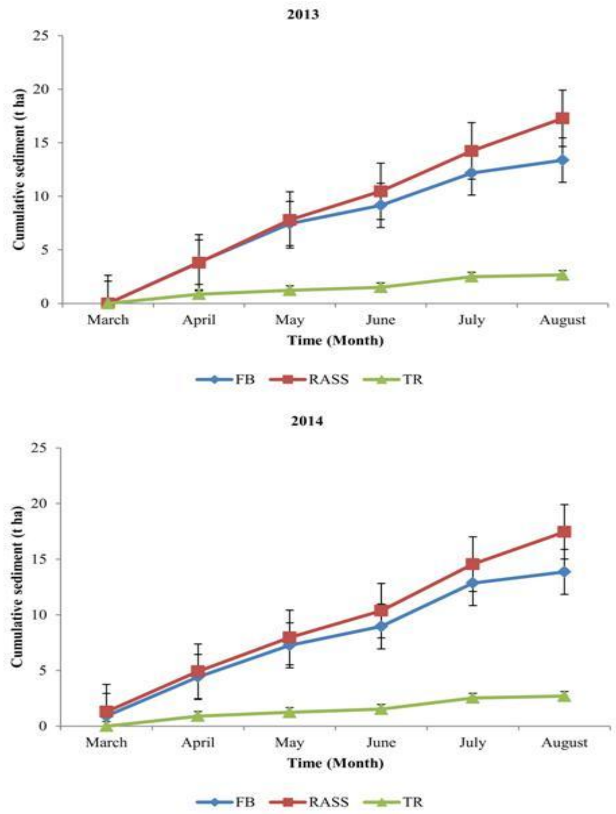


Fig.6 Chart of average cumulative sediment per hectare, per tillage method on 11% slope

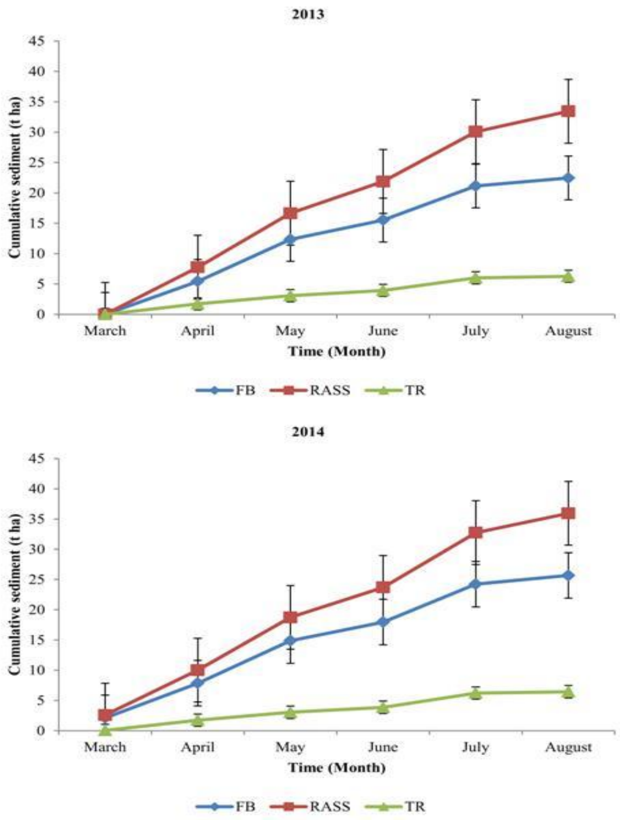


Fig.7 Chart of average cumulative sediment per hectare, per tillage method on 29% slope

D. Effects of Slope and Tillage on Crop Yield

For both years, average potato yield was calculated for each of the three land preparation methods on any slope tested.

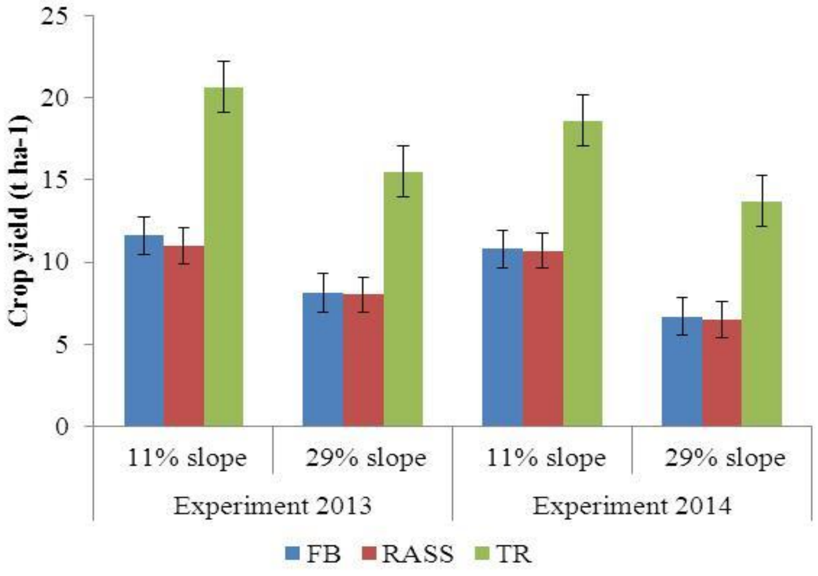


Fig.8 Chart of average crop yield per hectare, per tillage method and per slope

Considering all modes of tillage, crop yields were lower on 29% slope than 11% slope during both Years. Considering average value of 2013 and 2014 on all slopes, FB and RASS had lower crop yield, while TR had the highest crop yield ($F(2, 2) = 287.7$, $p = 0.003$, Fig. 8). In addition to the fact that TR prevents fertilizers from migrating out of the plot, this increase in performance is also a result of the high seedling density.

IV. ASSESSMENT OF TECHNIQUE PERFORMANCE

A. Water Runoff

Regarding the amount of water runoff, FB was identified as control because it is more prone to runoff than RASS and TR.

Table II: Percent change in water runoff per hectare as compared to flatbed

Tillage method	2013		2014	
	11% slope	29% slope	11% slope	29% slope
FB	-	-	-	-
RASS	-15.52	-17.69	-5.65	-18.87
TR	-80.29	-82.31	-80.24	-82.76

Source: Computed from field data

In both years, Table II shows RASS and TR have less water runoff than FB. With greater than 80% efficiency on any slope, TR proved to be the best runoff retention means.

B. Seedling Density, Workforce, Sediment Reduction, and Yield

Table III below shows the percent change in seedling density, workforce, sediment retention, and yield calculating using each of three land preparation methods.

Table III: Percent change in density, workforce, and yields per hectare compared to tied ridging

Tillage method	Increased seedling density	11% slope			29% slope		
		Increased workforce	Increased sediment	Increased yields	Increased workforce	Increased sediment	Increased yields
FB	-	-	-21.67	3.55	-	-30.67	2.33
RASS	3	1.33	-	-	0.75	-	-
TR	7	40.66	-84.75	81.18	41.35	-81.68	101.86

Source: Computed from field data, 2013 and 2014

In Table III, negative sediment percentage values can be seen increasing illustrate the efficiency of sediment retention of FB and TR compared to RASS. Sediment movement was the most disadvantaged in TR, with an 85% and 82% reduction of sediment as compared to RASS on the 11% slope and 29% slope respectively. Within the 29% slope, 24.06 $t.ha^{-1}$ (9.74 $t.ac^{-1}$).$year^{-1}$ average soil loss in FB was recorded; erosion tests conducted in Morocco on a similar mode of culture and gradient in tertiary seasonally wet series led to soil loss averages of 61$t.ha^{-1}$ (24.69 $t.ac^{-1}$).$year^{-1}$ [20]. The difference observed amongst soil losses could be explained by the fact that the ground was more stable in our experimental site. Other erosion tests were also held in Uganda on banana cultivation and generated soil loss of 16$t.ha^{-1}$ (6.47 $t.ac^{-1}$).$year^{-1}$ [21]; in this case the soil texture and slope was not specified, the difference observed could be the capacity of banana to prevent soil erosion. On a 20% slope in the Western Highlands of Cameroon with maize, erosion tests showed that discontinuous terraces retained thirty-one times more soil losses than parallel ridging [11]; discontinuous terraces seem more efficient, but this technique is not suitable for the small farmer.

Regarding seedling density, workforce, and yield, table 3 shows density for FB was the lowest of the three treatments, while density for TR was the highest. Positive percentage values shows increasing amounts of density, workforce and yield for TR compared to those obtained by RASS and FB. Increased workforce and seedling density leads to additional costs for farmers, while higher yields pride increased revenue. On the 29% slope for example, TR yields were more than double the yields obtained in RASS. From our point of view on site, this increase in performance could be due not only to increased seedling density, but also to the fact that inter mounds could prevent organic matter, pesticides, and fertilizers from migrating out of the plot.

C. Assessment of Tillage Methods in expenses and revenue

Table IV: Farmers' expenses, revenue, and profit per hectare

Tillage method	**11% slope**			**29% slope**		
	Expenses ($US)	**Revenue ($US)**	**Profit ($US)**	**Expenses ($US)**	**Revenue ($US)**	**Profit ($US)**
RASS	1,420	2,341	922	1,382	1,565	184
FB	1,433	2,426	995	1,390	1,602	212
TR	1,609	4,241	1,608	1,557	3,160	1,604

Source: Computed from field data 2013 and 2014. $US: Dollar United States of America

Taking into account all production expenses for each treatment, and considering the RASS treatment as a baseline for calculations, Table IV shows that farmers would have 1.08 and 1.74 times their baseline earnings (using FB and TR respectively) in the 11% slope, and 1.15 and 8.71 times their baseline earnings (using FB and TR respectively) in the 29% slope. Using TR would increase farmer's profitability by 686 $US\$.ha^{-1}$ and 1420 $US\$.ha^{-1}$ over RASS in 11% and 29% slopes, respectively. Tied ridging seem significantly more profitable but it remains to see if it would be easily adopted by the majority of farmers exploiting steepest slopes since it leads to significant additional cost (for extra seedlings and workforce).

V. Conclusions

Regardless of slope gradient, we can conclude that despite overall soil loss in RASS, yield was almost identical to that of FB; only TR presented a largely positive effects on water runoff (lowered by a factor of seven), soil loss (lowered by a factor of five), farmers' profitability (686 $US\$.ha^{-1}$ and 1420 $US\$.ha^{-1}$ in 11% and 29% slopes, respectively), and yield (an 80% and increase in 11% and 29% slopes, respectively). Given the results of this experiment, 70% (8 over 12) participating farmers and others non participating farmers committed unconditionally to TR. Financial means was limiting factor for the four other participating farmers who are not adopted TR on all their plots. Farmers in the study area should enthusiastically engage themselves in TR, which is an effective way to fight against erosion by runoff.

Beside its benefits in farmers' profitability, and in soil and water conservation, TR leads to 40% and 7% extra work and extra seedlings, respectively. Although these two aspects represent a benefit for the entire community (employment opportunities and seedlings' market), it should first of all that farmers have financial resources for the implementation of TR.

This research opened pathway for many other relevant researches since besides all advantages of TR technique listed above, the following questions remain as yet unanswered:

1. Will the TR technique prove similarly suitable for other vegetable crops each taken separately or crop associations?

2. Does socio economic situation of farmers encourage the TR's adoption in the Bamiléké's hills?

3. Will the TR technique prove suitable for limiting siltation and pollution of rivers?

APPENDIX
Financial assessment

Designation	FB			RASS			TR		
	Quantity	PU (FCFA)	PT (FCFA)	Quantity	PU (FCFA)	PT (FCFA)	Quantity	PU (FCFA)	PT (FCFA)
Plowing, demarcation, planting and basal application (man-day)	50	1300	65000	50	1300	65000	60	1300	78000
Seedlings (kg)	1540	200	308000	1557	200	311400	1689	200	337800
Basal application (kg)	1600	35	56000	1600	35	56000	1600	35	56000
Pesticides and chemical fertilizers (man-day)	35	1300	45500	35	1300	45500	35	1300	45500
Gramoxone (l)	2	3000	6000	2	3000	6000	2	3000	6000
Cypercot (l)	0,5	5000	2500	0,5	5000	2500	0,5	5000	2500
Plantizeb (kg)	2,5	3000	7500	2,5	3000	7500	2,5	3000	7500
NPK (kg)	500	400	200000	500	400	200000	500	400	200000
Hoeing and mounding (man-day)	50	1300	65000	50	1300	65000	60	1300	78000
Harvesting (man-day) 11% slope	52	1300	67600	50	1300	65000	91	1300	118300
Expenditures 11% slope			**823100**			**823900**			**929600**
Harvest (11% slope)	11213	125	1401625	10828	125	1353500	19619	125	2452375
Profit (11% slope)			**578525**			**529600**			**1522775**
Harvesting (man-day) 29% slope	34	1300	44200	33	1300	42900	68	1300	88400
Expenditures 29% slope			**799700**			**801800**			**899700**
Harvest (29% slope)	7406	125	925750	7237	125	904625	14609	125	1826125
Profit (29% slope)			**126050**			**102825**			**926425**

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AUTHOR’S PROFILE

Henri Grisseur Djoukeng is born Feb. 10, 1975 at Fosimondi (Cameroon). He has a master degree in agricultural engineering and an advanced master in animal and plant resources management in the tropics. He’s currently researcher-PhD candidate in the Department of Biosystems Engineering, University of Liège Gembloux Agro-Bio Tech, Gembloux, Belgium. **Email: hgdjoukeng@doct.ulg.ac.be**

Yves Brostaux is a Belgian, professor in the Department of AGROBIOCHEM, University of Liège Gembloux Agro-Bio Tech, Gembloux, Belgium.

Christopher Mubeteneh Tankou is a Cameroonian, professor in the Department of Agriculture, University of Dschang, Dschang, Cameroon.

Aurore Degré is a Belgian, professor in the Department of Biosystems Engineering, University of Liège Gembloux Agro-Bio Tech, Gembloux, Belgium.