Full Length Research Paper

Impact of plucking interval on tea productivity and green leaf quality

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Tea is an important cash crop in Rwanda. It ranks the second largest source of foreign income after coffee. Tea productivity and quality of green leaves lead to the black tea quality and quantity. Tea green leaves quality and quantity are affected by many factors including length of harvesting interval. Since the tea cultivated in Rwanda the proper harvesting interval has never been determined while it should be necessary for further improvement of the quality of Rwanda tea. The objective of this research was to determine the effect of harvesting interval on both quantity and quality of tea. Four harvesting intervals (7, 10, 13 and 16 days) were tested in a Randomized Complete Block Design with three replications. The experiment was conducted in season of 2014B at NYABIHU Tea Company on the clone 6/8 in industrial block II (BIIA) situated in hillside. Data were collected on four parameters: Production, quality, height of shoot and surface of leaves during three months from the beginning of February 2014 up to the beginning of May 2014. By using Genstat, the results from different harvesting intervals were showed that the mean of production of tea green leaves obtained varied between 0.62Kgs/12bushes and 0.50kg with 87.10%, and 59.67% of mean quality respectively. Analysis of variance shows that there were significant difference between the treatments with p value (P<0.001). The shoot height and leaf surface were increased and increase production. The results indicated that the appropriate plucking interval for quality and quantity of green leaves ranges between 10 and13days in NYABIHU tea company zone.

Keywords: Tea, green leaf, harvesting intervals, shoot, quality and quantity.

INTRODUCTION

In Rwanda, like other developing countries, agriculture is the main productive activity carried out by a large number of Rwandan populations (Minecofin, 2008). Statistics for the year 2002 shows that the total GDP was 635 billion Rwf, where agriculture contributed with 299 billion Rwf and cash export crops including tea earned 8 billion Rwf. Tea and coffee are the major export crops earning about US Dollars 49 million in 1998. Tea is an important industrial crop produced in Rwanda largely for export purposes to generate foreign exchange earnings. The crop is estimated to contribute up to 34% of the total national exports. It is among the important crops grown in Rwanda and has very high potential due to the following reasons: Tea crop provides the essential soil cover on steep hills and fights against erosion where it is grown; Rwanda tea is among the best quality tea in the world; and further, Rwanda needs

to diversify its export crops hence this crop has high potential in nowadays. Although, it has high potential in Rwanda, but its production faces some constraints including quality irregularity and the quantity. One of the causes of these constraints is probably due to uncomfortable plucking cycle. Hence the objective of this research is to identify the proper harvesting cycle that improves both tea quantity and tea green leaf quality as it determines the quality of made tea in order to recommend tea growers, processors and traders the proper cycle to do harvesting of green leaves in NYABIHU plantation.

Rwanda's land is fertile to the growing of tea, especially, acidic soil. The altitude allows for the production of first quality tea (MINAGRI, 2004). Due to the highland where Rwanda tea grows, its strength, bright color, brisk flavor and consistency in

manufacturing, Rwanda tea is known all over the world as a superior tea. Even though Rwanda tea has high potential all over the world in quality, most of time its productivity and quality of green leaf which leads to the black tea quality is affected by many factors including length of plucking interval.In fact, the plucking interval varies depending on growth rate of pluckable shoots and plucker availability. The growth rate is associated with the climatic conditions in which a tea crop is grown. It can vary from a region to another. From the tea introduction in Rwanda the proper harvesting interval has never been determined while it should be necessary for further improvement of Rwanda tea quality.

Normally the shorter the harvesting interval, the higher quality of green leaf and the lower quantity of tea harvested at unit of area but also the longer the harvesting interval the lower quality of black tea and the higher quantity of tea harvested at unit of area. Leslie, 1976 reported that as long as tea productivity and quality of green leaves are affected, the price of processed tea per Kilo on market decreases; this implies the reduction of income generation to the growers, processors, traders and even the whole society.

MATERIALS AND METHODOLOGY

This study was carried out in Nyabihu tea unit which is situated in Nord-West of Rwanda, in Western Province, Nyabihu District, Karago Sector, Kadahenda Cell, at 123Km of Kigali, the Rwandan Capital.

The tea unit covers 658.3ha of tea plantation, subdivided into industrial block plantations, with seven divisions which are: Mukamira, Nyabihu, Mutaho, Cyamabuye, Rutuku I, Rutuku Ii and Bwiza.

The village tea occupies 30.52ha in the tea unity, and it has also 80ha of forest (for the feeding of the boiler).

Nyabihu plantation is mainly situated in high altitudes, till 2300m on the sea level. 41% of tea plantation is situated in swamps. The soil is volcanic and that kind of soil ensures the best tea quality and good tea test to the Nyabihu black tea.

Nyabihu is characterized by abundant rains during the main part of the year, what ensures weak fructification at the tea production level. The climate is cold with the temperatures equal or less to 15^0c.

The study was conducted on 6/8 clone characterized by Small leaves, short internodes and extremity of leaves are pointed. High quantity excellent quality of black tea Resistance to tea mite. Green leaves were harvested manually at different harvesting intervals and were evaluated for the quantity, the quality of harvested leaves, and height of shoots and surface area of leaves (TRIT., 2014).

The experimental design was laid in Randomized Complete Block Design (RCBD) which is used in open field to increase homogeneity within block and heterogeneity between block. Three blocks were

delimited in the field and each block was subdivided in four plots. Each plot was occupied by 10m^2 with 12 plants and was subjected to a specific harvesting interval within the block. Four harvesting intervals (7, 10, 13 and 16 days) were evaluated in three replications/blocks.

At the beginning of this research on the field, experimental design was made on hillside where Samples were taken in each plot according to fixed specific harvesting interval.

The collected samples were firstly weighed in kg. On each weighed sample four types of data were recorded: The whole quantity of green leaves (production) harvested per plot at the fixed harvesting interval ; Mean height of shoot in cm; Mean surface of leaves in cm^2 and Quality of green leaves.

Weight of plucked tea green leaves

The green tea leaves were carried separately after harvesting in aerated bags according to the block up to the factory, and then the weight of tea harvested in each plot was weighed by using balance.

Quality of tea green leaves.

After weighing, 100gr were taken from a weighed sample and analyzed in wood box with 8 windows which were used to grade the green leaves. So depending on quantity of leaves found in a given window of this box, the percentage of marks may increase or decrease. The windows labeled: P+1, P+2, P+3 soft must present in total at least 70% otherwise, the quality of green leaves reduces. The best quality of green leaves were gotten when many leaves were found to be in window labeled P+2.The marks of the best quality of green leaves must be ranged from 70% onwards.

The quality of green leaf is the quality analyzed on harvested tea leaves. It consists of the use a frame with different labeled windows that indicate the stages of harvested shoots (P+1, p+2… FCA). The figure 1 shows the wood box used to analyze tea green leaves quality.

| P+1 | P+2 | P+3 soft | P+3 hard | B+1 | B+2 | FCO | FCA |
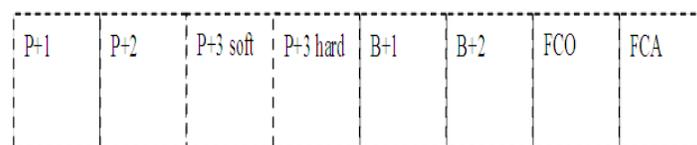
Figure 1: wood box used to grade green leaves

Surface of leaves

Among of the harvested tea green leaves, four shoots were taken randomly from each harvested plot and measured width and length of each leaf by using

Table 1: Green leaves production, Leaf quality, Height of shoot, Leaf surface as influenced by plucking intervals

Treatment	Green Leaves	Leaf Quality	Height of Shoot	Leaf Surface
7 days	0.5061c	87.10a	6.215d	6.31d
10 days	0.5409bc	83.96b	8.831c	9.08c
13 days	0.5986ab	74.19c	11.025b	13.45b
16 days	0.6285a	59.67d	13.115a	15.85a
SEm±	0.01745	0.733	0.1216	0.423
CD (P = 0.05)	0.06038	2.537	0.4207	1.463
CV (%)	1.5	0.7	1.2	4.1

The Means values within a treatment column followed by same letter(s) indicate that they are statistically similar (P>0.05) using DMRT.

graduated ruler then made average and multiplied with factor of correlation.

Surface calculation= length*width*factor of correlation.

Factor of correlation of tea crop vary from 0.65 to 0.83, so the average is 0.74 (Jian Wang et al., 2011).

Height of shoot

Among of the harvested tea green leaves, four shoots were taken randomly from each harvested plot and measured each shoot from the bottom up to the end of shoot by using graduated rule and then made average.

RESULTS AND DISCUSSION

The green leaf productions were proportional with plucking interval as was shown in the table 1 above. The results from different harvesting intervals were showed that the mean of production of tea green leaves obtained varied between 0.6285Kgs and 0.5061Kgs /120m^2 during three months of data recording and furthermore production were on par at 7days and 10 days while at 13 days and 16 days the production were significantly different. This is in conformity with the findings of Okinda and kwach, 2012 who reported that at 7, 14 and 21 days of harvesting interval the yield of green leaves were increased as plucking intervals were increased. The lengthening of plucking interval increased yield. This is in conformity with the findings of Saikia and Sarma, 2011 who carried out experimentation of 7 days and 9 days plucking interval treatments, they noticed that the yield were increased at 9 days of harvesting interval. This increasing was due to the increase in fibers and green leaf area.

The good quality of green leaves were obtained at

short plucking interval while at long plucking interval the quality were decreased as showed in the table1. The results obtained concerning leaf quality showed that the mean quality of tea green leaf at 7,10 and 13, and 16 days were significantly different with (p<0.001). In addition the quality were decreased as the plucking interval were increased. The results from four treatments 7, 10, 13, and 16 days of plucking interval for quality were 87.10%, 83.96%, 74.19%, 59.67% respectively. Means that at 7 and 10 days, the quality were increased with significant difference while at 13, and 16days, the quality were decreased. This is in conformity with the findings of Okinda and kwach, 2012.The way to maximize tea quality was to improve plucking standard by shortening harvesting intervals **(**Owuor et al., 2010**).**This decreasing was due to the high amount of fibers and large leaf area**.**

The height of shoot for green leaf tea was influenced by plucking interval and was predetermined the green leaf yield. The results indicated that an increased in green shoot height increased the yield amount. It should be mentioned that green leaves harvested from lower heights have better qualities for producing black tea. The table 1 shows that the mean of shoot height varied between 6.215 cm and 13.115cm and the analysis of Variance showed significant difference between treatments (p<0.001). The results from four treatments 7, 10, 13, and 16 days of plucking interval were 6.215cm, 8.831cm, 11.025cm, and 13.115cm respectively. Means that shoot height of green leaf was increased as plucking interval were increased with significant difference. This is in conformity with the findings of Salvatian et al. , 2014. The number of plucking interval was increased shoot height and the leaf surface simultaneously. it was reported by Okinda et al 2012**.** This increase was due to the accumulation of fibers in the shoots.

The green leaves surface were influenced by plucking intervals and predetermined the high amount of production. Means Surface of tea leaves at 7, 10, 13
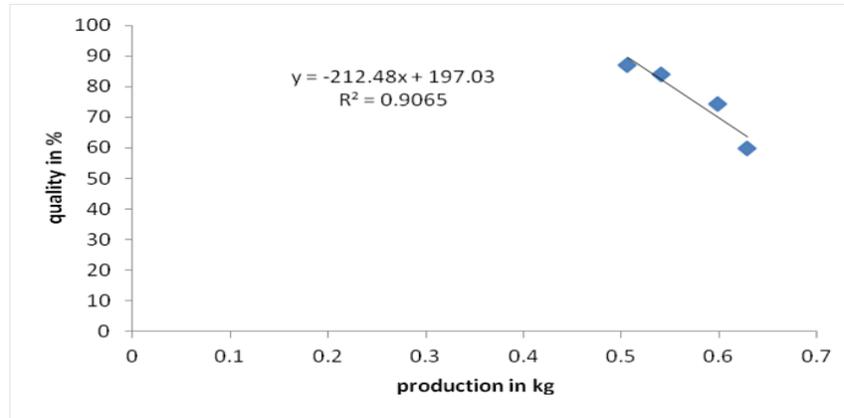
**Figure 2:** The correlation between production and quality.
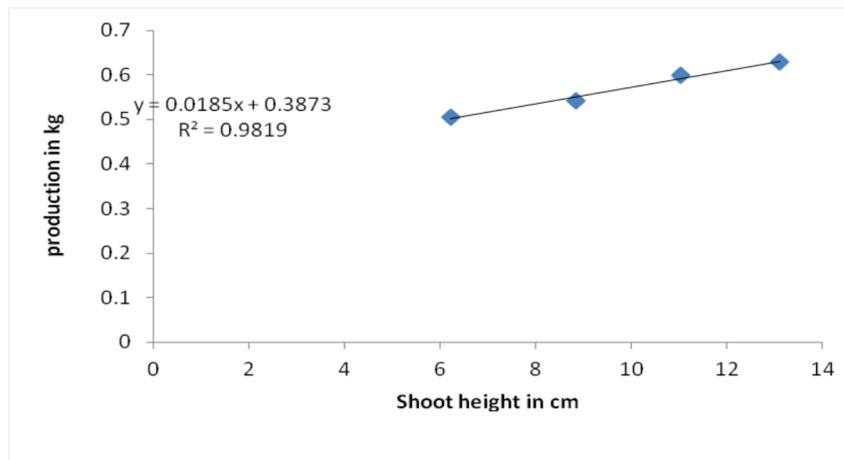
Figure 3 : The correlation between production and shoot height

and 16 days plucking interval were respectively 6.31cm^2, 9.08cm^2, and and13.45 cm^2 and15.85cm^2. The analysis of Variance showed that there were significant difference between treatments with (p<0.001). The table 1 shows that the leaf surface increased as the plucking interval increased and vice –versa. The result showed that the surface of green tea leaf at 7, 10,13 and 16 days were 6.31 cm^2, 9.08 cm^2, 13.45 cm^2, 15.85 cm^2. Means that surface of green tea leaf was increased as plucking interval were increased with significant difference. This is in conformity with the findings of Okinda et *al* 2012 and Okinda et al., 2013**.** This increase was due to the high photosynthesis rate as plucking interval increased.

The correlation between production and quality of green leaf tea

The figure 2 shows the negative correlation between production of green leaves and quality at different plucking interval during all the observations. This

indicates that as the production increase the quality decrease.

The correlation between production and shoot height

The figure 3 shows the positive correlation between mean production of green leaves and mean of shoot height at different plucking interval. It indicates that as the shoot height increase the production increase too. R= 0.981 this means that the shoot height contribute to the production increase at 98%.

The correlation between production and leaf surface of green leaf tea

The figure 4 shows the positive correlation between mean production of green leaves and mean of leaf surface at different plucking interval during all
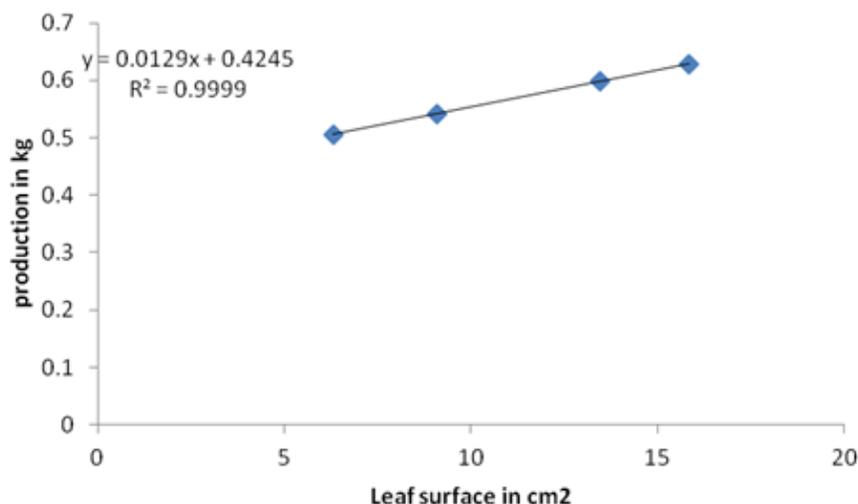
Figure 4: The correlation between production and leaf surface of green leaf tea.

observations. It indicates that as the leaf surface increase the production increase too. The r = 0.99 it means that the leaf surface contribute to the production increase at 99%.

CONCLUSION

The objective of this research was to determine the effect of harvesting interval on both quantity and quality of tea green leaves. Four different harvesting intervals: 7, 10, 13 and 16 days were evaluated in NYABIHU tea plantation especially in the industrial block (BIIA) during the period of 3 months in season 2014B. The different harvesting intervals were evaluated for production, quality, and shoots height and leaf surface.

   The greatest production was obtained at longest harvesting intervals (13 and 16 days intervals) while the greatest quality of green leaves were observed with lower harvesting intervals (7 and 10 days intervals). Quality decreased gradually when the period of harvesting interval increased. The quality of green leaf was very high at 7days (short intervals). On this harvesting interval, the quality of 87.1% was found which was above the recommended quality of 70%. The quality reduced at 59.67 % when the harvesting interval goes from seven to sixteen days and production increased with the increase of harvesting interval. The results from this study allow the author to conclude that the appropriate harvesting interval for quality and quantity of green leaves is range between 10 and13days in Nyabihu tea company zone. The harvesting interval should be adjusted within this range depending on growth rate of pluckable shoots and pluckers availability for both good quality and quantity of tea in this zone.

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