TOBACCO RESEARCH INSTITUTE OF TANZANIA (TORITA)

EVALUATION OF MINJINGU FERTILIZERS IN TOBACCO PRODUCTION FOR TOBACCO FARMERS OF TABORA URBAN, UYUI AND SIKONGE DISTRICTS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

LIST OF APPENDICES

ABSTRACT

Evaluation of Minjingu fertilizer started in 2017/2018 crop season in Tumbi –Tabora, Ushetu, Urambo and Chunya and it proceeded as on farm trial for 2018/2019 crop season in Tabora municipal, Uyui and Sikonge districts. The general objective was to assess yield and quality of tobacco produced by Golden leaf tobacco and Minjingu Top dressing fertilizers. The research was conducted by assessing tobacco in the field, during curing and determining tobacco grades and their value. Furthermore, samples of fertilizers and cured tobacco leaves were taken to laboratory for analysis of total alkaloids, reducing sugar and other elements. Results indicates that there was low nutrients in Golden leaf tobacco (NPK 10:18:24) and Top dressing fertilizer (CAN 27%) compared to the recommended nutrients required for tobacco plant nutrition. Dry leaf analysis indicates that there was high concentration of sulphur (0.7%) and low concentration of reducing sugar and nicotine which was 0.79% and 1.82% respectively which had negative effect on aroma of tobacco. There was slow nutrient release from Minjingu fertilizers which led failure of tobacco plants to absorb the nutrients at the right time hence low yield and leaf area especially for tobacco grown in sandy soil. Ripening rate for tobacco fertilized with Minjingu fertilizer was the same as the tobacco fertilized with YARA fertilizer. The average ripening rate after between harvests were four days for Primings, Lugs and Cutters and five days for Leaf. Number of days to accomplish one curing was the same for tobacco fertilized with Minjingu and that fertilized with YARA. For light tobacco it took five days to accomplish one curing and seven days to accomplish one curing for heavy tobacco. Tobacco grade distribution analysis indicates that, tobacco fertilized with YARA had 18.75% of top quality grades while tobacco fertilized with Minjingu produced 2.94% of top quality grades. Tobacco fertilized with Minjingu fertilizer in loam soil had tobacco with large leaf area compared to tobacco fertilized by Minjingu in sandy soil. Ninty percent (90%) of the interviewed farmers proposed that Minjingu fertilizer should be improved in order to be used in tobacco production. It is better Minjingu mines to look for other sources of Nitrogen that are recommmnded for tobacco production so that it can be easily absorbed by the plant. Ammonium nitrate is the best source of Nitrogen for tobacco plant nutrition. Rock phosphate (MOHP – PW) has slow nutrient release especially in sandy soil. The use of hydroxyl acids combined with calcium and iron could help to dissolve rock phosphate so that phosphate could be readly available to plant. Muriate of potash (MOP) require to be blended with other sources of potassium fertilizer by the ratio that could reduce the amount of chlorine in the fertilizer, it is recommended that the amount of chlorine that could be released should not exceed 13.6 kg/acre. Good source of Potassium for tobacco production is sulphate of potash (SOP) because contains no Chloride and hence has much lower salt index, also K-Mag (Sul-Po-Mag) is prefered because it release enough amount of Magnesium 11% and Sulphur 22% at the same time releasing little amount of Cl which is below 2.5%. Other source of K is Poatassium Nitrate. Futhermore Minjingu Mines and Fertilizer Company Ltd did not follow recommendations in the evaluation report of 2017/2018 crop season which required them to follow recomended specifications for tobacco plant nutrition requirements this is due to the fact that Minjingu fertilizer had nutrients below recommended specifications.

1.0 INTRODUCTION

Minjingu Organic Hyper Phosphate+ is a natural fertilizer. It has primary nutrients of Nitrogen, Phosphorus and Pottassium. Also it has Silica and Calcium which enhance availability of Phosphorus in the soil.

Calcium helps to reduce soil acidity and Silica helps to strengththen plant towards pests and diseses resistance (www.minjingumines.com).

For 2018/19 crop season TORITA did evaluation of Minjingu fertilizers in tobacco production. These fertilizers were; NPK 10:18:24 (Golden leaf tobacco) and CAN 27% (Minjingu top dressing fertilizer). Application rates were the same as those recommended for tobacco production which is 30 gram per plant for basal application and 8 gram per plant for top dressing fertilizer. The evaluation was done by comparing the performance of Minjingu fertilizers versus YARA NPK 10:18:24 and CAN 27% which was used as control

2.0 EVALUATION OF MINJINGU FERTILIZERS FOR FARMERS

TORITA which is an institute responsible to solve various challenges faced by tobacco farmers, received complaints from farmers regarding the use of Minjingu fertilizers in tobacco production. The complaints were; tobacco fertilized with Minjingu fertilizer had poor performance in the field. In order to clear doubts, TORITA by using team of its specialists visited some of the tobacco farmers who used Minjingu fertilizer in various primary societies (see appendix number 5).

3.0 OBJECTIVES

3.1 General objective

To assess yield and quality of tobacco produced by using Minjingu fertilizers

3.1.1 Specific objectives

- To analyse the amount of N, P, K, Ca, Mg, S, Cl and B in Minjingu Golden leaf tobacco (NPK 10:18:24) and Minjingu Top dressing fertilizer (CAN 27%)
- To assess plant growth in the field before reaping
- To determine ripening rate of tobacco leaves in the field
- To assess number of days used during curing
- To compare tobacco grades and their value for tobacco fertilized with Minjingu fertilizer versus tobacco fertilized with YARA
- To analyse the amount of nicotine, reducing sugar, N, P, K, Ca, Mg, S, Cl and B in cured tobacco leaves fertilized with Minjingu fertilizer.
- To assess the aroma of tobacco fertilized with Minjingu Golden Leaf and Minjingu top dressing fertilizer

4.0 STUDY AREA

Evaluation was done in various primary societies in Tabora urban, Uyui and Sikonge districts. Those primary societies were; Ilalwansimba, Ibelamilundi, Kigwa makazi, Kigwa kijiji, Tumaini, Mibono, Mgambo, Tumbi, Tupendane, Mkombozi and Magengati.

Table 1: Distribution of Golden leaf tobacco and Minjingu Top dressing fertilizers

No.	AMCOS	Golden leaf tobacco (NPK 10:18:24) (Bags)	Minjingu Top dressing fertilizer (CAN 27%) (Bags)	Number of farmers
1	ILALWANSIMBA NA MAGIRI	294	161	49
2	KIGWA KIJIJI	360	90	60
3	KIGWA MAKAZI	459	141	63
4	MIBONO	536	134	50
5	MKOMBOZI	436	106	60
6	TUPENDANE	421	106	85
	TOTAL	**2506**	**738**	**367**

As for other inputs, Minjingu fertilizers were also delivered to farmers as loan through primary societies. Some of these primary societies were having non perfoming loans.

Total number of primary societies under WETCU which participated in tobacco production for 2018/2019 crop season was 64 and total number of families participated was 8202. Out of 64 primary societies only 6 primary societies with 367 failies used Minjingu fertilizers. This makes 9.4% to be primary societies which used Minjingu fertilizers and 90.6% used YARA fertilizers. Also 4.5% of the farmers used Minjingu fertilizers and 95.5% of the farmers used YARA fertilizers.

5.0 MATERIALS AND METHODS

The research was conducted by assessing tobacco in the field, during curing and determing tobacco grades and their value. Furthermore, samples of fertilizers and cured tobacco leaves were taken to laboratory for analysis of nutrients

Leaf area was determined by using correction coefficient for FCV taken as **0.64** (Suggs *et al*, 1960).

$$\mathbf{A = C \times L \times W}$$

Where; (L) – Leaf length
(W) –Leaf width
(C) – Correction coefficient

(A) – Leaf area

Furthermore, number of leaves was counted to determine the nuber of leaves left after topping-up.

Ripening rate was assessed by counting number of days taken to accomplish ripening after the previous reaping/harvest.

Leaf curing was assessed for each stage. This was done by counting number of days required to accomplish each stage. These stages were yellowing, colour fixing, leaf drying and mid-rib drying.

Dry tobacco leaves were taken to laboratory to analyse nicotine, reducing sugar, N, P, K, Ca, Mg, S, Cl and B

Analysis of tobacco grades and its value was done after cured tobacco leaves being classified. Assessment of tobacco aroma was done where orange, lemon and mahogany colour was used to determine the aroma.

6.0 RESULTS AND DISCUSSION

6.1 Nutrient analysis in Minjingu Golden Leaf Tobacco (NPK 10:18:24) and Minjingu top dressing CAN 27%

Table 2: Laboratory analysis results of Minjingu fertilizers

S/N	SAMPULI	TN-Kjeld	B	Ca	Zn	Mn	Fe	P	Mg	TK2O	S
		%	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%
1	Golden leaf tobacco-NPK(10:18:24)	7.04	2,003.61	24.67	150.1	204.51	0.26	4.27155	5.68	21.86	0.22
2	Minjingu top dressing-CAN(27%)	15.23	10.18	14.39	88.1	309.77	0.5	6.27	4.95	0.52	0.11

Results in table 2 indicates laboratory analysis results of Minjingu Golden leaf tobacco (NPK 10:18:24) and Minjingu Top dressing fertilizer (CAN 27%). Results indicates that the nutrients are below standards contrary to what is indicated in Minjingu fertilizers packing bags shown in plate one

Plate 1: Minjingu NPK and CAN packing bags

6.1.1 Specifications for flue cured tobacco

NPK is 10:18:24 +0. 5Mg0+3Ca0+7S+0.012B

Specifications guidelines:

N total - 7.1% NH4

2.9% NO3

P_2O_5 total 18% Min

P_2O_5 water soluble 15.5%

K_2O total 24% based on 75% SOP and 25% MOP

MgO total 0.5%

CaO total 3%

S total 7%

B total 0.012%

Cl content 6% maximum this is from 120kg/t MOP.

Moisture content by weight: maximum 1.0%

6.1.2 Specification for CAN 27% N as a top dressing fertilizer in flue cured tobacco

Specification guidelines;

N total 26% N minimum

N split 13%NH4 – N minimum

13%NO3 – N minimum

MgO total 1.7%

CaO total 3.0%

S 3.0%

Moisture content not exceed 1%

6.1.3 How Minjingu fertilizers are manufactured

Minjingu fertilizers are manufactured through blending different types of fertilizers as follows;

Table 3: Manufacturing of NPK – Minjingu

S/N	Type of fertilizer/nutrient	Quantity (Kg)
1	MOP	400
2	DAP	230
3	MOHP – pw	195
4	UREA	100
5	SULPHUR	70
6	BORAX	5
	Total	**1000**

(Source: Minjingu mines and Fertilizer Company)

MOP contributes to release Potasiam for 60%, DAP releases Nitrogen (N) for 18% and phosphorus (P-Industrial) for 46%

MOHP – PW, this is rock phosphate which is mined in Minjingu releases natural phosphorus for 54%

UREA is the main source of Nitrogen (N) in Minjingu fertilizers (www.minjingumines.com)

6.1.4 Source of Nitrogen in Minjingu NPK 10:18:24

UREA is not recommended as the source of nitrogen for tobacco plant nutrition due to unpredictable release of nitrogen for plant absorption (International Potash Institute, 1988)

In best soil condition ammonium is quickly converted to nitrate by decomposition of soil micro organisms. But in case this convertion is slow tobacco plant which is in high demand of nutrients can absorb high quantity of ammonium which will be toxic to plant (Robert and Gary, 1997)

It may happens convertion of UREA to $NH_4 - N$ not to be completed (Partial nitrification of N) this can be toxic to plant (Elliot, 1986)

When there is low moisture content in sandy soil it takes long time for UREA to undergo decomposition from ammonium nitrogen ($NH_4 - N$) to nitrate nitrogen ($NO_3 - N$) which is absorbed by the plant. In this blending there is DAP which has ammonia nitrogen which also needs to be converted to nitrate nitrogen. This condition leads to late availability of nitrogen to plant from these sources of UREA and DAP this is due to the fact that tobacco plant absorbs nitrogen in the form of nitrate and not ammonium

Nitrogen (N) is very important in plant growth because it helps plant to synthesize its own food and absorption of other plant nutrients.

6.1.5 Source of Phosphorous (P) in Minjingu NPK 10:18:24

Rock Phosphate (MOHP – PW) is best used in the soil with high organic matter and pH below 5.5 (FAO, 1984). Tobacco is best produced in the soil with pH from 5.5 – 7.6 (International Potash Institute, 1988). Due to this reason it makes this fertilizer to be not suitable in soil with pH above 5.5 which is best for tobacco production

6.1.6 Source of Potassium (K) in Minjingu NPK 10:18:24

Muriate of Potash (MOP) which is used in blending Minjingu NPK fertilizer as the only source of Potassium (K) is not recommended because Potassium Chloride releases high amount of Cl. The amount of Cl released from this source reaches 45 – 47%, this amount is high hence its absorption could be high and toxic to plant. It can affect its growth and smoking characteristics (Vann *et al*, 2014)

6.1.7 Source of Nitrogen in (N) in minjingu top dressing CAN 27%

Minjingu top dressing fertilizer CAN 27% is manufactured by blending UREA and MOHP – PW. Since UREA is a source of nitrogen in this fertilizer, it is not recommended because

UREA has a feature of late decomposition so as to release nitrate to be absorbed by a plant (International Potash Institute, 1988)

6.2 Assessment of tobacco plant growth in the field before reaping

6.2.1 Recommended soil for tobacco production

Tobacco is best produced in sandy to loam soil (Sys *et al*. 1993). Furthermore other types of soil such as sandy, loam, clay loams to sandy clay loams can also be used in tobacco production, but it should be light, friable and freely drained.

Tobacco is also best grown in light loam soil with low organic matter, Potash, Phosphoric acid and iron. Soil with high organic matter and nitrogen produce high yield but low tobacco quality. Moreover heavy soil with water logging is not recommended in tobacco production. Tobacco is best produced in the soil with pH from 5.5 – 7.6 (International Potash Institute, 1988)

6.2.2 Reasons of Minjingu fertilizer to have good performance in loam soil (Ferralic Cambisols, Rhodic Ferralsols)

Loam soil have a property of having high organic matter content with largest percentage of N and P. Available nutrients are within exchange sites ready to beabsorbed by a plant.

Loam soils have high cation exchange capacity (CEC) hence not easy to lose nutrients through leaching. Also it has good buffering capacity thereby creating ability to replace nutrients lost in the soil after being utilized by a plant (Hodges, 2010). Nutrient removal (kg/ha in the period of tobacco growth) in order to produce 2.5 tonnes of dry leaves in the barn is: Nitrogen (N) = 50; Phosphorus (P_2O_5) = 15 and Pottassium (K_2O) = 125 (Sys *et al*. 1993).

Plate 2: Tobacco fertilized with Minjingu fertilizer in loam soil

6.2.3 Reasons of Minjingu fertilizer to have poor performance in sandy soil

Sandy soils have low organic matter hence less fertile. When Minjingu fertilizer is used in sandy soil it delays to release nutrients because of lack of exchange sites. Furthermore, in sandy soil microorganisms required to convert ammonia from UREA to nitrate and Phosphate are in less quantity because of low organic matter.

Plate 3: Tobacco fertilized with Minjingu fertilizer in sandy soil

6.2.4 Leaf length and width of tobacco leaves fertilized with Minjingu fertilizer in sandy and loam soil

Data of leaf length and width was taken from five farmers, whereby three farmers were in loam soil and two farmers were in sandy soil. The following are the results of leaf area for bottom, middle and top leaves of tobacco which were in sandy and loam soil;

Loam soil;

Bottom leaves;

Leaf area for bottom leaves was 270.61cm^2, 281.86cm^2 and 286.15cm^2

Middle leaves;

Leaf area for middle leaves was 978.23cm^2, 881.49cm^2 and 829.00cm^2

Top leaves;

Leaf area for top leaves was 975.56cm^2, 809.10cm^2 and 828.38cm^2

Sandy soil;

Bottom leaves

Leaf area for bottom leaves was 306.07cm^2 and 340.83cm^2

Middle leaves

Leaf area for middle leaves was 625.86cm^2 and 605.23cm^2

Top leaves

Leaf area for top leaves was 565.26cm^2 and 573.97cm^2

Results indicates that tobacco produced in loam soil had larger leaf area in the ratio of Medium – Thin compared to tobacco produced in sandy soil which had a ratio of Thin - Medium. 67% of the soil in primary societies which used Golden leaf tobacco fertilizer and Minjingu topdressing fertilizer was sandy soil 17.5% was loam soil and 15.5% was clay soil (See attachement number 4)

6.2.5 Number of leaves per plant

Number of leaves left after topping was counted, in sandy soil the average number of leaves left was 14 while in loam soil was 16

6.3 Ripening rate and leaf curing

6.3.1 Ripening rate

There was no difference in ripening rate for tobacco fertilized with Minjingu fertilizer and that fertilized with YARA. The ripening rate was in the average of four days for Primings, Lugs and Cutters and five days for Leaf

6.3.2 Leaf curing

There was no difference in leaf curing days for tobacco fertilized with Minjingu and that which was fertilized with YARA. It took about 7 days to cure heavy tobacco and 5 days to cure light tobacco.

6.4 Quality of grades and their prices

6.4.1 Results of grade analysis – Ilalwansimba AMCOS

The following are the results of grade analysis;

Chart 1: Grade distribution versus price for Ilalwansimba AMCOS farmers who used Minjingu fertilizer

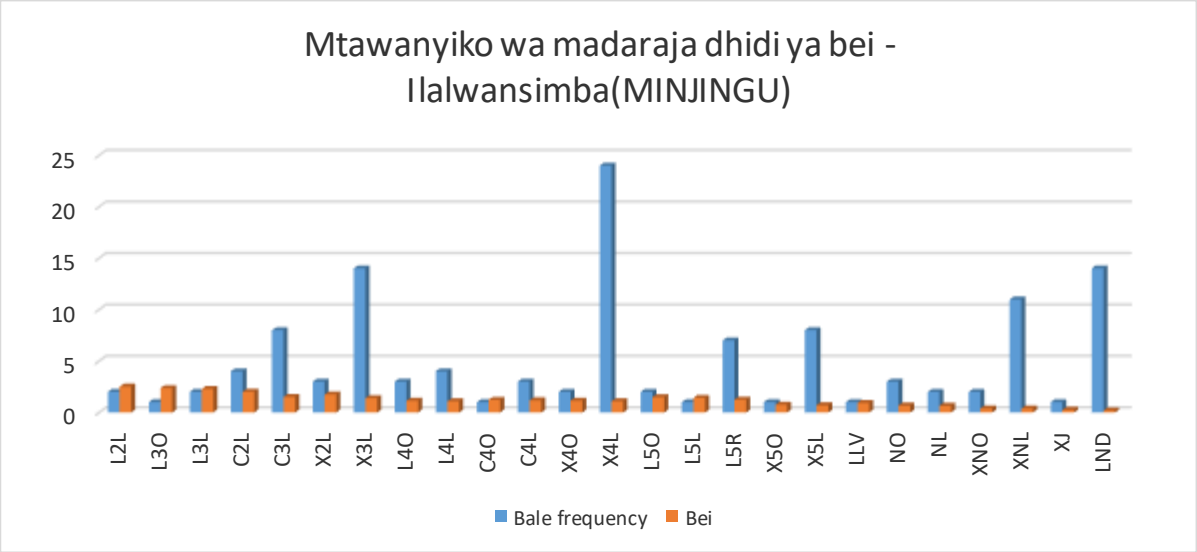
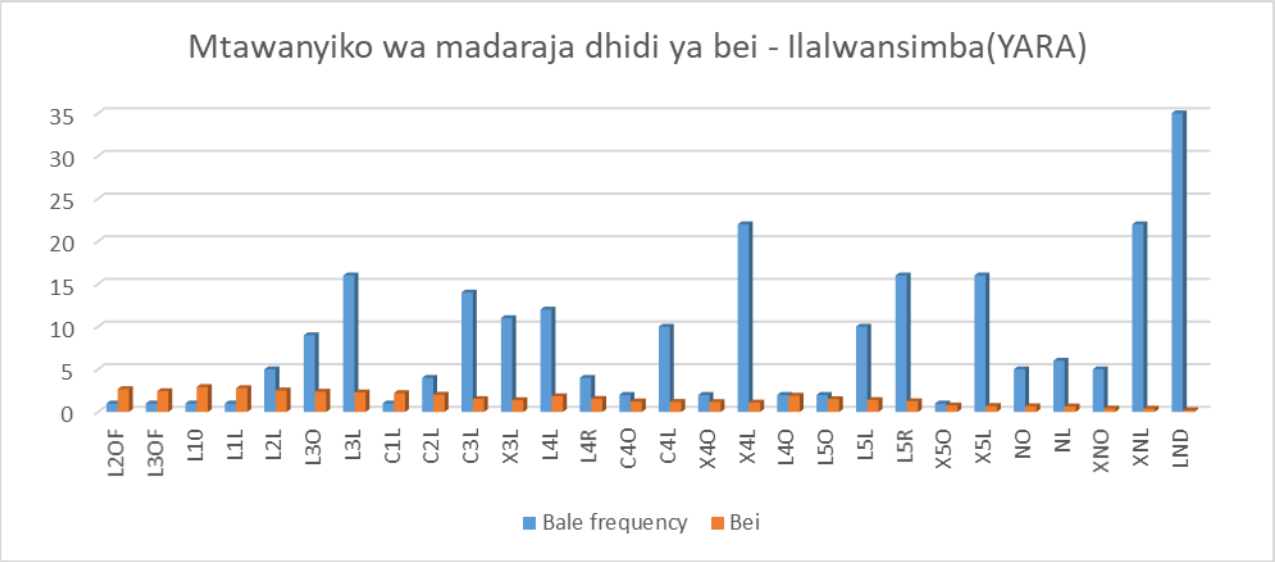


Chart number 2 indicates grade distribution versus price for Ilalwansimba AMCOS farmers who used YARA which has been used as control in this assessment.

Chart 2: Grade distribution versus price for Ilalwansimba AMCOS farmers who used YARAfertilizer



KEY;

Top quality grades – L1OF, L2OF, L3OF, L1O, L1L ,L2O L2L, L30, L3L, C1O, C1L, C2O, C2L,C3O, C3L, X1O, X1L, X2O, X2L, X3O, X3L

Fair quality grades – L4O, L4L, L4R, C4O, C4L, X4O, X4L

Low quality grades – L50, L5L, L5R, X5O, X5L, BO, BL

Poor quality grades & factored tobacco – LOV, LLV, NO, NL, LND, XOV, XLV, XNO, XNL, XJ

Chart 3: Top quality grade distribution versus weight for Ilalwansimba AMCOS farmers who used Minjingu fertilizer

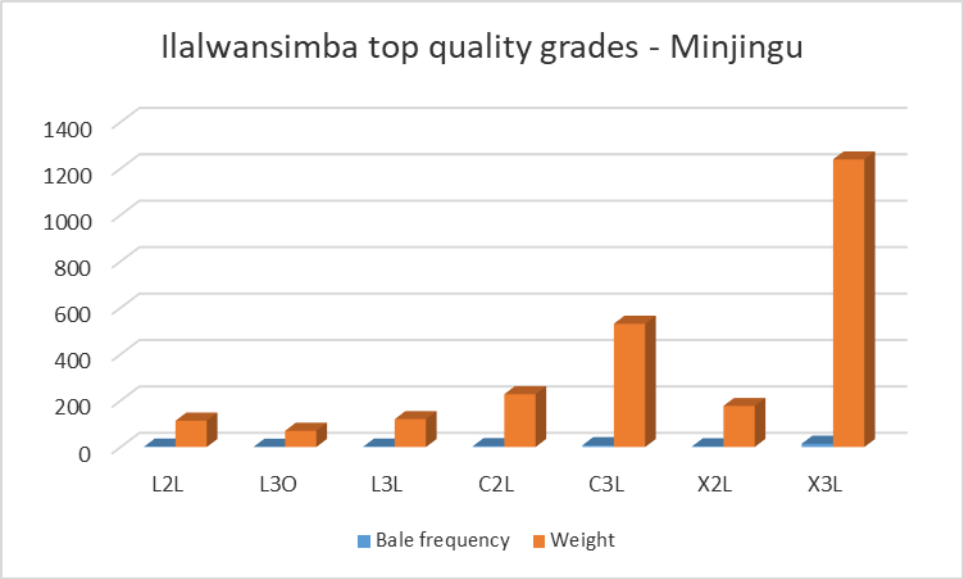
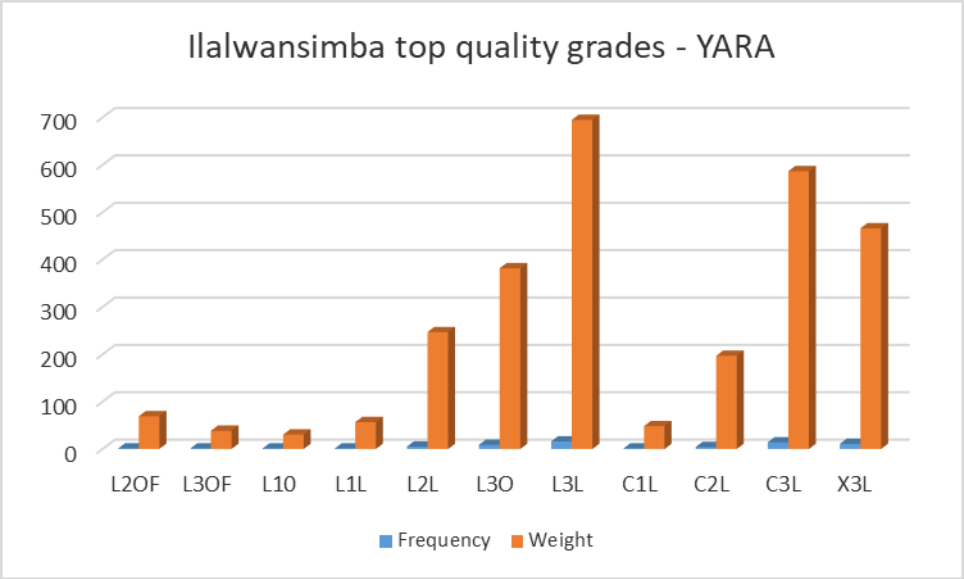


Chart 4: Top quality grade distribution versus weight for Ilalwansimba AMCOS farmers who used YARA fertilizer



Grade distribution analysis results indicates that sampled bales of the tobacco fertilized with YARA had higher percentage of top quality grades which was 18.75% while sampled bales of the tobacco fertilized with Minjingu had 2.94% of top quality grades (see chart 3&4)

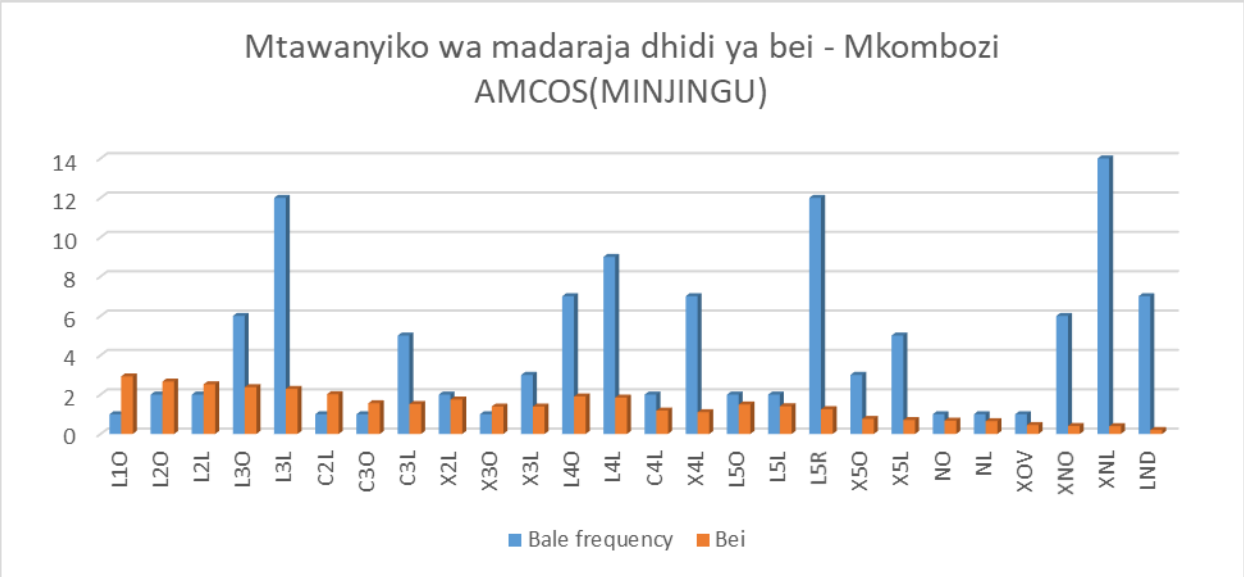
Grade distribution versus price analysis results indicates that sampled bales of the tobacco fertilized with YARA had tobacco grades with higher price compared with tobacco fertilized with Minjingu. Some of the grades of tobacco fertilized with YARA were L3L, L3O and C3O while those fertilized with Minjingu were C3L na X3L

The average price of the tobacco fertilized with YARA was $1.538 while that of Minjingu was $1.198.

Tobacco fertilized with Minjingu had higher lemon bale frequency as compared to those fertilized with YARA. This indicates that tobacco fertilized with Minjingu didn't get adequate nutrients. (See chart 1&2)

6.4.2 Results of grade analysis – Mkombozi AMCOS

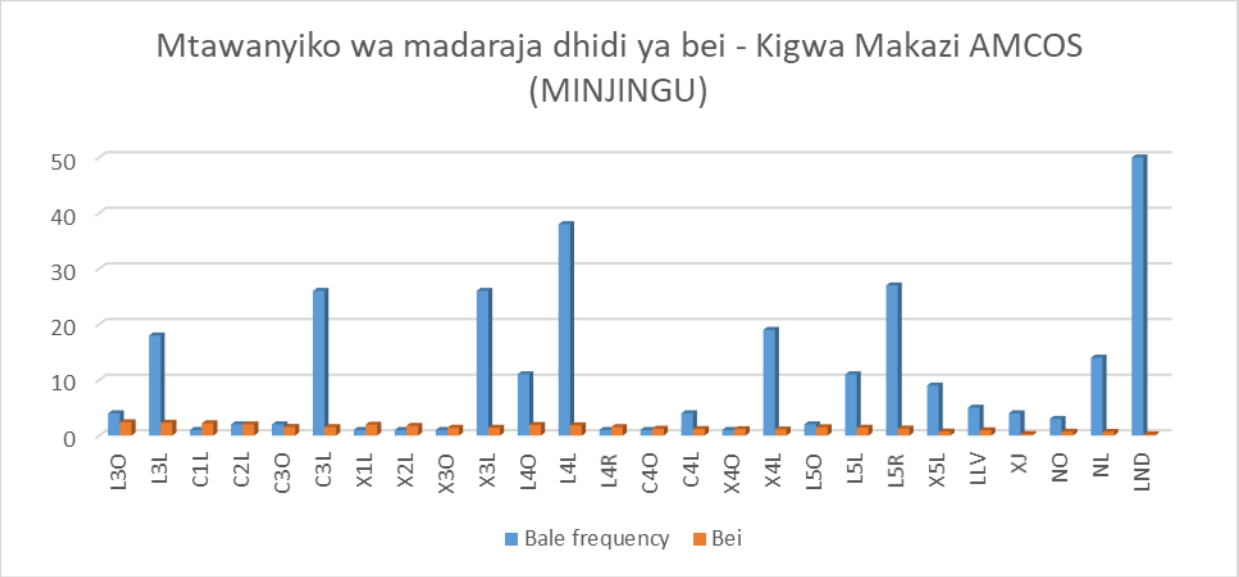
Chart 5: Grade distribution versus price for Kigwa Makazi AMCOS farmers who used Minjingu fertilizer



Grade analysis results in chart 5 indicate good performance of Minjingu fertilizer in Mkombozi AMCOS. The type of soil in this primary society is loam soil which Minjingu fertilizer had better performance compared to other types of soil. The results indicate that 66.09% of the sampled bales had lemon colour, 27.83% had orange colour and 6.09% had mahogany and factored tobacco. The average price of sampled bales was $1.417.

6.4.3 Results of grade analysis – Kigwa Makazi AMCOS

Chart 6: Grade distribution versus price for Kigwa Makazi AMCOS farmers who used Minjingu fertilizer

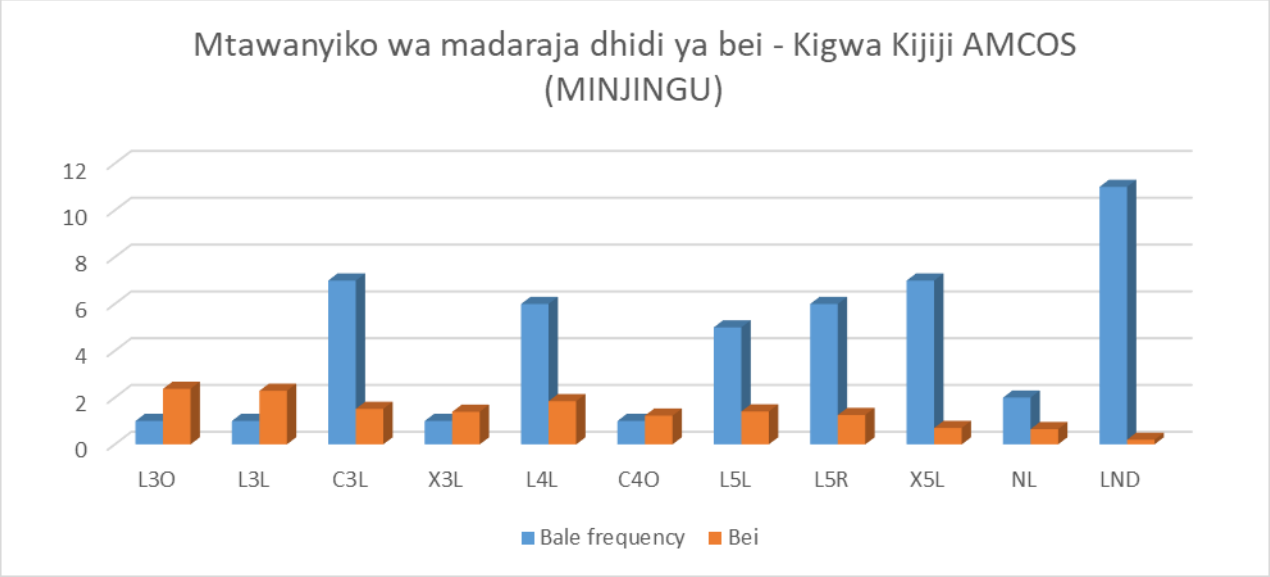


70% of the soil used for tobacco production in Kigwa is Sandy, 20% is clay and 10% is loam. Grade analysis indicates lower percentage of top to fair quality grades which was 29.1% and higher percentage of grades was of low to poor quality grades and factored tobacco which had 70.9%. Avearge price of these sampled bales for Kigwa Makazi AMCOS was $1.385

Grade colour distribution indicates that 62.41% had lemon colour, 8.87% had orange colour and 28.72% had mahogany and other factored tobacco.

6.4.4 Results of grade analysis – Kigwa Kijiji AMCOS

Chart 7: Grade distribution versus price for Kigwa kijiji AMCOS farmers who used Minjingu fertilizer

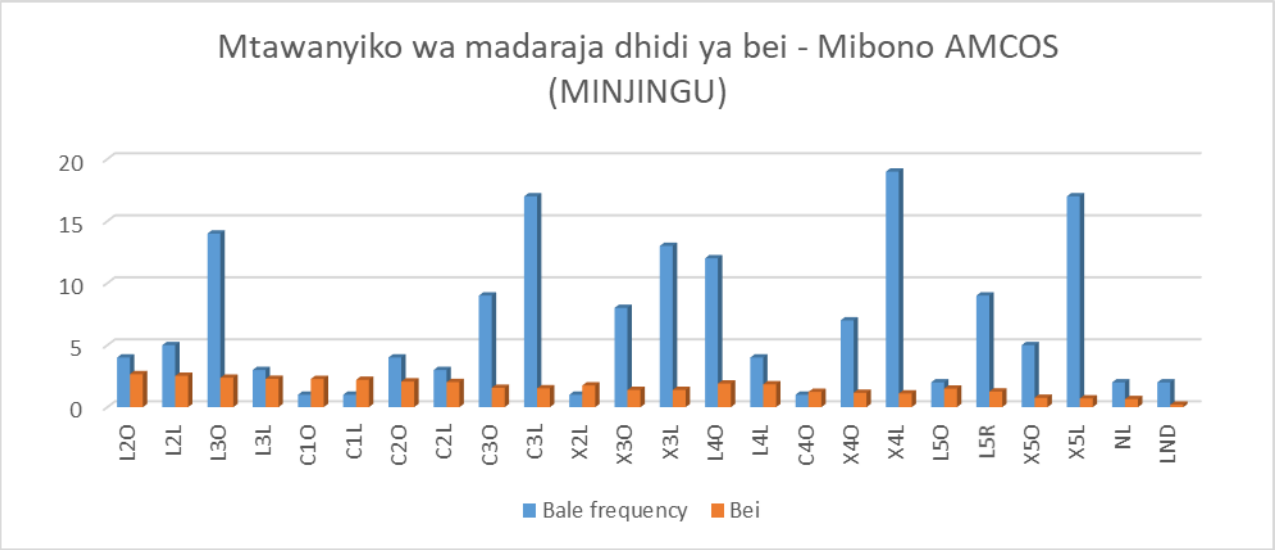


The results indicates that 60.42% of the sampled bales had tobacco with lemon clour, kwa 4.17% had orange colour and 35.41% had tobacco with mahogany colour and factored tobacco.

Tobacco with leomon colour normally have lower price compared to tobacco with orange colour. This is due to the fact that tobacco with leom colour indicates that tobacco plants didn't get adequate nutrients to reflect high quality tobacco leaves. The average price for this tobacco was $1.351

6.4.5 Results of grade analysis – Mibono AMCOS

Chart 8: Grade distribution versus price for Mibono AMCOS farmers who used Minjingu fertilizer



Results showed that grade with lemon colour had higher percentage 52.15% while those with orange colour had 41.10% and 6.75% had mahogany and other colours. This condition indicates that tobacco plants did not get enough nutrients during its growth.

75% of samples of grade in Mibono AMCOS were taken in farmers who grow their tobacco in loam soil and 15% grow in sandy soil. Also these farmers top dressed their tobacco using YARA fertilizer after getting negative response with Minjingu fertilizer. The average price of this tobacco was $1.597.

6.5 Determination of nicotine, chlorine, sugar, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and boron

Samples of dry tobacco leaves were taken and sent to laboratory to determine the amount of nicotine, chlorine, sugar, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and boron

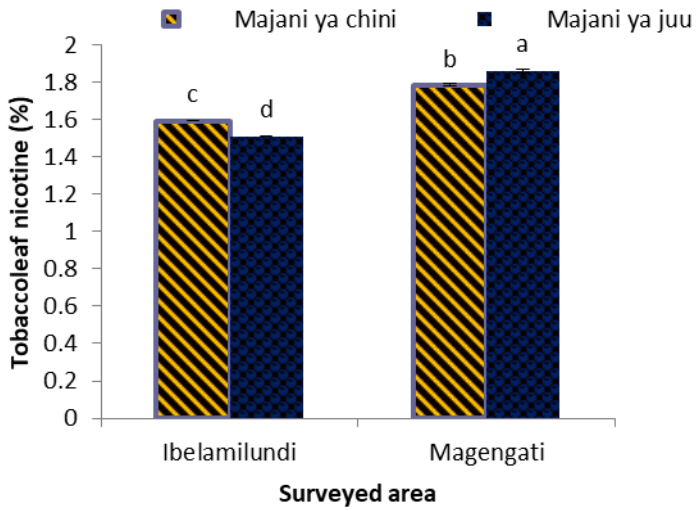
Table 4: Nutrients analysis results of dry tobacco leaves

Site	Nicotine (%)	Reducing sugars %	Nitrogen (%)	Phosphorous (%)	Calcium (%)	Magnesium (%)	Sulphur (%)	Chlorine (%)	Boron (%)
Ibelamilundi	1.55 ± 0.02 b	0.52 ± 0.02 b	2.03 ± 0.03 a	0.10 ± 0.00 b	3.31 ± 0.01 a	0.43 ± 0.01 a	0.65 ± 0.04 a	0.76 ± 0.02 a	6.19 ± 0.12 b
Magengati	1.82 ± 0.02 a	0.79 ± 0.01 a	1.69 ± 0.03 b	0.11 ± 0.00 a	3.29 ± 0.03 a	0.43 ± 0.01 a	0.70 ± 0.01 a	0.30 ± 0.03 b	8.02 ± 0.85 a
Treatments									
Majani ya chini(X&C)	1.68 ± 0.04 a	0.63 ± 0.07 b	1.86 ± 0.05 a	0.10 ± 0.00 a	3.30 ± 0.01 a	0.42 ± 0.01 a	0.64 ± 0.03 a	0.50 ± 0.09 a	6.02 ± 0.05 b
Majani ya juu(L)	1.68 ± 0.08 a	0.67 ± 0.06 a	1.85 ± 0.10 a	0.10 ± 0.00 a	3.30 ± 0.03 a	0.44 ± 0.01 a	0.70 ± 0.03 a	0.56 ± 0.11 a	8.18 ± 0.77 a
2 WAY ANOVA F-Statistic									
Site (S)	33.62***	22.68.75***	1387.2***	6.0ns	0.45ns	0.18ns	1.44ns	239.55***	248.37***
Treatment (T)	0.00ns	60.75***	1.8ns	0.00ns	0.00ns	1.68ns	2.07ns	4.07ns	346.03***
S x T	288.00***	18.75**	202.8***	0.00ns	0.11ns	0.18ns	0.92ns	2.83ns	189.86***

6.5.1 Nicotine

Nicotine content for top leaves in Magengati was 1.82% which was high by 1.55% for sampled leaves in Ibelamilundi. For bottom leaves the nicotine content was 1.68% which was the same as for top leaves. There was no significant differences and the results indicates that nicotine content was below the recommended amount of nicotine for bottom leaves which ranges between 2.0-2.5% and for top leaves ranges between 3.0-3.5% (Fisher *et al*., 2013). Low nicotine contents in dry tobacco leaves was due to the use of UREA as the source of Nitrogen which have slow release of NO^{3-} Nitrogen (International Potash Institute, 1988).

Chart 9: Results of nicotine content for bottom and top leaves in Magengati and Ibelamilundi

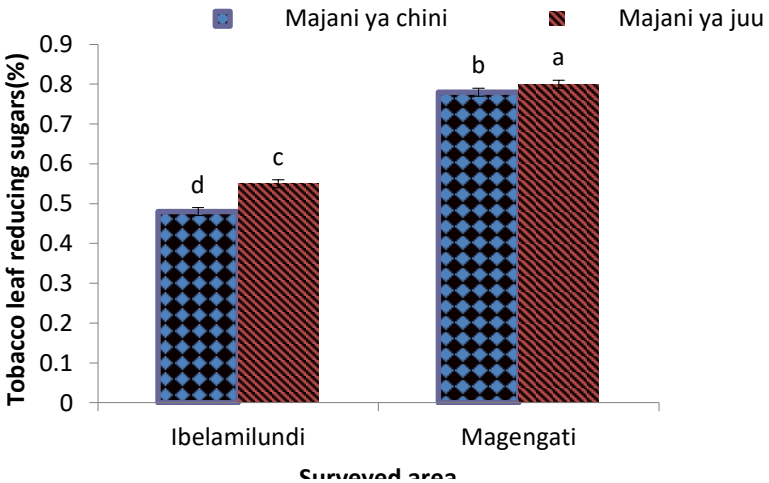


6.5.2 Total reducing sugar

Reducing sugar content for the two places where tobacco leaves samples were taken was 0.79% for Magengati top leaves while for Ibelamilundi top leaves was 0.52%. The results indicates that reducing sugar content for top leaves was below the recommended amount which ranges between 15.5%-20% (Fisher *et al*, 2013)

For Magengati bottom leaves reducing sugar content was 0.67% which was high compared to that of Ibelamilundi which was 0.63%. The results indicates that reducing sugar content for bottom leaves was below the recommended amount which ranges between 12% - 20% (Fisher *et al*, 2013)

Chart 10: Results of reducing sugar content for bottom and top leaves in Magengati and Ibelamilundi

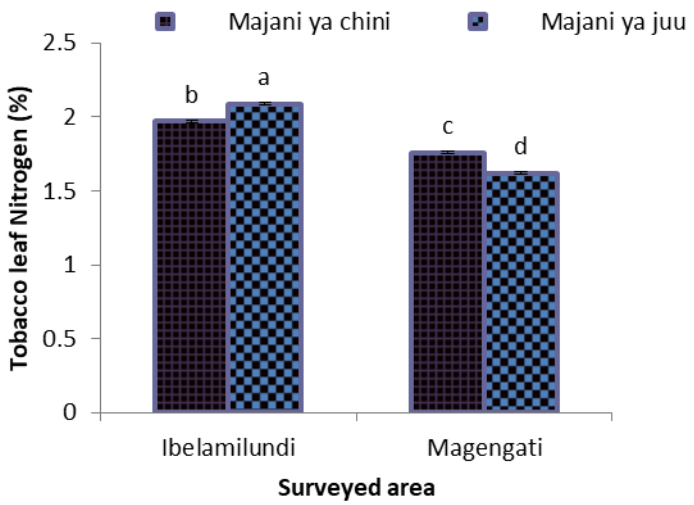


6.5.3 Nitrogen

Nitrogen (N) content for top leaves was 2.03% for sampled leaves in Ibelamilundi while for sampled leaves in Magengati was 1.69%. The Nitrogen content for sampled leaves in Ibelamilundi was within recommended range for top leaves which ranges between 2.0% - 2.25% (Baker *et al*., 2000).

Nitrogen (N) content for bottom leaves was 1.86% for sampled leaves in Ibelamilundi and 1.85% for sampled leaves in Magengati. The recommended amount of Nitrogen in bottom leaves ranges between 1.3% hadi 1.75% (Baker *et al*., 2000).

Chart 11: Results of reducing sugar content for bottom and top leaves in Magengati and Ibelamilundi



6.5.4 Phosphorus

Phosphorus content for top leaves was 0.11% for sampled leaves in Magengati and 0.1% for sampled leaves in Ibelamilundi. For bottom leaves was 0.1% for sampled leaves in Magengati and 0.1% for sampled leaves in Ibelamilundi. The results indicate that phosphorus content was within the recorecommended amount in both top and bottom leaves. The recommended amount of phosphorus for bottom leaves is between 0.12% - 0.3% and for top leaves is between 0.14% - 0.3% (Baker *et al*., 2000)

6.5.5 Calcium

Calcium content for top leaves was 3.31% for sampled leaves in Ibelamilundi and 3.29% for sampled leaves in Magengati. For bottom leaves the calcium content was 3.3% for both Magengati and Ibelamilundi. The results indicates that the calcium content was higher compared to the recomnded amount of calcium which ranges between 1.0 % - 2.5% for bottom leaves and 0.75% - 1.5% for top leaves (Baker *et al*., 2000)

6.5.6 Magnesium

Magnesium content for top leaves was 0.43% for sampled leaves in Ibelamilundi and Magengati. For bottom leaves magnesium content was 0.44% for sampled leaves in Magengati while for Ibelamilundi was 0.42%. The results indicates that magnesium content was within the recommended range which is 0.18% - 0.75% for bottom leaves and 0.2% - 0.6% for top leaves (Baker *et al*., 2000)

6.5.7 Sulphur

Sulphur content for top leaves was 0.7% for sampled leaves in Magengati and 0.65% for sampled leaves in Ibelamilundi. For bottom leaves sulphur content was 0.7% for sampled leaves in Magengati and 0.64% for sampled leaves in Ibelamilundi. The results indicate that sulphur content was higher compared to the recommended range. This high amount of sulphur has negative effects on aroma, combustibility, ash coulour and smoking characteristics (Deng *et al*, 2007). The recommended amount of sulphur for bottom leaves is 0.15% - 0.4% and 0.15% - 0.4% (Baker *et al*., 2000)

6.5.8 Chlorine

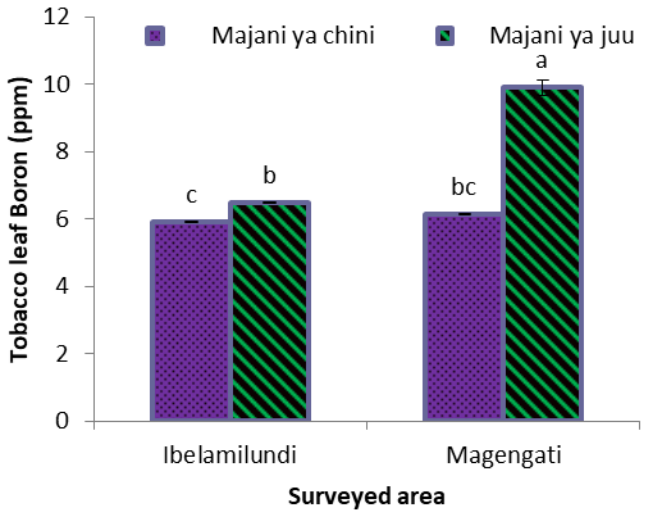
Chlorine content for top leaves was 0.76% for sampled leaves in Ibelamilundi and 0.30% for sampled leaves in Magengati. For bottom leaves chlorine content was 0.56% for sampled leaves in Mgengati and 0.5% for sampled leaves in Ibelamilundi. The results indicate that the chlorine content was within the recommended range. For bottom and top leaves the recommended range is between 0.2% - 3%.

6.5.9 Boron

Boron (B) content for top leaves was 8.02% for sampled leaves in Magengati and 6.19% for sampled leaves in Ibelamilundi. Results indicate that boron content was low compared to the recommended amount. The recommended amount of boron for top leaves ranges between 18% - 30%

Boron content for bottom leaves was 8.18% for sampled leaves in Magengati and 6.02% for sampled leaves in Ibelamilundi. The boron content was low compared to the recommended range of boron in bottom leaves which ranges between 15% - 30% (Baker *et al*., 2000)

Chart 12: Results of boron content for bottom and top leaves in Magengati and Ibelamilundi



6.6 Determination of aroma of tobacco produced by Minjingu Golden Leaf and Minjingu top dressing fertilizer

Asessment of aroma in dry tobacco leaves was done to investigate the quality of tobacco. Laboratory leaf analysis results indicates that there was high sulphur content in dry tobacco leaves which contributed to produce tobacco of poor aroma (Deng *et al*, 2007)

7.0 RESULTS OF FARMERS' OPINIONS ON THE USE OF MINJINGU FERTILIZER IN TOBACCO PRODUCTION

After farmers' interviews on the use of Minjingu fertilizer in tobacco production, data analysis was done and the following are the results;

Table 5: Farmer's experience in tobacco production

Farmer's experience in tobacco production		
Years	Frequency	Percent (%)
1-5	5	25.0
Above 5	15	75.0
Total	20	100.0

Table number 5 above indicates that 75% of the farmers interviewed have experience of tobacco production for more than five years.

Table 6: Yield obtained by tobacco farmer for 2018/2019 crop season

Expected yield per area		
	Frequency	Percent (%)
Yes	2	10.0
No	18	90.0
Total	20	100.0

Table number 6 above indicates farmers' opinions on whether they get satisfactory yield per area cultivated. The results indicates that 90% of the farmers interviewed responded that they get low yield than what they expected and 10% said they get satisfactory yield

Table no 7: Causes of low yield tobacco

	Frequency	Percent (%)
Bad weather	6	30.0
Inadequate nutrients	6	30.0
Failure to perform on time	1	5.0
Require high moisture content to work properly	6	30.0
Late inputs delivery	1	5.0
Total	20	100.0

Table number 7 above indicates causes of low yield tobacco. The results indicates that 30% of the farmers interviewed responded that bad weather was the cause of low yield, 30% said it was because of inadequate nutrients in Minjingu fertilizer, 5% responded that it was because of failure of Minjingu fertilizer to perfrom on time, 30% said Minjingu fertilizer require high moisture content to work properly and 5% responded that low yield tobacco was as a result of late inputs delivery.

Table 8: Farmers' opinions on appropriateness/inappropriateness of Minjingu fertilizer in tobacco production

Farmers' opinions on appropriateness/inappropriateness of Minjingu fertilizer in tobacco production		
	Frequency	Percent (%)
Yes	4	20.0
No	15	75.0
Don't know	1	5.0
Total	20	100.0

Table number 8 above indicates farmers' opinions on appropriateness/inappropriateness of Minjingu fertilizer in tobacco production. The results indicates that 75% of the farmers interviwed responded that it is not appropriate to use Minjingu fertilizer in tobacco production while 20% it was appropriate to use Minjingu fertilizer in tobacco production.

Table 9: Causes of the farmers to reject Minjingu fertilizer to be used in tobacco production

Causes of the farmers not to prefer Minjingu fertilizer in tobacco production		
	Frequency	Percent (%)
Does not produce orange colour after curing	3	15.0
Late absorption by the plant	3	15.0
Produce tobacco of low quality grades	6	30.0
Inadequate nutrients	1	5.0
Poor performance in sandy soil	4	20.0
Needs high moisture content to work properly	3	15.0
Total	20	100.0

Table number 9 above indicates causes of the farmers to reject Minjingu fertilizer to be used in tobacco production. The results indicates the following reasons; 15% Does not produce orange colour after curing, 15% Late absorption by the plant, 30% Produce tobacco of low quality grades, 5% Inadequate nutrients, 20% Poor performance in sandy soil and 15% Needs high moisture content to work properly.

Table 10: Farmers' advice for Minjingu fertilizer manufacturer

Farmers' advice for Minjingu fertilizer manufacturer			
		Frequency	Percent (%)
	Should be improved to have nutrients to satsfy tobacco plant	18	90.0
	wabadilishe mjengeko wa utengenezaji wa virutubisho vyake	1	5.0
	Should be improved to perform well in all types of soil	1	5.0
	Total	20	100.0

Table number 10 above indicates farmers' advice for Minjingu fertilizer manufacturer. The result indicates that, 90% responded that Minjingu fertilizer should be improved to have nutrients to satsfy tobacco plant nutrition.

Table 11: Causes of the farmers to get tobacco of low quality

Causes of the farmers to get tobacco of low quality			
		Frequency	Percent (%)
	Inadequate nutrients	3	15.0
	Late absorption by the plant	12	60.0
	Shortage of barns	1	5.0
	Inadequate rainfall	1	5.0
	Shortage of storage facility	1	5.0
	Total	18	90.0
Missing	System	2	10.0
Total		20	100.0

Table number 11 above indicates causes of the farmers to get tobacco of low quality. The results indicates that 15% Inadequate nutrients within Minjingu fertilizer, 60% Late absorption of Minjingu fertilizer by the plant, 5% Shortage of barns, 5% Inadequate rainfall, 5% Shortage of storage facility

Table 12: Farmers opinions on improving tobacco production

Farmers opinions on improving tobacco production		
	Frequency	Percent (%)
Inputs should be delivered to farmers on time	6	30.0
Farmers training on principles of tobacco production	1	5.0
The quality of Minjingu fertilizer should be improved	10	50.0
Farmers should continue to use YARA	2	10.0
CAN ya minjingu iondolewe UREA	1	5.0
Total	20	100.0

Table number 12 above indicates farmers' opinions on improving tobacco production. Results indicates that; 30% Inputs should be delivered to farmers on time, 5% Farmers training on principles of tobacco production, 50% The quality of Minjingu fertilizer should be improved, 10% Farmers should continue to use YARA and 5% mbolea ya CAN ya minjingu iondolewe UREA.

Table 13: Availability of inputs on time

Availability of inputs on time		
	Frequency	Percent (%)
No	20	100.0

Table number 13 above indicates farmers' opinions on availability of inputs on time. Results indicates that 100% of the farmers interviewed responded that inputs are not delivered on time

8.0 CONCLUSION

- ✓ The amount of nutrients in Minjingu NPK(Golden tobacco leaf) and CAN(Top dressing fertilizer) has been observed to be low as compared to the recommended fertilizer specification for tobacco production in Tanzania
- ✓ Tobacco leaves fertilized in loam soil had greater leaf size compared to those fertilized in sandy soil.
- ✓ There was no difference in days of reaping and drying for tobacco fertilized with Minjingu fertilizer and that fertilized with YARA fertilizer.
- ✓ High sulphur content in dry tobacco leaves have contributed to destroy the aroma of tobacco
- ✓ Tobacco fertilized with Minjingu fertilizer has produced high number of lemon grades leading to lower average price.

- ✓ Currently Minjingu fertilizer should not be used for tobacco production until there is improvement in recommended nutrients required by the tobacco plants so as to avoid loss to farmers.

9.0 RECOMMENDATIONS

- ✓ It is recommended that Minjingu mines and Fertilizer Company should use other sources of Nitrogen that could be readly available to plant. Ammonium nitrate is the best source of nitrogen to be used in tobacco production.
- ✓ Rock phosphate (MOHP – PW) is best used in soil with high organic matter and pH below 5.5. This makes Rock Phosphate not suitable for tobacco production because tobacco grows well in pH range from 5.5 – 7.6. Rock phosphate have slow nutrient release especially in sandy soil hence the use of hydroxyl acids combined with calcium and iron could help to dissolve organic phosphorous to enhance phosphate to be readly available to plant.
- ✓ Muriate of Potash (MOP) used in blending minjingu NPK as the only source of Potassium (K) is not recommended because Potassium Chloride release high amount of chlorine (Cl). The amount of chlorine released from this source of Potasium chloride ranges between 45 – 47%. This amount is toxic to tobacco plant and it is not recommended because it destroys smoking characteristics, growth and quality of tobacco leaves. Hence MOP is best blended with other sources of Potassium fertilizers for the ratio that could reduce the amount of Cl in the fertilizer. It is recommended that the amount of chlorine released should not exceed 13.61 per acre. Good source of Potassium is sulphate of potash (SOP) because contains no Chloride and hence has much lower salt index also K-Mag (Sul-Po-Mag) is prefered because it release enough amount of Magnesium 11% and Sulfur 22% while releasing very little amount of Cl which is below 2.5%. Other recommended source of K is Potassium Nitrate.
- ✓ In manufacturing NPK and CAN fertilizers for tobacco production it is very important to consider proper nutrients recommended for tobacco production in Tanzania. This advice has also been delivered in the previous research report of 2017/18 crop season (*evaluation of Minjingu NPK 10:18:24 and CAN 27% in Tabora, Kahama, Urambo and Chunya released 30th April, 2018*).

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Appendix 1: Types of soil used for tobacco production in Tabora region

No.	District	Ward	Village	Sand soil (Kichanga)*"Isenga"* (%)	Kichanga chekundu*"Kikungu)* (%)	Clay soil *(Manda)* (%)
1	Kaliua	Kaliua	Kasungu	43	42	15
2	Kaliua	Kamsekwa	Kamsekwa	70	20	10
3	Kaliua	Kanindo	Kanindo	75	20	5
4	Kaliua	Mwongozo	Ibambo	30	50	20
5	Nzega	Puge	Upungu	90	5	5
6	Nzega	Magengati	Usagali	80	15	5
7	Nzega	Milambo Itobo	Kakulungu	60	35	15
8	Nzega	Milambo Itobo	Malole	70	10	20
9	Nzega	Mambali	Mambali	50	50	0
10	Nzega	Mambali	Mbutu	70	30	0
11	Nzega	Ikindwa	Kayombo	75	15	15
12	Nzega	Ikindwa	Malolo	75	25	0
13	Uyui	Magiri	Mayombo	25	50	25
14	Uyui	Magiri	Magiri	75	10	15
15	Uyui	Magiri	Imalampaka	75	10	15
16	Uyui	Isikizya	Ilalwansimba	80	15	5

17	Uyui	Isikizya	Igoko	30	50	20
18	Uyui	Kigwa	Kigwa	70	10	20
19	Uyui	Kigwa	Itundaukulu	70	30	0
20	Uyui	Bukumbi	Ishihimulwa	80	20	0
21	Uyui	Bukumbi	Mbeya	0	80	20
22	Uyui	Ilolangulu	Isila	55	25	20
23	Uyui	Ilolangulu	Mpenge	80	0	20
24	Uyui	Mabama	Mabama	75	10	15
25	Uyui	Ndono	Ndono	82	15	3
26	Uyui	Ufuluma	Ufuluma	80	10	10
27	Uyui	Ibiri	Ibiri	60	10	30
28	Uyui	Igalula	Igalula	75	25	0
29	Sikonge	Mole	Mole	65	20	15
30	Sikonge	Kisanga	Kisanga	5	75	20
31	Sikonge	Kipanga	Ukondamoyo	75	20	5
32	Sikonge	Ipole	Udongo	60	30	10
33	Sikonge	Kitunda	Mgambo	55	30	15
34	Tabora	Tumbi	Tumbi	60	20	20
35	Tabora	Ntalikwa	Ntalikwa	70	25	5
36	Urambo	Uyumbu	Ussoke mlimani	80	2	18
37	Urambo	Usisya	Katunguru	50	30	20
38	Urambo	Ukondamoyo	Ukondamoyo	73	27	0
39	Urambo	Vumilia	Motomoto	70	20	10
			Total	**2463**	**986**	**466**
			Average (%)	**63**	**25**	**12**

Source: Evaluation of soil status in tobacco growing regions (Gama *et. al*, 2014)

Appendix 2: Leaf area for tobacco produced in sand and loam soil

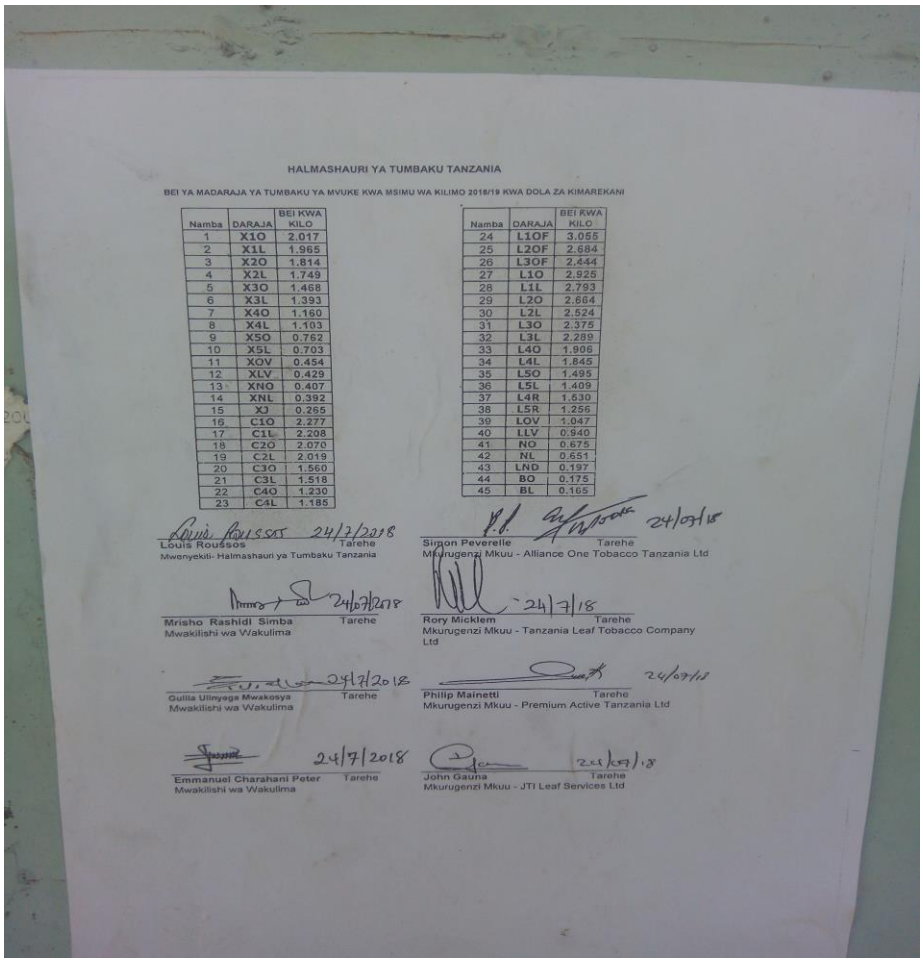
Farmer 1(Kikungu)	Entry	Bottom leaves (cm)		Middle leaves (cm)		Top leaves (cm)		Leaf area index		
		Length	Width	Length	Width	Length	Width	Bottom leaves	Middle leaves	Top leaves
	1	28	16.4	56.5	28.6	63.1	27.2	270.613	978.231	975.56
	2	32.4	17	52	23.4	59.7	20.7			
	3	32.3	20.4	53.6	28.8	58.2	20.2			
	4	30.4	14.8	54.4	26.1	60	25.3			
	5	26.2	13	59.5	32.2	61.2	31.3			
	6	31.5	14.5	55.3	31.2	58.2	26.1			
	7	22.4	11.2	52.4	24.5	62.1	27.8			
	8	25	15.3	58.2	20	51.2	21.5			
	9	26.1	13.2	57.5	28.8	63.4	32.3			
	10	29.1	13.4	52.4	33.4	59.5	23.1			
		28.34	14.92	55.18	27.7	59.66	25.55			
Farmer 2(Kikungu)	1	34	17.3	51.4	29.2	61	22.3	281.863	881.491	809.105
	2	30.5	16.4	49.5	20	58.3	17.1			
	3	28.2	13	57.6	34.4	50.3	20.7			
	4	27	13.4	50	25.5	60.3	22			
	5	32.4	18	51.2	22.5	62.1	23.2			
	6	32.1	15.2	53.4	24.3	55.6	20.2			
	7	24	11.4	58.3	28	59.3	25.1			
	8	27.2	15.3	54.5	29.8	53.1	21.3			
	9	33	19.5	55.2	26.8	57.8	18.4			
	10	22.3	12	45	21.3	60	28.5			
		29.07	15.15	52.61	26.18	57.78	21.88			
Farmer 3(Kikungu)	1	30.2	13.5	51.2	19	50.1	28.3	286.148	829.008	828.376
	2	36.7	18.6	45.2	26.3	55.2	27.2			
	3	28	15	51	22.5	61.3	28.6			
	4	34.6	20.4	53.1	28.6	53.2	18.3			
	5	30.3	16	57.2	24.5	60.1	22.3			
	6	26	12	44.5	26	57.6	22.7			

	7	31.4	16	43.3	19.5	54.4	19.5			
	8	34.3	18.2	54.5	24.2	53	22.1			
	9	21.2	10	52.4	35.5	58.3	18.3			
	10	20.1	13	52.6	30.4	59.8	22.6			
		29.28	15.27	50.5	25.65	56.3	22.99			
Farmer 4(Kichanga)	1	29.2	18.5	43.2	22.5	39.8	20.3	306.067	625.856	565.258
	2	30	19	44.6	21.5	41.8	19.6			
	3	29.5	17.4	40.5	25.5	39.6	21.7			
	4	27.6	19	41.7	24.4	41.4	21.4			
	5	29.7	16.2	42.5	20.5	49.4	19.9			
	6	28.5	17.4	44.8	22.4	47.6	21.5			
	7	29.4	17.2	43.4	23.2	42.8	20.2			
	8	26	14	40.8	25.6	43.4	19.6			
	9	29.9	14.8	41.7	24.9	42.5	20.5			
	10	25.2	14.3	40.5	20.3	39.2	21.9			
		28.5	16.78	42.37	23.08	42.75	20.66			
Farmer 5 (Kichanga)	1	31.2	17.9	43.7	22	48.1	14.2	340.826	605.247	573.969
	2	30.4	14.5	45.1	19.2	51.8	27.5			
	3	30.2	26	43.3	16	42.2	17.1			
	4	29.4	14.5	58.2	21.3	42.3	14			
	5	30.3	20	44.9	22.1	50	18.2			
	6	28.6	13.2	53.2	24	50.2	16.5			
	7	29.5	22	50	21.3	51	23.2			
	8	29.9	19.8	42.2	18.4	51.2	21			
	9	24.3	17.6	48.5	21.5	43	16.2			
	10	31.4	14.9	42.1	14.9	50.3	18.9			
		29.52	18.04	47.12	20.07	48.01	18.68			

Appendix 3: Types of soil in primary societies which used Minjingu fertilizer

N0.	AMCOS	Sand (%)	Loam (%)	Clay (%)
1	Ilalwansimba	80	15	5
2	Kigwa Kijijij & Makazi	70	10	20
3	Ibelamilundi	80	15	5
4	Magengati	80	15	5
5	Mibono	60	30	10
6	Tumbi	60	20	20
7	Mkombozi	60	10	30
8	Tupendane	60	10	30
9	Kitunda	55	30	15
10	Tumaini	65	20	15
Average (%)		**67**	**17.5**	**15.5**

Appendix 4: Grade prices for 2018-219 crop season



HALMASHAURI YA TUMBAKU TANZANIA

BEI YA MADARAJA YA TUMBAKU YA MVUKE KWA MSIMU WA KILIMO 2018/19 KWA DOLA ZA KIMAREKANI

Namba	DARAJA	BEI KWA KILO
1	X1O	2.017
2	X1L	1.965
3	X2O	1.814
4	X2L	1.749
5	X3O	1.468
6	X3L	1.393
7	X4O	1.160
8	X4L	1.103
9	X5O	0.762
10	X5L	0.703
11	XOV	0.454
12	XLV	0.429
13	XNO	0.407
14	XNL	0.392
15	XJ	0.265
16	C1O	2.277
17	C1L	2.208
18	C2O	2.070
19	C2L	2.019
20	C3O	1.560
21	C3L	1.518
22	C4O	1.230
23	C4L	1.185

Namba	DARAJA	BEI KWA KILO
24	L1OF	3.055
25	L2OF	2.684
26	L3OF	2.444
27	L1O	2.925
28	L1L	2.793
29	L2O	2.664
30	L2L	2.524
31	L3O	2.375
32	L3L	2.289
33	L4O	1.906
34	L4L	1.845
35	L5O	1.495
36	L5L	1.409
37	L4R	1.630
38	L5R	1.256
39	LOV	1.047
40	LLV	0.940
41	NO	0.675
42	NL	0.651
43	LND	0.197
44	BO	0.175
45	BL	0.165

Louis Rousos 24/7/2018
Louis Rousos — Tarehe
Mwenyekiti- Halmashauri ya Tumbaku Tanzania

24/07/18
Simon Peverelle — Tarehe
Mkurugenzi Mkuu - Alliance One Tobacco Tanzania Ltd

24/7/2018
Mrisho Rashidi Simba — Tarehe
Mwakilishi wa Wakulima

24/7/18
Rory Micklem — Tarehe
Mkurugenzi Mkuu - Tanzania Leaf Tobacco Company Ltd

24/7/2018
Gulila Ulimyoga Mwakosya — Tarehe
Mwakilishi wa Wakulima

24/07/18
Philip Mainetti — Tarehe
Mkurugenzi Mkuu - Premium Active Tanzania Ltd

24/7/2018
Emmanuel Charahani Peter — Tarehe
Mwakilishi wa Wakulima

24/07/18
John Gauna — Tarehe
Mkurugenzi Mkuu - JTI Leaf Services Ltd

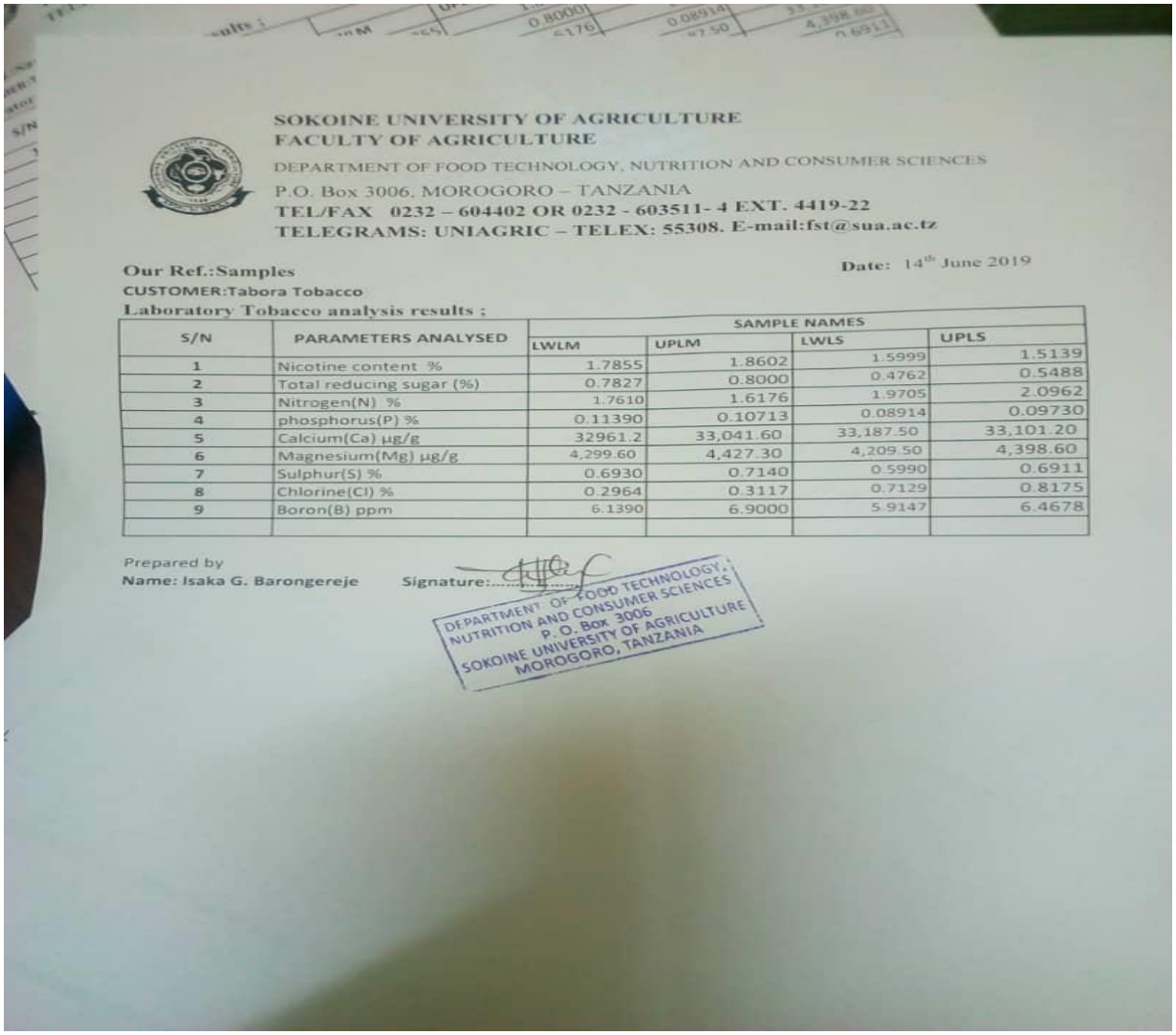
Appendix 5: Sufficiency ranges for macro and micro nutrients in flue cured tobacco leaves

Macronutrients (%)							
Growth stage	Tissue	**N**	**P**	**K**	**Ca**	**Mg**	**S**
Seedling	MRML	4.0 - 6.0	0.2 - 0.5	3.0– 4.0	0.6- 1.5	0.2-0.6	0.15-0.6
Early growth	MRML	4.0 - 5.0	0.2 - 0.5	2.5 - 3.5	0.75-1.5	0.2-0.6	0.15-0.6
Flowering	MRML	3.5 - 4.5	0.2 - 0.5	2.5 - 3.5	0.75-1.5	0.2-0.6	0.15-0.6
Maturity	MRML	2.25 – 3.0	0.17-0.5	1.6 -3.0	0.75-1.5	0.2-0.6	0.15-0.6
Harvest	Upper leaf	2.0 – 2.25	0.14-0.3	1.5– 2.5	0.75-1.5	0.2-0.6	0.15-0.4
Harvest	Middle leaf	1.6 – 2.0	0.13- 0.3	1.5– 2.5	1.0-2.0	0.2-0.6	0.15-0.4
Harvest	Lower leaf	1.3 - 1.75	0.12- 0.3	1.3-2.5	1.0-2.5	0.18-0.75	0.15-0.4

Micronutrients (ppm)						
Growth stage	Tissue	**Fe**	**Mn**	**Zn**	**Cu**	**B**
Seedling	MRML	50-300	20-250	20-60	5-10	18-75
Early growth	MRML	50-300	20-250	20-60	5-10	18-75
Flowering	MRML	50-300	20-250	20-60	5-10	18-75
Maturity	MRML	50-300	20-250	20-60	5-10	18-75
Harvest	Upper leaf	40-200	20-350	18-60	5-10	18-30
Harvest	Middle leaf	40-200	20-350	18-60	4-10	18-30
Harvest	Lower leaf	40-200	18-350	18-60	3-10	15-30

Source: Southern Cooperative Series Bulletin (SCSB)

Appendix 6: Dry tobacco leaves analysis results



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Our Ref.:Samples
Date: 14th June 2019
CUSTOMER:Tabora Tobacco
Laboratory Tobacco analysis results ;

S/N	PARAMETERS ANALYSED	SAMPLE NAMES			
		LWLM	UPLM	LWLS	UPLS
1	Nicotine content %	1.7855	1.8602	1.5999	1.5139
2	Total reducing sugar (%)	0.7827	0.8000	0.4762	0.5488
3	Nitrogen(N) %	1.7610	1.6176	1.9705	2.0962
4	phosphorus(P) %	0.11390	0.10713	0.08914	0.09730
5	Calcium(Ca) µg/g	32961.2	33,041.60	33,187.50	33,101.20
6	Magnesium(Mg) µg/g	4,299.60	4,427.30	4,209.50	4,398.60
7	Sulphur(S) %	0.6930	0.7140	0.5990	0.6911
8	Chlorine(Cl) %	0.2964	0.3117	0.7129	0.8175
9	Boron(B) ppm	6.1390	6.9000	5.9147	6.4678

Prepared by
Name: Isaka G. Barongereje Signature:.....

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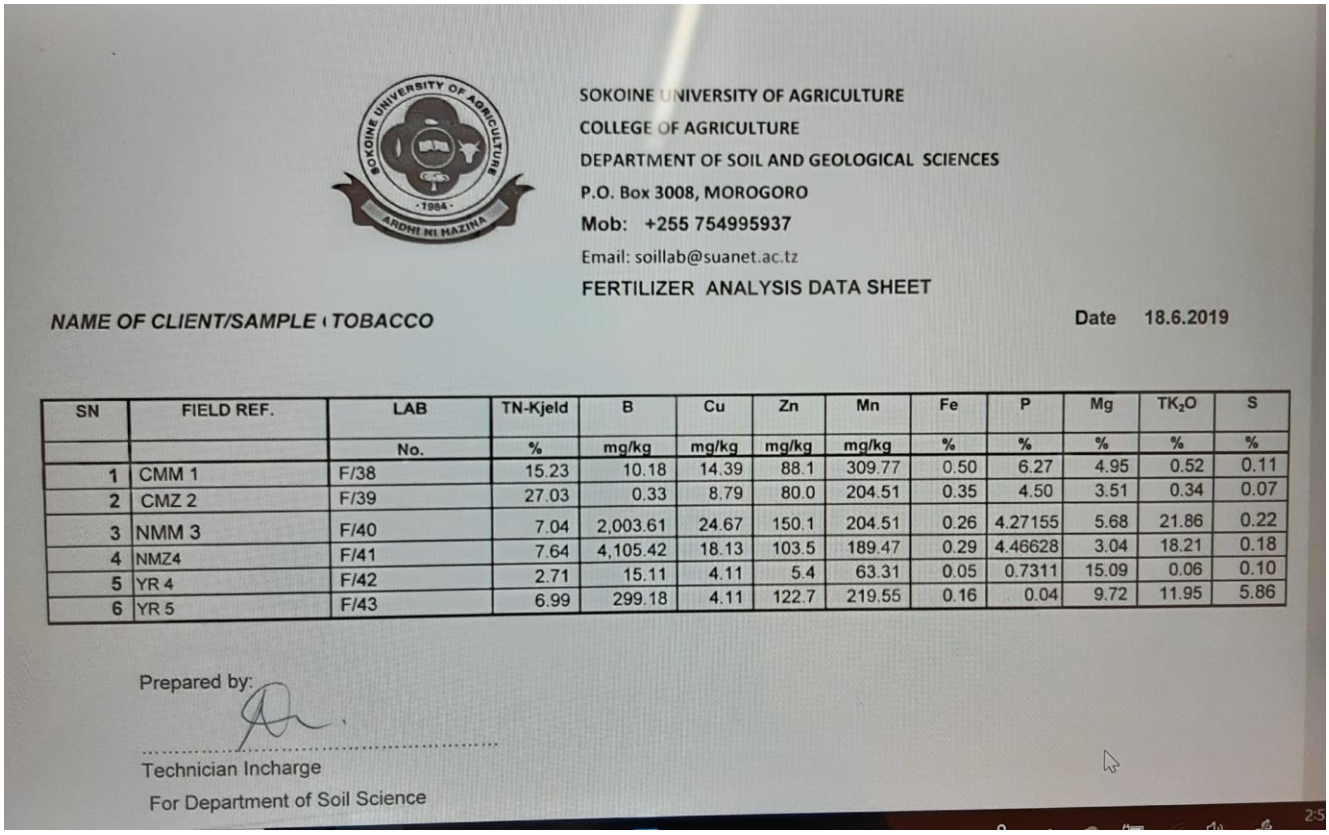
Appendix 7: Minjingu fertilizer laboratory analysis results



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FERTILIZER ANALYSIS DATA SHEET

NAME OF CLIENT/SAMPLE : TOBACCO

Date 18.6.2019

SN	FIELD REF.	LAB	TN-Kjeld	B	Cu	Zn	Mn	Fe	P	Mg	TK_2O	S
		No.	%	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%
1	CMM 1	F/38	15.23	10.18	14.39	88.1	309.77	0.50	6.27	4.95	0.52	0.11
2	CMZ 2	F/39	27.03	0.33	8.79	80.0	204.51	0.35	4.50	3.51	0.34	0.07
3	NMM 3	F/40	7.04	2,003.61	24.67	150.1	204.51	0.26	4.27155	5.68	21.86	0.22
4	NMZ4	F/41	7.64	4,105.42	18.13	103.5	189.47	0.29	4.46628	3.04	18.21	0.18
5	YR 4	F/42	2.71	15.11	4.11	5.4	63.31	0.05	0.7311	15.09	0.06	0.10
6	YR 5	F/43	6.99	299.18	4.11	122.7	219.55	0.16	0.04	9.72	11.95	5.86

Prepared by:

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Technician Incharge

For Department of Soil Science