Chemical Constituents of Different Cultivars of *Manihot esculenta* Crantz Treated by Inorganic Fertilizer

Htaik Htaik Lin

Abstract

Growing of cassava plant (*Manihot esculenta* Crantz) was set up in two factors factorial of RCBD. Factor A was the cultivar and factor B was the treatment, the inorganic fertilizer (15:15:15) 300 kg ha^{-1}, 400 kg ha^{-1} and 500 kg ha^{-1} were applied as the treatments, factors B. The nutritional analyses showed the starch content of both cultivars were higher (65.55% and 56.29%) than the reference value (56.0%). The protein content of both cultivars was lesser (1.840%, 2.258%) than the reference value (5.36%). Most of the cassava gives dizzy or sometimes vomiting after diet. However, the cyanide content of boiled tubers of the experimental cultivars was not detected.

Keywords**:** Cassava, two factors factorial of RCBD, inorganic fertilizer, protein, cyanide

Introduction

Cassava (*Manihot esculenta* Crantz) is the fourth most important source of food energy in the tropics. More than two-thirds of the total production of this crop is used as food for human, with lesser amounts being used for animal feed and industrial purposes (Cock and Reyes, 1985). Inorganic fertilizers are usually quick-release formula making nutrients rapidly available to plants. The advantages of using inorganic fertilizers are nutrients immediately available to plants and exact amount of a given element can be measured before feeding to plants (www.en.wikipedia.org/wiki/inorganic). In Myanmar, cassava production is still lesser than other Asia countries. It is therefore this study is aimed to determine the effects of inorganic fertilizer, on growth and yield of cassava with different cultivars, and to select the best cultivar for high production for future trade.

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Materials and Methods

Source of plant materials

The plant materials, the cutting pieces of stem are collected from Nyaung-hnit-pin, crop cultivation zone (3), Hmaw-bi Township, and Yangon Region.

Cultivation of stem cut and experimental design

The prepared stem cuts were cultivated in the prepared beds using triangular system. There are 2-cultivars of cassava and each cultivar had 4 treatments. Each treatment had 3- replications. They are planted in 2 factors factorial of randomized completely block design (RCBD).

Data collection and statistical analysis

Used IRRISTAT software

Fertilization

Split fertilization of the inorganic fertilizer (15:15:15) was applied to the crop 2 months after cultivation.

Preparation of tubers for the analysis of cyanide, protein, and starch content

Firstly, tubers were thoroughly washed from the cultivated field and the cleaned tubers were sliced and air-dried under good ventilation. After air drying tuber were slices, then they were blundered to get powder. These powders were put in to an air tight plastic bag, and submitted to Myanma Scientific and Technological Research Department, Ministry of Science and Technology for analysis.

Results

Table 1. Yield of white and red cultivars of cassava resulted from different levels treatment

FA (Cultivar)	FB (Treatment)	Yield (kg/Treatment)	Yield (kg)ha $^{-1}$
C1 (white)	T1 (Control)	1.59	180.84
	T2 (300 kg/ha)	1.62	184.26
	T3 (400 kg/ha)	2.17	247.70
	T4 (500 kg/ha)	2.53	287.98
C2 (Red)	T1 (Control)	2.31	263.67
	T2 (300 kg/ha)	1.86	212.37
	T3 (400 kg/ha)	2.49	283.42
	T4 (500 kg/ha)	2.79	318.37
F-test		ns	ns
5%LSD		1.12	128.03
Cv%		29.6	29.6

**= highly significant, ns = non significant

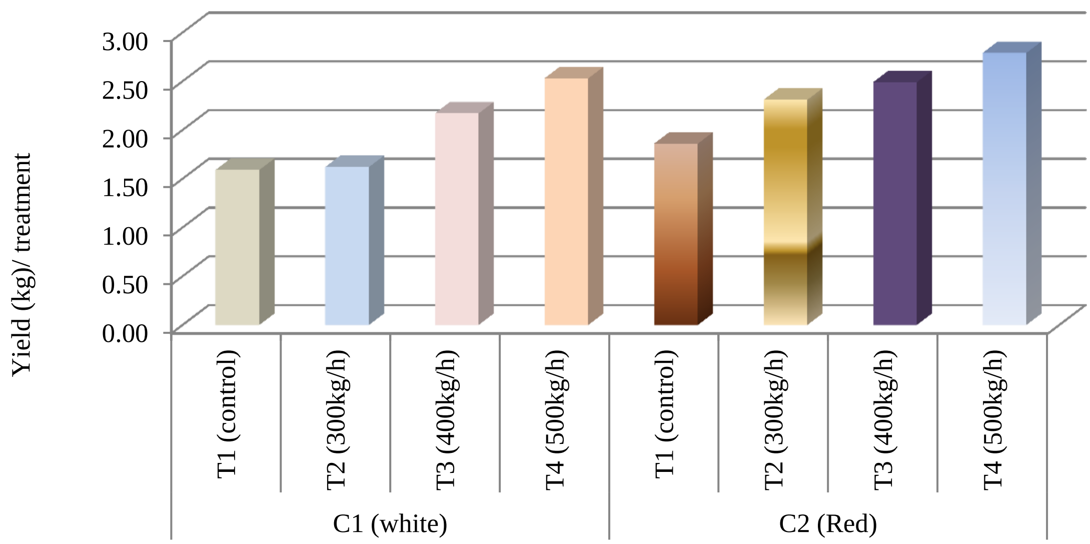
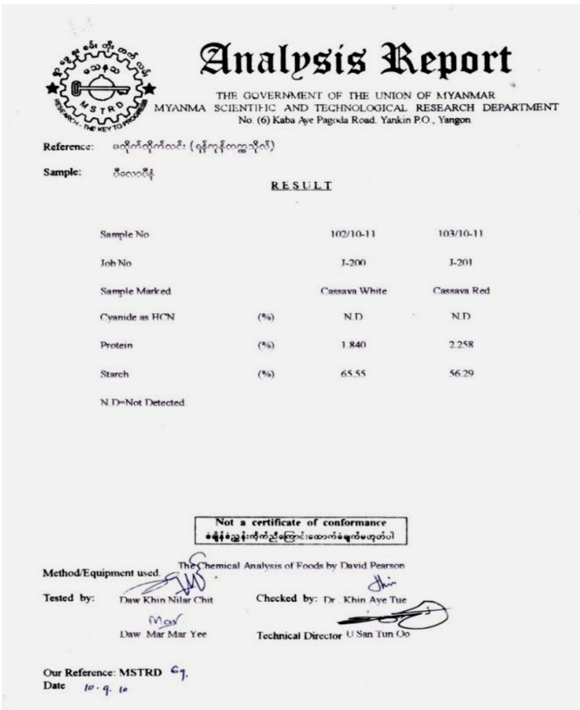


Figure .1 Interaction of white and red cultivars and different levels treatment effect on yield of cassava

The statistical analyzed results of the interaction of factor A and B showed that the highest yield (2.79 kg/ha) was produced from the interaction of red cultivar and NPK (500kg/treatment). The second highest yield (2.53kg/ha) was produced from the interaction of white cultivar and NPK (500kg/treatment). The lowest yield (1.59kg/ha) was produced from the interaction of white cultivar without treatment, the control (Table1 and Figure 1).

Table 2. Analyzed result of different cultivars of cassava

Analyzed Item	Result of Experiment		Reference Value (FAO, 2005)
	cv. white	cv. red	
Protein (%)	1.840 %	2.250 %	5.30%
Starch (%)	65.55 %	56.29 %	56.00 %



Analysis Report

THE GOVERNMENT OF THE UNION OF MYANMAR
MYANMA SCIENTIFIC AND TECHNOLOGICAL RESEARCH DEPARTMENT
No. (6) Kaba Aye Pagoda Road. Yankin P.O., Yangon

Reference: မထိုက်ထိုက်လင်း (ရန်ကုန်တက္ကသိုလ်)

Sample: ပီလောပီနံ

RESULT

Sample No		102/10-11	103/10-11
Job No		J-200	J-201
Sample Marked		Cassava White	Cassava Red
Cyanide as HCN	(%)	N.D	N.D
Protein	(%)	1.840	2.258
Starch	(%)	65.55	56.29

N.D=Not Detected

Not a certificate of conformance

Method/Equipment used. The Chemical Analysis of Foods by David Pearson

Tested by: Daw Khin Nilar Chit

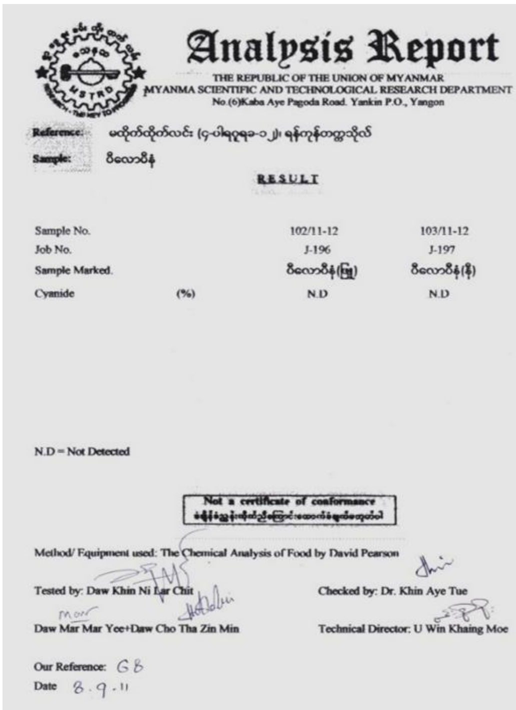
Daw Mar Mar Yee

Checked by: Dr. Khin Aye Tue

Technical Director U San Tun Oo

Our Reference: MSTRD 67.

Date 10.9.10



Analysis Report

THE REPUBLIC OF THE UNION OF MYANMAR
MYANMA SCIENTIFIC AND TECHNOLOGICAL RESEARCH DEPARTMENT
No.(6)Kaba Aye Pagoda Road. Yankin P.O., Yangon

Reference: မထိုက်ထိုက်လင်း (၄-ပါရဂူရာ-၁၂)၊ ရန်ကုန်တက္ကသိုလ်

Sample: ပီလောပီနံ

RESULT

Sample No.		102/11-12	103/11-12
Job No.		J-196	J-197
Sample Marked.		ပီလောပီနံ(ဖြူ)	ပီလောပီနံ(နီ)
Cyanide	(%)	N.D	N.D

N.D = Not Detected

Not a certificate of conformance

Method/ Equipment used: The Chemical Analysis of Food by David Pearson

Tested by: Daw Khin Ni Lar Chit

Daw Mar Mar Yee+Daw Cho Tha Zin Min

Checked by: Dr. Khin Aye Tue

Technical Director: U Win Khaing Moe

Our Reference: G8

Date 8.9.11

The result of nutritional analysis showed that the protein content of the both cultivars were lesser (1.840% and 2.258%) than that of the FAO reference value. The starch content of the both cultivars was higher (65.55% and 56.29%) than that of the FAO reference value.

Table 3. Analyzed result of different cultivars of fresh and boiled cassava

Analyzed Item	Result of Experiment (Fresh Cassava)		Boiled Cassava
	Cassava (white)	Cassava (red)	Cassava (White and Red)
Cyanide	94.32 ppm	244.29 ppm	ND

Table 4. Analyzed result of two varieties

Reference Value (FAO, 1990)	Reference of cyanide contents	
	Sweet	Bitter
Cyanide	40-130 ppm	80-412 ppm

Figure2. Planting of cassava (red) and (white) in cultivated field

Figure3. After harvesting of tubers (red) and (white)

Figure 4. Prepared tubers for the analysis of protein, starch and cyanide

Discussion and Conclusion

The result of yield of factor A also showed that red cultivar had higher yield (2.36) than white cultivar (1.97). The result of yield of factor B showed that T4 (500kg ha^{-1}) treated plants produced the highest yield of 2.51kg, whereas T1 (0 kg ha^{-1}) plants had 1.74 kg. It can be concluded that the higher fertilizers levels gave the optimum plant growth and yield. Application of chemical fertilizers is generally more practical and economical when cassava is grown at somewhat larger scales (O'Hair, 1990). From applied compound fertilizer, the potassium is not a basic component of protein, carbohydrates or fats, but plays an important role in their metabolism; K is also essential for translocation of carbohydrates from the top of the roots (Obigbesan, 1973). Obigbesan (1973), also reported that K is increased the starch and decreased the HCN content of the roots. Like N and P, deficiency of K results mainly in reduced plant height and vigor. Stem internodes are markedly reduced and the upper stem tends to lignified prematurely and grows in zigzag. Phosphorus is an important element for the process of phosphorylation, photosynthesis, respiration, and the synthesis of carbohydrates, proteins and fats.

Through these processes an adequate P supply is essential for the synthesis of starch and thus for normal root production (Coursey, 1973). Phosphorus deficient plants are shorter and less vigorous, have thinner stems, and smaller and narrower leaves than normal plants. Root yield can be seriously depressed by P-deficiency (Cock and Reyes, 1985). The result of nutritional analysis showed that the protein content of the both cultivars were lesser (1.840% and 2.258%) than that of the FAO reference value. The starch content of the both cultivars was higher (65.55% and 56.29%) than that of the FAO reference value. In this experiment, cassava tubers were harvested at 9 months after cultivation. In addition to varietal differences, the cyanide content in cassava tissues appears to be affected by the age of the plant; longer duration of tubers in the field could enhance cyanide content. Moreover, environmental factors such as soil and temperature conditions also influenced on cyanide content. (Bolhuis, 1954). Onwuem and Charles (1994) reported that as the plant gets older, the cyanide in the tuber increases attains a peak, and then declines. Plants growing on soil with low potassium or high nitrogen also tend to have higher cyanide content. Onwuem and Charles (1994) reported that the cyanogenic glucosides are soluble in water, and tend to decompose if heated up to 150°C. They can be hydrolyzed at ambient temperatures under the influence of the enzyme linamarase, to produce the corresponding cyanohydrins as well as those normally present in the tissues, in turn breakdown to give HCN and ketones. This breakdown is spontaneous at pH above 5.0. Nitrogen is also a constituent of the cyanogenic glycosides linamarin and lotaustralin, which produce hydrocyanic acid (HCN) which damaged the cells. HCN is the bitter, highly toxic component of cassava leaves, stems and roots, which must be eliminated before consumption by drying or cooking the leaves and roots tubers (Conn,1969). The cyanide levels in fresh chips decreased progressively from the 9 to 12 month of age of plants in a manner similar to the trend observed with respect to the cyanide content of the root cortex. At 12 months, the total cyanide levels in fresh chips were 61 and 66% of those found at 9 months of age for the varieties (Bolhuis, 1954). Hydrocyanic acid or HCN is a volatile compound. It evaporates rapidly in the air at temperature over 28°C and dissolves rapidly in water. It may easily be lost during transport, storage and analysis of specimens (Conn, 1969). In conclusion, the cyanide content of both cultivars was not detected because of some factors: early harvesting, high potassium on soils and volatility of hydrogen cyanide (Onwuem and Charles, 1994).

Acknowledgements

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