

## **Effect of Cultivation Location on the Nutritional Composition of Jute Mallow (*Corchorus olitorius*)**

**Omenna, E.C.<sup>1</sup>, Ojo, A.O.<sup>2</sup> and Odurinde, A.O.<sup>3</sup>**

<sup>1</sup>*Kenaf and jute improvement programme, Institute of Agricultural Research and Training, Obafemi Awolowo University, P.M.B. 5029, Moor Plantation, Ibadan. Oyo state, Nigeria.*

<sup>2</sup>*Land and water Resources management Programme, Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan. Oyo state, Nigeria.*

<sup>3</sup>*Home and Rural Economics Department, Federal College of Agriculture, Moor Plantation, Ibadan, Nigeria.*

*Corresponding author's email: emmanuelomenna@gmail.com; +2348039334092.*

### **Abstract:**

The study evaluated the effect of location on the nutritional composition of jute mallow. Jute leaves samples obtained from three different locations namely: Iwo, Kila and Omi-Adio were subjected to proximate and nutrients analysis while the soil samples from the locations were made to undergo routine analysis. The results showed that there was no significant difference between the jute from Iwo and Omi-Adio in terms of crude protein, crude fibre and ash contents which were significantly higher than that of Kila. Jute mallow from Kila and Omi-Adio recorded the same crude fat content which was slightly higher than that of Iwo. The dry matter content of jute mallow from Iwo (94.05%) was the highest followed by Omi-Adio (93.64%) and least in Kila (93.19%). The decreasing order of the macro minerals (Na, K, P, Ca, and Mg) in jute from the three locations was: Iwo > Omi-Adio > Kila. Similarly, jute mallow from Iwo contained higher amount of micro-elements (196.55mg/kg Fe, 31.51mg/kg Zn, 5.25mg/kg Cu, and 16.45mg/kg Mn) than the jute from Kila (193.65mg/kg Fe, 31.10mg/kg Zn, 4.05mg/kg Cu, & 15.05mg/kg Mn) and Omi-Adio (194.25mg/kg Fe, 31.19mg/kg Zn, 4.70mg/kg Cu & 15.60mg/kg Mn). On the other hand, the results of soil analyses revealed that the soils from these three locations were moderately acidic with the pH of 6.52 for Iwo, 6.12 for Kila and 6.65 for Omi-Adio. Iwo soil had better physical and chemical properties which favoured jute vegetable production with higher yield components than others. It could be inferred that the variation in soil nutrients influence the nutritional composition of the crop plant. In conclusion, the jute mallow from Iwo contained higher nutritive values with better yield and growth performance.

**Keywords:** Soil nutrients; Jute mallow; Mineral elements; Proximate compositions

### **Introduction**

The increasing awareness of health promoting and protecting properties of non-nutrient bioactive compounds in vegetables has placed vegetables as pivotal components of human daily diets. In Africa, vegetables are important dietary components and they are indispensable ingredients for soup or sauces that normally accompany carbohydrate staples. Plant nutrients are the main sources of carbohydrates, proteins, minerals, and dietary fibres as well as other nutrient bioactive compounds

(Geneva, 2014; Tei *et al.*, 2000). Root and tuber crops majorly provide carbohydrates while leafy vegetables are the chief sources of vitamins, dietary fibres, essential amino acids, and antioxidants (Fasuyi, 2006). There are inadequate production, availability and consumption of fresh leafy vegetables like jute mallow in sub-Saharan African countries like Nigeria. This may be due to low production, seasonal climatic conditions, susceptibility of these vegetables to various environmental factors and lack of awareness of the nutritional benefits that

can be derived from the consumption.

Jute mallow (*Corchorus olitorius*), belongs to the family *Tiliaceae*. Jute mallow commonly called 'Ewedu' by the Yorubas, is a fibre crop with great nutritional and health significance. It was however found wild in many parts of India as well as China and many parts of Australia and Africa, especially in south western Nigeria (Aluko *et al.*, 2014). The major areas of production in south western parts of Nigeria include Oyo, Ondo, Osun, Ekiti and Lagos state (Aluko *et al.*, 2014). Jute mallow (*Corchorus olitorius*) or Ewedu is widely grown in the tropics for the viscosity of its leaves either fresh or sundried. The leaves are cooked into thick viscous soup added to stew and eaten with starchy staples (Sen *et al.*, 2008; Palada and Chang, 2003). It has been reported as the most Nigerian leafy vegetable that is rich and relatively regarded as cheap sources of vitamin C, mineral, dietary fibre, protein, beta-carotene, phosphorus, calcium and iron (Aluko *et al.*, 2014; Mahbul, 2013). The edible leaves of jute mallow (*Corchorus olitorius*) on the average contains 85-87g water, 5-6g protein, 0.7g oil, 5g carbohydrate, 1-5g carbohydrate, 1-5g fibre, 250-266mg Calcium, 4-8mg iron, 300mg vitamin A, 1.0mg thiamine, 0.3mg riboflavin, 1.5mg nicotinamide and 53-100mg ascorbic acid (per 100g) (Aluko *et al.*, 2014). Presently, the production of readily available vegetable like jute mallow has been affected by multifactorial challenges. There is paucity of data on the impact of cultivation location or soil type on the nutritional composition of jute leaves. Hence, this study was conducted to evaluate the impact of cultivation location on the nutritional quality of jute leaves.

## Materials and Methods

### Site description and sampling

The study was conducted in three different farmers' field plots located in Iwo (Osun state and lies within latitude 3°84'N and longitude 7°38'E), Omi-Adio and Kila (both in Oyo state, the areas lie between longitudes 3°45' and 4°05' east and latitudes 7°10' and 7°30' North). The areas were characterized by the tropical rainforest (for Iwo) and transitional forest (for Omi-Adio and Kila) climate with heavy rainfall between the months of April-October. The randomly selected farmers' field plots were demarcated each with a dimension of 7m x 15 m which covered a total land area of 120m<sup>2</sup> with 1.0m inter plot boundary. Each plot was tilled manually using a hoe. The plot was measured out into beds. A total of ten seed beds were constructed with a dimension of 4m x 2m. A 0.5m border separated the beds that served as blocks. Jute seeds were pre-treated with hot water as to break the dormancy before the jute seeds were planted at rate of two seeds per hole at a spacing of 35cm x 35 cm (population of about 45,555 plants/ha). The experiment was laid out in a Randomized Complete Block Design (RCBD) and was replicated three times. NPK -15-15-15 fertilizer was applied at the rate of 100kg/ha for optimum growth. All plots were weeded manually in all the three locations.

### Routine soil Analysis

The soil samples collected at 0-15cm from the jute mallow plot in Iwo, Omi-Adio and Kila were subjected to particle size analysis using the Bouyoucos hydrometer method. Soil pH was determined using the glass electrode pH meter in a soil to water ratio 1:2.5. Soil exchangeable acidity/

aluminium was determined by titration method (Mc- Lean, 1965). Soil organic carbon was determined by Walkley and Black (1934) method, and soil total nitrogen by micro-Kjeldahl digestion and distillation method. The available phosphorous was determined by using Bray and Kurtz (1945), Ca and Mg by EDTA titration method while potassium and sodium were determined by flame photometry. The effective cation exchange capacity was calculated (as the sum of exchangeable bases: -  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^{+}$ ,  $\text{Na}^{+}$ ). The exchangeable acidity was expressed in cmol/kg.

#### **Agronomic data collection**

Jute mallow were randomly selected in a plot at harvest (8WAP). All tests were done in triplicates. Agronomic characteristics collected from each plot were numbers of leaves by counting the number of leaves on the plant. Plant height was determined by using a meter rule. Stem diameter (mid and butt) was determined with the use of Venier Calipers. The yield of plant at harvesting (plant dry matter) was done by oven drying the plant samples at 75°C till constant weight was reached.

#### **Sample preparation**

At eight weeks after planting (8WAP), equal number of jute leaves were collected from farmer's field plot in the three locations namely: Iwo (Osun state), Omi-Adio and Kila (both in Oyo state). Consequently, the jute leaves were dried, milled and subjected to chemical analyses.

**Proximate Analysis:** The moisture, ash, crude fat, crude fibre, dry matter and crude protein contents of jute leaves were assayed as described by AOAC (2005).

**Mineral elements analysis:** The mineral (manganese, iron, zinc, copper, calcium, phosphorus, and magnesium) contents of jute leaves was determined by atomic absorption spectrophotometry; while sodium and potassium were determined by flame photometry.

#### **Statistical Analysis**

Data obtained were subjected to Analysis of Variance (ANOVA) and means were separated using least significant difference (LSD) at 5% level of probability.

#### **Results and Discussion**

The results of the proximate analysis in Table 1 showed that the crude protein content of jute from Iwo and Omi-Adio were similar and significantly higher than that of Kila. The crude protein contents of jute leaves from the three locations were significantly higher than the data reported by Aluko *et al* (2014). Jute mallow from Kila and Omi-Adio recorded the same crude fat contents which were slightly higher than that of Iwo. In all the locations under investigation, the crude fat contents in jute leaves were within the range of 2.49 to 3.91% and this data confirmed the report by Aluko *et al* (2014). Similar values of crude fibre and ash were obtained from the jute from Iwo and Omi-Adio and these were significantly higher than Kila's. In all the three locations, the jute leaves contained crude fibre ranged from 19.67 -19.87% which was significantly higher than 11.12% crude fibre content of *Talinum triangulare* (Orluchukwu and Poripo, 2014). It is noted that a diet rich in fibre helps to maintain healthy digestive system. The moisture

**Table 1: Percentage proximate composition of jute leaves from three different locations**

Parameter	Iwo	Kila	Omi-Adio
C. Protein	15.43 ± 0.06 <sup>a</sup>	15.02 ± 0.13 <sup>b</sup>	15.23 ± 0.06 <sup>a</sup>
C. Fat	3.27 ± 0.02 <sup>b</sup>	3.40 ± 0.06 <sup>a</sup>	3.33 ± 0.06 <sup>a</sup>
C. Fibre	19.87 ± 0.02 <sup>a</sup>	19.67 ± 0.02 <sup>b</sup>	19.76 ± 0.02 <sup>a</sup>
Ash	9.23 ± 0.20 <sup>a</sup>	9.00 ± 0.03 <sup>b</sup>	9.15 ± 0.12 <sup>a</sup>
Moisture	5.96 ± 0.02 <sup>c</sup>	6.82 ± 0.03 <sup>a</sup>	6.37 ± 0.12 <sup>b</sup>
Dry matter	94.05 ± 0.02 <sup>a</sup>	93.19 ± 0.03 <sup>c</sup>	93.64 ± 0.12 <sup>b</sup>

Means (± SEM) with the same letter in a row are not significantly different (P<0.05)

content of jute mallow from Kila was significantly higher than others. The dry matter content of jute from Iwo (94.05%) was the highest followed by Omi-Adio (93.64%) and then Kila (93.19%). The result showed that the jute from Omi-Adio and Iwo had higher proximate composition when compared with the jute from Kila.

The results of the macro elements analysis in Table 2 showed that there was significant difference among the macro elements content of jute leaves from the three different locations. The decreasing order of these macro elements (Na, Ca, and Mg) in jute from the three locations was: Iwo > Omi-Adio > Kila. The result obtained in this study was in agreement with the report by Mahububul (2013)

which stated that boiled jute contained 12mg of sodium. There was no significant difference between the jute from Kila and Omi-Adio in terms of potassium and phosphorus. From the result, Iwo's jute mallow had higher level of sodium, potassium, calcium, phosphorus and magnesium when compared with others. This result inferred that the jute from Iwo was richer in macro minerals than others. The results of this study suggested that regular intake of such mineral-rich- jute mallow will enhance the development of strong bone and teeth.

Table 3 showed the micro elements contained in jute leaves from the three locations. The Iron (Fe) content of the jute leaves from Iwo was significantly higher than that of Kila and Omi-Adio. This was in

**Table 2: Percentage macro elements in jute leaves from the three locations**

Parameter	Iwo	Kila	Omi-Adio
Na	0.24 <sup>a</sup>	0.22 <sup>c</sup>	0.23 <sup>b</sup>
K	0.88 <sup>a</sup>	0.86 <sup>b</sup>	0.86 <sup>b</sup>
Ca	0.27 <sup>a</sup>	0.23 <sup>c</sup>	0.25 <sup>b</sup>
P	0.38 <sup>a</sup>	0.35 <sup>b</sup>	0.36 <sup>b</sup>
Mg	0.29 <sup>a</sup>	0.24 <sup>c</sup>	0.25 <sup>b</sup>

Means (± SEM) with the same letter in a row are not significantly different (p<0.05)

consonance with Mahububul (2013) that the iron content of jute mallow ranged from 11.00mg-11.6mg when boiled. Zinc contents of jutes mallow were 31.15mg/kg for Iwo, 31.10mg/kg for kila and 31.19mg/kg for Omi-Adio. The same trend of values were recorded for manganese where Iwo was significantly higher than Kila and Omi-Adio. There was no significant difference in the copper content of jute mallow from Iwo and Omi-

Adio which were significantly higher than Kila's. Preferably, the jute from Iwo contained higher amount of micro-elements (Fe, Zn, Cu, and Mn) than that of Kila and Omi-Adio.

The physical soil characteristics showed (Table 4) that the soils were dominantly sandy loam with low organic matter and clay. Omi-Adio and Kila soils had the same range of values for sand and silt which was significantly lower than Iwo

**Table 3: Micro elements contents of jute leaves from three different locations (mg/kg)**

Parameter	Iwo	Kila	Omi-Adio
Fe	196.00±0.15 <sup>a</sup>	193.65±0.15 <sup>b</sup>	194.25±0.15 <sup>b</sup>
Zn	31.51±0.03 <sup>a</sup>	31.10±0.1 <sup>b</sup>	31.19±0.03 <sup>b</sup>
Cu	5.25±0.15 <sup>a</sup>	4.05±0.15 <sup>b</sup>	4.70±0.10 <sup>a</sup>
Mn	16.45±0.15 <sup>a</sup>	15.05±0.25 <sup>c</sup>	15.6±0.10 <sup>b</sup>

Means (± SEM) with the same letter in a row are not significantly different (p<0.05)

**Table 4: Physical and chemical properties of soil at 0-15cm soil depth from three different locations.**

Parameter	Iwo	Omi-Adio	Kila
pH	6.52 ± 0.02 <sup>b</sup>	6.65 ± 0.02 <sup>a</sup>	6.12 ± 0.03 <sup>b</sup>
% Sand	92.65 ± 0.20 <sup>a</sup>	91.88 ± 0.02 <sup>b</sup>	90.95 ± 0.02 <sup>b</sup>
% Silt	3.73 ± 0.02 <sup>a</sup>	3.47 ± 0.02 <sup>b</sup>	4.46 ± 0.02 <sup>b</sup>
% Clay	3.57 ± 0.02 <sup>c</sup>	4.64 ± 0.02 <sup>a</sup>	4.55 ± 0.02 <sup>b</sup>
% Total N	0.76 ± 0.02 <sup>a</sup>	0.65 ± 0.02 <sup>b</sup>	0.61 ± 0.23 <sup>c</sup>
Organic carbon(gkg <sup>-1</sup> )	13.1 ± 0.02 <sup>b</sup>	14.3 ± 0.02 <sup>a</sup>	13.8 ± 0.02 <sup>b</sup>
Exchangeable bases(cmolkg <sup>-1</sup> )			
Ca <sup>2+</sup>	3.63.01 <sup>a</sup>	3.56 ± 0.02 <sup>b</sup>	3.36 ± 0.02 <sup>b</sup>
Mg <sup>2+</sup>	1.34 ± 0.02 <sup>a</sup>	1.26 ± 0.02 <sup>b</sup>	1.18 ± 0.02 <sup>b</sup>
Na <sup>+</sup>	0.56 ± 0.01 <sup>a</sup>	0.52 ± 0.01 <sup>b</sup>	0.51 ± 0.02 <sup>b</sup>
K <sup>+</sup>	1.85 ± 0.01 <sup>a</sup>	1.77 ± 0.02 <sup>b</sup>	1.67 ± 0.02 <sup>b</sup>
Exch. Acidity (cmol/kg)	0.77 ± 0.02 <sup>a</sup>	0.7 ± 0.02 <sup>b</sup>	0.71 ± 0.03 <sup>b</sup>
Available P(gkg <sup>-1</sup> )	6.36 ± 0.02 <sup>b</sup>	6.56 ± 0.04 <sup>a</sup>	6.51 ± 0.03 <sup>b</sup>

Means (± SEM) with the same letter in a row are not significantly different (p<0.05)

soil. The chemical properties on the other hand revealed that the soils had pH ranged from 6.12 to 6.25. The pH of soils from the three locations (Iwo, Omi-Adio and Kila) was moderately acidic. The soil nitrogen was significantly lower in both Omi-Adio and Kila than Iwo soil, while the soil available phosphate was moderate in all the three locations for jute mallow production. Conversely, Iwo soil had higher amount of exchangeable cations (K, Na, Ca and Mg) than Omi-Adio and Kila soils. It was observed that percentage organic carbon of Omi-Adio soil was significantly higher than others.

The result in Table 5 showed the micro nutrients in soils from the three locations. Manganese was significantly higher in Kila's soil than others. Conversely, copper content of Iwo soil was significantly higher than that of Kila and Omi-Adio. The result of soil micronutrients obtained from the three locations strongly supports the publication by Udom and Nuga (2014) that the levels of micronutrients in the soil are rarely indicative of plant availability, because their availability depends on certain parameters such as soil, pH, soil organic matter, biological, physical and chemical properties of the soil. The range of values for Mn and Cu in table 5 showed positive relationship between soil micronutrients and its physical properties

like silt and clay. This finding was also in agreement with Chhabra *et al.* (1996), who observed that the availability of Mn and Fe decreased with soil pH and availability of Cu decreased with clay and soil organic carbon, whereas availability of Fe decreased as sand content increased. The zinc content of Iwo's jute was significantly higher than that of Omi-Adio and Kila. The amount of zinc obtained in Iwo's jute was of the same range with the report by Aluko *et al.* (2014).

The results of vegetative parameters in Table 6 and Figure 1 showed that Iwo jute mallow had superior growth performance (higher plant height and more number of leaves) than Omi-Adio and Kila. On yield components, Iwo jute mallow also had better yield than others. This finding supported the publication by Orluchukwu and Poripo (2014) that the soil chemical properties influenced growth and yield response of water leaf (*T. triangulare*).

### Conclusion

The results of this study showed that the soil quality greatly affects the nutrient contents of jute leaves. It was observed that the jute leaves from Iwo contained higher nutritive values with better yield and growth performance. The variation of mineral elements in jute leaves may be due

**Table 5: Micro nutrients in soils from the three locations (mg/kg)**

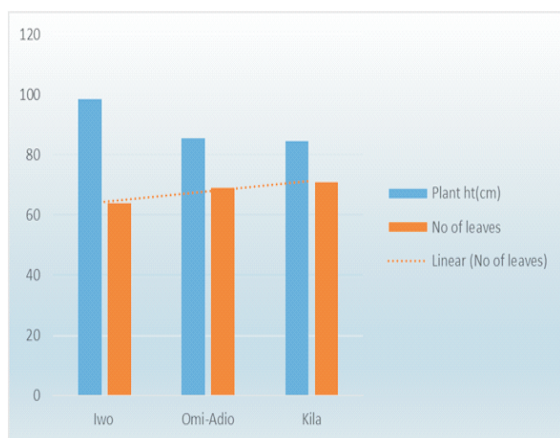
Parameter	Iwo	Omi-Adio	Kila
Mn	7.47 ± 0.02 <sup>b</sup>	7.11 ± 0.10 <sup>b</sup>	7.66 ± 0.02 <sup>a</sup>
Cu	0.88 ± 0.02 <sup>a</sup>	0.77 ± 0.03 <sup>b</sup>	0.75 ± 0.02 <sup>b</sup>
Zn	2.47 ± 0.02 <sup>a</sup>	2.26 ± 0.05 <sup>b</sup>	2.19 ± 0.03 <sup>b</sup>

Means (± SEM) with the same letter in a row are not significantly different (p<0.05)

**Table 6: Agronomic characteristics of jute mallow from the three locations**

Location	Stem girth(cm)	Stem butt(cm)	No branches	Leaf yield/plot(kg)	Stem yield/plot(kg)	Root yield/plot(kg)
Iwo	0.78 <sup>a</sup>	1.12 <sup>a</sup>	9.41 <sup>c</sup>	5.90 <sup>a</sup>	9.37 <sup>a</sup>	4.32 <sup>a</sup>
Omi-Adio	0.65 <sup>b</sup>	1.10 <sup>b</sup>	11.62 <sup>b</sup>	5.32 <sup>a</sup>	8.85 <sup>b</sup>	3.27 <sup>b</sup>
Kila	0.63 <sup>c</sup>	1.03 <sup>c</sup>	12.01 <sup>a</sup>	4.91 <sup>b</sup>	8.86 <sup>b</sup>	3.21 <sup>c</sup>

Means with the same letter in a row are not significantly different (p<0.05)



**Figure 1:** Growth performance of Jute mallow from the three locations

to the difference in the levels of these elements present in the soil and the different rate of absorption of these elements by the jute mallow, which in turn is influenced by the pH of the soil, interaction with the soil colloids, microbial activity and soil physical conditions.

**Acknowledgment**

The authors heartily appreciate the effort of Mr. O.O.Afolabi in carrying out the bench work analysis.

**References**

AOAC (2005). Association of Official Analytical Chemists. 12<sup>th</sup> edition, Washington DC.Pp.15-75.

Aluko, O.A., Olanipekun, T.O., Olasoji, J.O., Abiola, I.O., Adeniyani, O.N., Olanipekun, S.O., Omenna, E.C., Kareem, K.O. and Douglas, A.I. (2014). Effect of organic and inorganic fertilizer on the yield and nutrient composition of jute mallow. *Global Journal of Agriculture Research*. 4: 024-029.

Bouyoucos, G. H. (1957). A Recalibration of the hydromelto method of Tasting Mechanical Analysis of Sials. *Agronomy Journal*. 43: 434-438.

Bray, R.H. and Kurz, L.T. (1945). Determination of Total, Organic and Available forms of Phosphorus in Soil. *Journal of Corchorus oltorius L*. 59: 45-59.

Chhabra, D., Srivastava, P.C., Ghosh, D. and Agrihotri, A.K. (1996) .Distribution of available micro-nutrients cations as related to soil properties in different soil zones of Gola-KosiInterbasin. *Crop Research Hisor*.11:296-303.

- Fasuyi, A.O. (2006). Nutritional potentials of some tropical vegetable leaf meals: Chemical characterization and functional properties. *Afri. J. Biotech.* 5 (1):49-53.
- Geneva, O.N., Aduni, U.A., Nelson, N.N., Festus, A.N., Beatrice, N.D., Louis, E.N. and Conrad, K.B. (2014). Sweet potatoes in cameroon: Nutritional Profile of leaves and their potential new use in local foods. *Afri. J. Agricultural Research* 9(18): 1371-1377.
- Kjeldahl J, (1883): Determination of protein nitrogen in food products. *Encyclopedia of Food Science*, 439 - 441.
- Mahbulul Islam, M.D. (2013). Biochemistry, medicinal and food value of jute. *Int'l Journal of enhanced Research in Science Technology and Engineering*. 2(11):35-44.
- Mc-lean, E.O. (1982). Soil pH and Lime requirement, *Method of Soil Analysis, Part 2, 2<sup>nd</sup>ed. Agronomy Mono-graph, ASA-SSSA Madison WI*, 9: 199-224.
- Orluchukwu, J. A. and Poripo, C. (2014). Growth and yield response to plant density of water leaf (*Talinum triangulare*) in Rivers state. *Niger. Agric. J.* 45(1,2): 36-42.
- Palada, M.C. and Chang, L. C. (2003). Suggested cultural practices for jute mallow. *International Co-operative Guide 2*: 1-4.
- Ranganna, S. (1977) *Manual of analysis of fruit and vegetable products*. Tata McGraw-Hill Company Ltd, New Delhi. Pp. 21-60.
- Sen, Zhou, W., Yang, T. And Hamilton (2008). Role of Plant nutrients for sustainable food crop production. *American Euroasian Journal of Sustainable Agriculture* 3: 57-75.
- Tei, F., Benincasa, P. and Ginducci, M. (2000). Effect of nitrogen availability on growth and nitrogen uptake. U.K.S. National Resources Institute Technical Report. Pp. 56.
- Udom, B.E. and Nuga, B.O. (2014). Micronutrient status and their distribution in aggregate-size fractions of tropical coastal plain sands under different land use. *Nigerian Agricultural Journal* 45(1,2):298-310.
- Walkley, A. and Black, I. A. (1934). An examination on method for determining soil organic matter and a proposed modification of the chronic acid in soil analysis. *Experimental Soil Science* 79: 459-465.