POLICY BRIEF
January, 2014
UNU-INRA
Volume 2 No. 1

FEEDING THE SOIL WITH LOCAL PLANT GENETIC RESOURCES

By Wassie Haile and Abebe Abay

Introduction

Declining soil fertility is a major challenge to crop production in Sub-Saharan Africa (SSA) countries though the degree of depletion varies from country to country and within localities. The causes are diverse and complex and vary from country to country. In general, continuous cropping, abandoning of traditional soil fertility restoration practices, crop nutrient removal, depletion of organic matter and soil erosion are universal causes of soil fertility decline in Africa. The problem can be addressed to an appreciable extent through the applications of inorganic fertilisers. Indeed, dramatic increases in the yields of several crops have been reported in Africa due to the use of this input. However, the use of this important input is increasingly being limited by skyrocketing costs. Though the use of farm yard manure (FYM) and compost could be alternatives to fertiliser use, there are a number of factors that limit their use as organic fertilisers. Thus, there is a need to develop easy to use, relatively affordable, locally available and sustainable methods of soil fertility improvement technology for increased crop production in smallholder farming systems in Africa.

Figure 1: ***Erythrina brucei***

Potential of Africa's Plant Genetic Resource as Organic Nutrient Sources

Due to unique and diverse climatic conditions and geographic positions, Africa is by far the richest continent in its plant genetic resources that can be exploited for variety of purposes. However, even if some plant species are being used as organic fertiliser in different localities by traditional farmers, the scientific community has done little so far to identify plants from local sources to use as organic fertilisers. However, these days, there is an increasing tendency for the exploitation of plant genetic resources for use as organic fertilisers. In this regard, recently three indigenous plants in Ethiopia namely *Erythrina brucei* (Figure 1), *Erythrina abayssinica* (Figure 2) and *Enste ventricosom* (Figure 3) have been identified to be potential sources of nutrients for soil fertility improvement.

The two former species are N-fixing indigenous multipurpose agro-forestry trees in Ethiopia which are widely grown in the southern and

and South-western regions of the country. The leaf nutrient compositions of these species were studied and it was found that *E. abyssinica* has N, P and K contents of 4.2, 0.39 and 2.6% respectively. The corresponding values for *E. brucei* were 3.5, 0.38 and 2.0% respectively. The N content of both *Erythrina brucei* and *Erythrina abyssinica* species was found to be as high as or even higher than N contents of most green manure crops and trees. The P content of both *Erythrina brucei* and *Erythrina abyssinica* was found to be higher than the P content of Tithonia which is well known for its very high organic P content. Being a non N-fixing crop plant, *Enste* was found to have relatively lower content of NP but far better than the NP content of cereal residues. However, it was found to have very high content of K (4.2%).

Figure 2: *Erythrina abyssinica*

Figure 3: *Enste ventricosom*

A field experiment was further conducted to investigate the effect of transferred biomass of *E. brucei* on the yield of wheat in Southern Ethiopia. *E. brucei* biomass incorporated at 2.5 tDM/ha increased the grain yield from 1.2 t/ha in the control to 2.8 t/ha (Figure 4.).

It was also found that yield produced with biomass of *E. brucei* was almost equal to that which was produced with recommended dose of nitrogen fertiliser for wheat production in the study area. The result of economic feasibility study revealed that *E. brucei* biomass produced a net benefit of 10570 Ethiopian Birr (ETB) with marginal rate of return (MRR) of 1169% against a net benefit of 4725 ETB produced in the control (Wassie, 2012). This implies that resource poor farmers can produce reasonably high yield of crops by using *E. brucei* biomass as organic fertiliser.

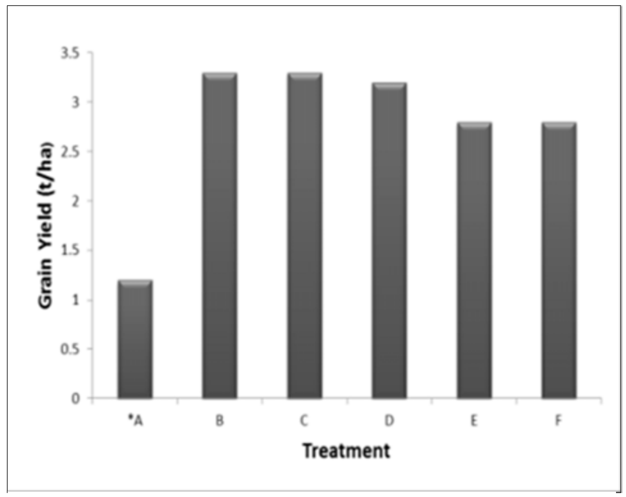

Figure 4: The effect of combined application of inorganic N fertiliser and E. brucei biomass on the grain yield of wheat at Kokate, Ethiopia over two years (2010-2011). (Source: Fieldwork, 2010-2011)

*A= 0/0 inorganic/organic N,
B= 46 kg N/ha + 0 E.brucei biomass (EbB),
C= 34.5 kg/ha N + 0.625 t DM EbB/ha,
D= 23 kg N/ha + 0.125 tDM EbB/ha,
E= 11.5 kg N/ha + 1.875 tDM EbB/ha,
F= 0 kg N/ha + 2.5 tDM EbB /ha .

Similarly, in Kwali, a Tanzanian village, seven local plant species that are used by farmers as organic fertilisers were studied for their NPK contents (Table 1) All of them had N content > 2.5% indicating that they are high quality materials as organic nutrient sources. However, Tughutu (*Vernonia subligera*) was reported to be the most preferred plant species by local farmers for a variety of reasons including high biomass production potential (Wickama and Mowo, 2001). These examples indicate that SSA has rich plant resources that can be exploited for soil fertility improvement.

Table 1. Nutrient content (%) of shrub samples taken from Kwali

Local Name	Farmer Preference	Botanical name	Nitrogen	Phosphorous	Potassium
Tughutu	1	*Vernonia subligera*	3.6	0.25	4.7
Mhasha	2	*Vernonia amyridiantha*	3.4	0.23	4.5
Mshai	2	*Albizia schiniperiana*	3.1	0.32	1.3
Mkuyu	3	*Ficus vallis-choudae*	3	0.23	4.4
Boho	4	*Bothriocline tementosa*	2.1	0.27	1.5
Sopolwa	**4**	**Kalanchoe crinata**	**2.1**	**0.23**	**3.8**
Tundashoz	4	*Justicia glabra*	2	0.27	2.1
Alizetimwitu	n.m	*Tithonia diversifolia*	3.2	0.24	3.4

Key: n.m = not mentioned. Source: Wickama and Mowo (2001)

Approaches Required to Effectively Exploit Africa's Plant Species as Organic Nutrient Sources

Additional research both in the laboratories and fields are required to determine the extent to which the already identified potentially important organic nutrient sources/plants can improve soil fertility, soil quality and improve crop yield.

The performance or adaptability study of the potentially known organic nutrient sources or plants in different agro ecologies and countries should be conducted for possible use of such resources in other locations or countries other than their origin.

Further exploration and identification of additional plant species from different countries of SSA and other localities that could potentially have nutrient rich organic resources is recommended. This in turn requires standard guidelines that will help professionals who study such plants to collect all the necessary data.

There should be the determination of nutrient and chemical composition and mineralisation rate of plant species preliminarily identified as potential organic nutrient source to validate them as organic nutrient sources. Based on quality indices obtained from laboratory experiments, both on station and on-farm experiments are required to demonstrate and verify the importance of the plant species for soil fertility and quality improvement.

Finally, it is equally important to ensure the dissemination and scaling up of proven plant species as organic nutrient sources across locations and possibly countries for their wider use.

Policy Recommendations

Strengthening Research Facilities

Determination of nutrient and chemical composition of potential plant species is important to decide whether a particular plant species serves as organic fertiliser or not. This requires high standard soil and plant analytical laboratory. Thus, it is crucial to establish analytical laboratories either nationally or at a regional level in SSA.

Capacity Development/Training

Establishing laboratory and research systems alone could take Africa nowhere unless it has a critical mass of trained manpower. Thus, there is the need to equip communities with all the necessary skills and knowledge to work with advanced and sustainable soil fertility management technologies including organic nutrient sources. Equally, sufficient attention should be given to the provision of incentives in various forms for individuals to take on this training.

Strengthening Networking and Partnership

In order for Africa to benefit from its diverse plant genetic resources, there is the need for the creation of a network and strengthening of partnerships among various professionals and stakeholders within Sub-Saharan Africa nations.

Organic Resource D-base

A centralized Database (D-base) system of information on nutrient and chemical composition, suitable ecology and management of organic nutrient sources/plant species should be created and data shared among professionals and relevant stakeholders.

Ex-situ and in-situ Conservation Potential Organic Nutrient Sources/Plant Species

In the face of climate change and high population pressure, Africa's plant genetic resources are likely to go extinct. To face this challenge, there is the need to identify potential plant species that are useful for soil fertility improvement and other purposes and these should be conserved either through ex-situ or in-situ conservation methods or both. To achieve this objective, regional biodiversity conservation centres should be established in Africa.

Strengthening Extension Service

Be it organic fertiliser or any other agricultural practice, it is the extension services sector that ultimately takes them to farmers. Thus, strengthening the extension service sector in terms of logistics and manpower is crucial.

References

Wassie, H. 2012. Appraisal of Erythrina brucei as a source for soil nutrition on Nitisols of South Ethiopia. Int. J. Agric. Biol., 14: 371–376

Wickama, J. M and J. G. Mowo. 2001. Using local resources to improve soil fertility in Tanzania, Managing Africa's Soil, Working paper No. 21, IIED, London.

ABOUT THE AUTHORS

Dr. Wassie Haile is an Assistant Professor of Soil Science in the School of Plant and Horticultural Science, Hawassa University, College of Agriculture in Ethiopia, whereas Mr. Abebe Abay is a graduate student at Hawassa University, specializing in the field of soil science.

This Policy Brief is prepared from a UNU-INRA Working Paper:

Potential of *Erythrina brucei, Erythrina abyssinica* and *Ensete venticosom* (indigenous plants) as organic sources of N P K on small holder fields in Southern Ethiopia

by Wassie Haile and Abebe Abay as part of UNU-INRA's Visiting Scholars Programme.

CONTACT

United Nations University Institute for Natural Resources in Africa
Location: Second Floor, International House, Annie Jiagge Road, University of Ghana, Legon, Accra, Ghana
Address: PMB, KIA, Accra, Ghana
Email: inra@unu.edu
Website: www.inra.unu.edu
Tel: +233 302 500396