Advances in Life Science and Technology
ISSN 2224-7181 (Paper) ISSN 2225-062X (Online)
Vol.67, 2018

The Effect of Moringa Leaf Juice on Sorghum Yield Production, in Case of Sirinka , North Wollo,Ethiopia

Andualem Ayalew Gezahagn Getachew Derbie wudu
Sirinka Agricultural Research *Center*, P. o. box 74, Woldia, Ethiopia

Abstract
A Study was conducted in Sirinka to investigate the effect of Moringa juice to increase Sorghum yield. The trial was laid in a Randomized Complete Block Design (RCBD) and four times replicated. The treatments were used for three frequency of foliar application. Moringa juice (25ml) application on combined years on sorghum as a yield advantage is recommended to increases Sorghum yield from 5.5 -37.8% over 50ml and control. Based on the input and out price incurred during the experiment, the marginal rate of return for Moringa leaf juice of 25ml and 50 ml on Sorghum in combined years against the control was 775.05% and 213.3%.This implies that for one birr additional cost on the use of 25ml and 50ml application of. Moringa leaf juice preparation and spraying on sorghum can help to obtain an additional birr of 7.75 and 2.13.Based on the results, Moringa extract on germination problems of seeds and other crops can be tested for food self sufficiency and sustainable use of the forest resources are suggested.
Keywords: Moringa Foliar application, Sirinka, yield advantage, Marginal rate of return

1. Introduction

Worldwide, some 14 species of the Moringa tree (family Moringaceae) have been described. Among these, the best studied with regard to potential medicinal uses and the identification of compounds of potential therapeutic importance is *M. oleifera* and *M. stenopetala*. *M, stenopetala* (Bak.f) Cuf and *M. oleifera* are the most domesticated species of the genus. *M. stenopetala* is endemic to East Africa and mainly present in northern Kenya and Ethiopia. This native (*M. stenopetala*) is the second most important species in terms of domestication, but has a higher genetic base than *M. oleifera(*Anwar and Bhanger,2003).

Moringa stenopetala is a green and also drought-resistant plant (Berhe *et al*., 2007).Moringa stenopetala is often referred to as the African Moringa tree.Because it is native only to Ethiopia and northern Kenya. It is multipurpose tree and all parts of the tree except the wood are edible, providing a highly nutritious food for both humans and animals. Many parts of the plant have been used in medicinal preparations. Moringa can also be used as a living hedges, fences and wind breaks, for paper making, low grade fire wood and poor charcoal. The crush seeds could also be used for cleaning water for drinking. This crop is traditionally grown in the Konso area, south Ethiopia. It is now introduced to the central and north Ethiopia. According to (Kaleb et al.,2013), Moringa stenopetala occurs in Ethiopia,between 1000 and 1800 m, which may in certain conditions, extend to 2000 m.

Moringa trees can be planted in marginal lands where it will not complete with food crops (FAO, 2011).The reduction of crop yield in Ethiopia due to drought, disease and pest incidence is a serious problem. Hence, spraying Moringa leaf juice extract on sorghum plant help to increase biomass, growth and crop yield in the field. This is due to, the extract obtained from the leaves of Moringa in 80 % ethanol contains growth enhancing principles (i.e. hormones of the cytokinine type). The extract obtained from the leaves of Moringa with 80 % ethanol has growth enhancing properties (Zeatin, i.e. hormones of the cytokinine type).The extract used in the form of a foliar spray to accelerate the growth of young plants(Muhammad,2014*)*. The growth hormone spray also causes the plants to be firmer and more resistant to pests and disease. Plants that are treated with this growth hormone spray also produce more and larger fruit and consequently have a higher yield at harvest time. Makker and Becker (1996) have revealed that the juice from fresh Moringa leaf can be used to produce an effective plant growth hormone, which increase for crops like soyabean, maize and coffee.

Spraying the leaves of plants with the Moringa extract prepared in 80 % ethanol and then diluted with water produced some notable effects such as a longer, more vigorous life-span, heavier roots stems and leaves, bigger fruits and higher sugar levels .The extract from fresh Moringa leaf juice can be used to increase yields, stem diameter, number of axels etc by 25-30% for nearly many crops (Foidl *et al*., 2001). Thus, this component of the project is proposed to evaluate effect of Moringa juice on Sorghum yield and survival under drought prone environments.

2. Materials and Methods:

2.1. Description of the study area

The study area (Figure 1) is located in Habru District, North Wollo Zone, Amahra Region at the distance of 519 km far from Addis Ababa along Dessie to Woldiya road. It is found at 18 km from Habru district at sirinka Agricultural research center (sirinka Kebele). The study area is located between UTM 56°60'70"-56°80'95"E longitude and latitude 37N 12°94'.50"to 13°40'.20"N latitude. The study area is estimated to cover an area

of ….The annual mean temperature of study area is 23˚c with mean annual rain of 950mm. The altitudinal ranges is from 1950 meters above sea level (m.a.s.l.), which was carried out between July up to November 2013 and 2014 for Moringa juice effect on sorghum trial (source…..).

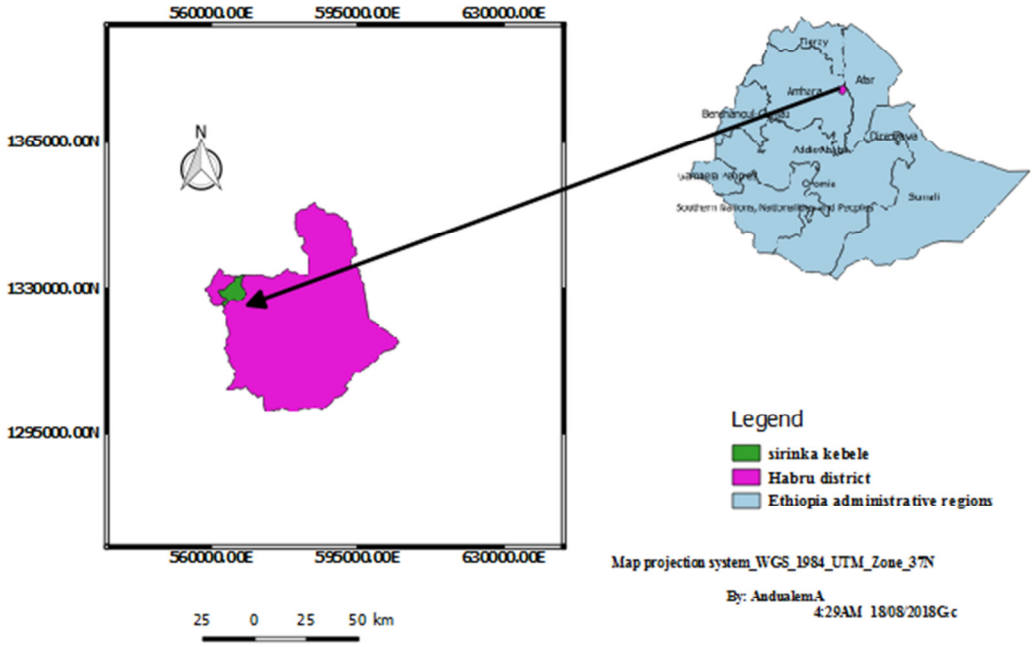

Figure 1.Map of the study area

2.2. Sampling design

For Sorghum bicolor, 5m x5m agronomic study plots with the inter row spacing of 80 cm and intera row spacing of 15 cm were established in Randomized complete block design (RCBD) with four replications using three treatments i.e,25ml Moringa stenopetala juice and 50ml Moringa stenopetala juice and control. Other agronomic practices like application of recommended fertilizer rates of 100 kg/ha of DAP and 110kg/ha urea were used, using the recently released variety and so on were applied equally for all treatments.

2.3. Data collection method

2.3.1. Moringa juice foliar spray preparation

Extraction was made by grinding young Moringa shoots collected from Kobo research on station site (not more than 40 days old) together with 80% ethanol (about one liter per 10 kg fresh material) and filtered the solid part from the solution. This was done placing the solution in a cloth and wringing out the liquid. 112 ml tap water was added on one liter of ethanol (C_2H_5OH). The extract with water was diluted at a 1:36 ratio and was sprayed directly on plants. *Then the* effect of extracted hormone was tested on Sorghum bicolor which was raised at sirinka on station site to enhance yield production.

2.3.2. Moringa juice foliar spraying on *Sorghum*

Firstly, the foliar spray on Sorghum was applied10 days (from) the moment plants emerged (seedling stage). Secondly, 30 days before plants was begun to flower (panicle initiation stage) and eventually when seed was appeared or during the maturation phase.

The effect of extracted hormone was tested on biomass and yield production of sorghum (Sorghum bicolor) at sirinka on research center station site.

2.4. Data analysis

At the end of nursery period, growth data such as total plant height, root collar diameter, root and shoot ratio was collected and analyzed.

Yield estimates are needed to make production and economic comparisons between treatments. To be valid, yield measurements were taken from comparable areas in each treatment plot. The grain yield from inner harvestable area as large an area as possible after discarding any border areas on all four sides of a plot was measured. Thresh, clean, dry, and weigh all grains harvested from each plot separately. Immediately after the grain from a plot is weighed, its moisture content was determined using Moisture tester.

The data collected were averaged and subjected to analysis of variance (ANOVA) of the SAS package version 9.0(2005).The means were separated for significance difference at P=0.05 using Duncan's Multiple Range Test(DMRT).

3. Result and discussion

Moringa stenopetala leaf juice effect on the yield of sorghum (var.Mesay) in sirinka 2013 crop production year had shown the higher height, above ground biomass and grain yield with the application of M. stenopetala 25 ml juice than M.stenopetala 50 ml and control with a significantly difference. It has also yield increment 5.7% and 5.5% over 50ml moringa juice application and control (Table 1).The result of better *Codia africana* growth performance at the nursery and field and also Sorghum yield increment is similar to the report of Moringa .stenopetala (Shah et *al*.,2011).

Table 1.Agronomic performance of yield and yield trait of sorghum in 2013

	Growth and yield performance of Sorghum at trial site			
Treatment	Mean Plant height(cm)	Stand count per plot	Mean Biomass yield (kg/ha)	Mean Grain yield (kg/ha)
Mo	15270[b]	228.25[a]	195.8[b]	4350[b]
M_1	15910[a]	236.00[a]	200.3[a]	4590[a]
M_2	15130[b]	243.25[a]	194.2[b]	4340[b]
DMRT (5%)	*	NS	*	*
LSD	1000.5	20.55	6.86	321.1
CV (%)	3.7	5.1	2.0	4.2

Means with different letters in the same columns are significant different (P<0.05) according to LSD test.
M0=control-no moringa stenoptela extract added, M1= 25 ml moringa stenopetata extract sprayed on Sorghum, M2=50 ml Moringa extract sprayed on Sorghum. * Significance at P<0.05 ,** p<0.01, ***P<0.00

Table 2.Agronomic performance of yield and yield trait of sorghum in 2014.

	Growth and yield performance of Sorghum at trial site					
Treatment	Mean Plant height(cm)	No of tiller per plant	Stand count per plot	Mean Biomass yield (kg/ha)	Mean Grain yield (kg/ha)	1000seed weight(gm)
Mo	**161.32[b]**	2.48[a]	206.50 [a]	**17617[a]**	**1214[b]**	**29.73[a]**
M_1	168.40[a]	2.73[a]	209.25 [a]	17498[a]	1673[a]	30.83[a]
M_2	165.25[ab]	2.70[a]	207.00 [a]	17831[a]	1249[b]	30.48[a]
DMRT (5%)	*	Ns	Ns	Ns	**	Ns
LSD	5.1	0.881	37.55	1645.5	202.2	4.23
CV(%)	1.8	6.9	5.8	5.4	8.5	8.1

Means with different letters in the same columns are significant different (P<0.05) according to LSD test.
M0=control-no moringa stenoptela extract added, M1= 25 ml moringa stenopetata extract sprayed on Sorghum , M2=50 ml Moringa extract sprayed on Sorghum.
**= Significant at 5% probability and **= Significant at 1% probability level*

Moringa stenopetala juice effect on the yield of Sorghum(Var.mesay) in sirinka 2014 crop production year with the25ml application of M. stenopetala has showed higher height & Grain yield increment > 400kg than M.stenopetala 50 ml and control, but no statistically difference in above ground biomass. It has also yield increment 33.94% and 37.8% over 50ml moringa juice application and control (Table 2). Similar results on yield increment also reported by (Martin ,2000,Fuglie,2008).

According to Fuglie, (2008), yield adjustments in a general rule should be between 5 and 30% to be appropriate.

This foliar spray should be used in addition to other fertilizers, watering and sound agricultural practices.

Foliar Application of 25ml Moringa stenopetala juice effect on the yield of Sorghum (Var.mesay) in sirinka in combined years has shown statistically significance difference with the highest grain yield increment >300kg than 50 ml M.stenopetala and control, But no statistically difference in plant height and above ground biomass in the combined result. Whereas year revealed very highly significance difference in plant height. Biomass yield and grain yield increment of 12%and 12.54% with M.stenopetala 25mlapplication than M.stenopetala 50 ml and control.

But year by treatment interaction has revealed non-significance in all parameters (Table 3). Similar results indicates low dose of Moringa foliar application can be used to increase growth and yield (Forbes and Watson ,1992).

Table 3.Agronomic performance of yield and yield trait of sorghum in combined years.

Treatment	Growth and yield performance of Sorghum at trial site			
	Mean Plant height(cm)	Stand count per plot	Mean Biomass yield (kg/ha)	Mean Grain yield (kg/ha)
Mo	178.5[a]	217.4[a]	16268[a]	2782[b]
M_1	184.4[a]	222.6[a]	16704[a]	3131[a]
M_2	179.7[a]	225.1[a]	16480[a]	2795[b]
DMRT (5%)	Ns	NS	Ns	*
Year	***	Ns	***	***
Year *trt	Ns	Ns	Ns	Ns

*Means with different letters in the same columns are significant different (P<0.05) according to LSD test. M0=control-no moringa stenoptela extract added, M1= 25 ml moringa stenopetata extract sprayed on Sorghum and M2=50 ml Moringa extract sprayed on Sorghum. * Significance at P<0.05 ,** p<0.01, ***P<0.001*

When the objective of the analysis is to make a recommendation, there should enough repetitions over time and space to assess the reliability of the technology requires at least two years.(CIMMYT, l988).

Table 4. Two year combined Partial budget analysis foliar Application of Moringa juice on sorghum yield.

	Control	*25ml moringa leaf juice on Sorghum*	*50ml moringa leaf juice on Sorghum*
Average yield(kg/ha)	*2782*	*3131*	*2795*
Adjusted yield (kg/ha) with 10%	*2503.8*	*2817.9*	*2515.5*
Gross field benefit($/ha)	*21,282.3*	*23,952.15*	*21,381.75*
Cost of ethanol(C_2H_5OH) ($/ha)	*0*	*1,014.95*	*2,029.91*
Cost of Moringa leaf collection /purchase($/ha)	*0*	*494.66*	*943.33*
Cost of labor to apply moringa foliar preparation and application on sorghum($/ha)	*0*	*1,195.5*	*2,000*
Cost of labor for hand weeding($/ha)	*3,650*	*1,250*	*1,250*
Cost of harvesting, threshing and process of seed obtaining ($/ha)	*4,435*	*4,435*	*4,435*
Total cost that vary($/ha)	*8,085*	*8,390.11*	*10,658.24*
Net benefit ($/ha)	*13,197.30*	*15,562.04*	*10,723.51*

Partial budget analysis was carried out for the application of Moringa leaf juice on sorghum against the control using CIMMYT, (1988) methodology (Table 4).

Marginal analysis is necessary to compare the extra (or marginal) costs with the extra (or marginal) net benefits. This comparison is important to farmers because they are interested in seeing the increase in costs required to obtain a given increase in net benefits. Higher net benefits may not be attractive if they require very much higher costs (CIMMYT, 1988).

Marginal analysis is conducted to know returns to investment and thus the less benefited treatments were eliminated by making the use of dominance analysis. Marginal rate of return indicate what farmers can expect to gain, on average, in return for their investment when they decide to change from one practice to another (Table 5).

Table 5. Two year combined Dominance analysis of foliar Application of Moringa juice on sorghum yield.

Treatment	*Cost of labor for hand weeding($/ha)*	*Cost of Ethanol, Moringa collection/purchase and foliar application($/ha)*	*Cost of sorghum harvesting($/ha)*	*Total cost that Vary($/ha)*	*Net benefit ($/ha)*
control	*3650*	*0*	*4435*	*8,085*	*13,197.30*
25ml moringa leaf juice on Sorghum	*1250*	*1,014.95*	*4435*	*8.390.11*	*15,562.04*

Dominance analysis was conducted as it is a prerequisite for further economic analysis to identify the dominant treatments for which the net benefits decreased while cost that vary increased. The results are presented in table 6.Treaetments foliar application of 50 ml moringa leaf juice dominates as there cost was high as compared to the control, 25 ml moringa leaf juice with higher benefits. Hence these treatments were excluded from the further analysis.

The returns to investment for different experimental treatments are evaluated through marginal analysis as measured through marginal Rate of Return(MRR) .The results for foliar application of moringa juice sequence depicted in (Table 6) indicated that 25ml moringa leaf juice gave highest rate of return as the MRR was equal to 775.05% which showed that one Birr invested would give an additional benefit of 7.75 Birr to farmers when they move from with no moringa leaf juice(control) to 25ml foliar application of moringa leaf juice(Table

6)

Table 6. Two year combined of Marginal analysis for foliar Application of Moringa juice on sorghum yield.

Treatment	Total variable cost	Net benefit ($/ha)	Change in TVC ($/ha)	Change in NB ($/ha)	MRR
control	8,085	13,197.30			
25ml moringa leaf juice on Sorghum	8,390.11	15,562.04	]305.11	]2364.74	775.05
50ml moringa leaf juice on Sorghum	10,658.24	10,723.51	]2268.13	]4838.53	213.3

Based on the input and out price incurred during the experiment, the marginal rate of return for *Foliar application of 25ml moringa leaf juice on Sorghum in combined years against* the control was 775.05% whereas the foliar application of 50 ml Moringa leaf juice on sorghum was 213.3%.This implies that for one birr invested to prepare foliar application to spray on *Cordia africana* and Sorghum brought additional benefit of 1 birr of 7.75 and 2.13 respectively.

Generally, the use of foliar application of 25ml Moringa foliar application and control on sorghum(var.mesay) with their production package gave a net benefit of 15,562.04 ETB/ha and 13,197.30 ETB/ha respectively.

4. Conclusion and recommendation

Significant variations were observed among the foliar application of 25ml, 50ml and control for Sorghum yield. A combination of biological parameters were considered to select promising rate of Moringa juice for optimizing sorghum yield.Accordingly,25ml *Moringa stenopetala* juice selected for its high grain yield, biomass and plant height for wide production of sirinka of Eastern Amhara and similar agro ecologies of the country.

Finding out what the foliar application of Moringa juice on Cordia african growth performance and enhancement of sorghum yield and satisfying the demand of famers was the key to successful forest production and crop yield increment there by improve the income as well as food self sufficient environment for the farmers. Based on the findings the following recommendation was forwarded:

- Raising awareness on the values of the Moringa and its leaf juice for the farmers.
- Investigating Moringa extract on germination problems of seeds to enhance germination of some indigenous tree species and other crops can be tested for food self sufficiency and sustainable use of the forest resources are suggested.

Acknowledgments

We gratefully acknowledged the financial support provided by ARARI and the staff members providing technical backup to accomplish the project successfully from tree raised activity from nursery up to planting at field, and successive management and data taking process and also the support of Kale drug store Dessie to purchase Ethanol for research purpose.

5. References

Anwar,F. and M.I. Bhanger.(2003).Analytical characterization of *Moringa oleifera* seed oil Grown in temperate regions of Pakistan.J. Agric. Food Chem., 51: 6558-6563.

CIMMYT (1988).From Agronomic Data to Farmer Recommendation:An Economics Training Manual. Completely Revised Edition.CIMMYT, Mexico, D.F.79pp.

Edward,B.andJerry,J (2009).TheeffectofM*oringa*leafysprayontheyieldofvegetablecropsECHO,N.FEmyers,Fl33917USA.

FAO (2011).Oil Trees for Energy in the Near East Region.

Foidll, N., Makkar, H. P. S and Becker, K. (2001).The potential of *Moringa oleifera* for Agricultural and Industrial uses.Areport presented at Dares-salam on what development potential for moringa products. October 20th November, 2nd.

Fuglie, L. (2008). New Uses of Moringa Studies in Nicaragna. ECHO technical news.

Kaleb Kelemu,G irrna Eshete, Busha Teshonie(2013). Commercialization of Moringa Production in Ethiopia: Establishing Moringa Value Chain Experiences and Lessons. Proceeding of the 1 st National Workshop on Commercialization of Moringa Production, June 4/2013, Hiruy Hall, Ethiopian Institute of Agricultural Research, Addis Ababa

Makkar, H.P.S. & Becker, K.(1996). Nutritional value and anti nutritional components of whole and ethanol extracted Moringa oleifera leaves. Animal Feed Science and Technology **63**, 211-228.

Martin, L. P. (2000). Tree Echo technical note.

Muhammad Aamir (2014). Role of Moringa, Brassica and Sorghum Water Extracts in Increasing Crops Growth and Yield: A Review