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Research Article

Effect of spacing and cutting management on survival, growth and biomass production of *Moringa oleifera* intercropped with maize on-station at Gairo inland plateau and Ruvu, Coast region - Tanzania

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ABSTRACT

Evaluation of the effect of spacing and pollarding height of *Moringa oleifera* intercropped with maize on growth, foliar and stems biomass production, maize yields and soil fertility improvement was conducted at Gairo (semi arid inland plateau) and Ruvu (sub-humid coastal area). Replicate trials were planted in a split-split plot design arranged in a Randomised Complete Block Design (RCBD) with three replications. Results showed that maize grain weights as affected by different spacing and pollarding treatments differed significantly ($P<0.05$) in third season at Gairo site while at Ruvu site nothing was harvested in second and third seasons other than stover. During first season at Gairo site, grain weight ranged from 818.90 kg/ha to 1343.19 kg/ha, while for Ruvu site grain weight ranged from 1702.13 kg/ha to 2451.69 kg/ha. Biomass decreased with increasing spacing in both sites. Increase in soil pH, available Nitrogen, available P and Electrical conductivity in two years were observed at Gairo. Moringa showed varied but good performance in the two sites and pollarding height (50 cm) and a spacing of 2.5x2.5 m led to more maize production. Pollarded foliar biomass was inadequate to improve soil fertility. Intercropping with maize was not detrimental to Moringa biomass production.

INTRODUCTION

Tanzania has a population of over 40 million people and a low per capita income. To reverse this situation, one of the major concerns of the Government is poverty alleviation and food security. Agroforestry (AF) has a very important role to play in increasing food security and hence improving nutrition and alleviating poverty (Mbwambo *et al.,* 2006). This is due to the fact that AF is a dynamic, ecologically based natural resource management system that, through the integration of trees on farmlands and rangelands, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels. However, success of any AF system relies heavily on the choice of suitable tree species that should offer diversity of benefits and show compatibility with food crops (Edward *et al.,* 2006).

Moringa oleifera, a native to northern India (Panga, 2002) is a multipurpose tree species suitable for fuelwood, fodder, food, medicinal and improvement of soil fertility. These properties makes the tree species a good candidate for intercropping systems (Follard and Sutherland, 1996). While there has been some planting of *Moringa oleifera* in various parts of Tanzania, no systematic studies have been carried out to evaluate its management under intercropping. This study was therefore carried out in two contrasting sites (semi arid inland plateau and sub-humid coastal) to evaluate the effect of spacing and pollarding height of *M. oleifera* intercropped with maize on growth, foliar and stems biomass production, maize yields and soil fertility improvement.

MATERIALS AND METHODS

Study sites

Replicated trials were established in two sites: Gairo (Morogoro) and Ruvu (Coast region). Gairo is within Kilosa District, Morogoro Region (36º 45' E; 6º 0º S; 1300 m a. s. l.) along the Morogoro-Dodoma highway some 130 km from Morogoro town and 140 km from Dodoma. Climate and geology of the area is as described by Ezekiel et al. (2012). The soil properties have been described by Mugasha *et al.* (2000). The soil has low inherent fertility with sandy clay loam texture. The upper 50 cm has pH varying from 6.1-6.3, total Nitrogen between 0.11 - 0.16% and Bray I available Phosphorus between 0.18-3.38 ug/g.

Ruvu site is located in Kibaha District, Coast Region (6º 33' - 6º 43'; 38º 48' S - 39º 03' E) some 60 km from Dar-es-Salaam city along Dar-es-Salaam - Morogoro highway. It is within low elevations, some 80 m a. s. l. receiving about 900 mm of rainfall per annum (Maghembe, 1979; Kindo, 2008). Long rains fall between March and May and short rains between November – December. January and February are the hottest months (23^{o}C and 27 ^{o}C) having occasional minima as low as 18^{o}C and maxima of 33^{o}C. Soils are free draining, primarily sandy, sandy loam and gravel varying substantially within short distances. The top 50 cm has low pH (5 – 6.5), increasing with increase in soil depth reaching extremes of pH 9.4 at 72 cm below surface (Holmes, 1988). The common natural vegetation found at Ruvu can be described as semi deciduous open to partly closed woodland to fairly open evergreen thicket and riverine forest. Main genera include; *Pteleopsis, Strichnos, Combretum, Albizia, Brachystegia, Jubernadia, Vitex, Afzelia* and *Dalbergia.*

Experimental design

Trials were planted in a split-split plot design arranged in a Randomised Complete Block Design (RCBD) with three replications. The main factor was intercropping (no intercropping and intercropping). Factor two or sub-major plot was pollarding at four levels (no pollarding, 50, 100 and 150 cm height). Factor three or minor plot was tree spacing at three levels (2 x 2, 2.5 x 2.5, and 3 x 3 m spacing). The plot sizes were 8 x 8, 10 x 10 and 12 x 12 m for 2 x 2, 2.5 x 2.5 and 3 x 3 m tree spacings respectively. The number of trees per plot was 25.

Field procedures

Land preparation was done by clearing all vegetation using hand hoes followed by tractor ploughing and pitting (pit size: 30 cm x 30 cm). Planting was done in January and March at Gairo and Ruvu sites respectively. Weeding was done three times during the rainy season and once during the dry season.

Data collection

Assessments were carried out at ages of 6, 12, 24 and 36 months. Assessment of survival, root collar diameter (RCD), height (HT) and crown width (CW) was done in the first assessment, while biomass production was done in subsequent assessments. Maize grain weight assessment was done yearly. Height was measured to the nearest 0.01 m while RCD was measured to the nearest 0.01 cm using a veneer calliper and measuring tape was used to measure CW. Soil samples were taken from four randomly selected points at 0 -15 and 15-30cm soil depths, bulked by soil depth and by block, mixed thoroughly and sub-sampled for chemical analysis. Soil samples for site characterization were analyzed for pH, total N, available P and electrical conductivity (Anderson and Ingram, 1993).

Data analysis

Standard analysis of variance (ANOVA) of split-split plot design was used to subject plot means of all response variables (tree survival, RCD, HT, CW, maize yields and tree biomass). Duncan’s Multiple Range Test (DMRT) (Gomez and Gomez, 1983) at 5% probability level was used to separate significant means. Tree survival percentage data was transformed to arc sine values to induce normality and equal variance (Sokal and Rohlf, 1969).

The General Linear Model used was as shown:
Y= replication + treatment + error... (1)
Where; Y = the measurement.

RESULTS AND DISCUSSION

M. oleifera growth performance

Growth performance in terms of tree survival, RCD, HT and CW for different spacing treatments planted alone and intercropped with maize at Gairo and Ruvu sites are presented in **Table 1**. At both sites, differences in survival, RCD, HT and CW for spacing treatments were not significantly different (P>0.05) during the 6 months assessment. Untransformed survival for Gairo ranged from 93.06% to 98.15%, RCD ranged from 3.02 cm to 3.32 cm, HT ranged from 1.69 m to 1.72 m and CW from 1.08 m to 1.14 m. For Ruvu, the values for survival, RCD, HT and CW ranged from 95.83% to 96.76%, 2.31 cm to 2.64 cm, 2.29 m to 2.44 m and 0.91 m to 0.99 m respectively. For the Gairo site, intercropping effects were only significant for RCD and CW while for Ruvu, all measured variables were significantly different with no intercropping treatment having higher values than intercropping treatment. At Gairo, untransformed survival, RCD, HT and CW for monoculture and intercropped treatments were 95.99% and 96.61%, 3.56 cm and 2.69 cm, 1.79 m and 1.63 m, 1.23 m and 1.01 m respectively. The values for Ruvu were 99.07% and 93.83%, 3.13 cm and 1.79 cm, 2.83 m and 1.86 m, 1.07 and 0.81 m for survival, RCD, HT and CW respectively. When interactions were considered, significant effect were depicted only for spacing with intercropping for RCD and CW width for Gairo site and for HT and RCD; for Ruvu site as shown in **Table 2**.

Table 1: Survival, transformed survival, height, root collar diameter, crown width, of *Moringa oleifera* (before pollarding treatments were imposed) planted at Gairo, Morogoro, and Ruvu Coast region in Tanzania.

	Age 6 (months)									
	Gairo,					Ruvu				
Factors	Unt Surv	Tran Surv	Ht (m)	RCD (cm)	Cw (m)	Unt Surv	Tran Surv	Ht (m)	RCD (cm)	Cw (m)
2 x 2 m	93.06b (2.57)	81.65a (2.84)	1.69a (0.05)	3.02a (0.09)	1.12a (0.02)	95.83a (1.31)	83.14a (2.05)	2.29a (0.12)	2.31a (0.17)	0.91a (0.04)
2.5 x 2.5 m	97.69ab (0.94)	85.94a (1.65)	1.71a (0.13)	3.06a (0.16)	1.08a (0.04)	96.76a (1.05)	84.31a (1.85)	2.31a (0.14)	2.44a (0.21)	0.92a (0.05)
3 x 3 m	98.15a (1.28)	87.66a (1.62)	1.72a (0.05)	3.32a (0.14)	1.14a (0.03)	96.76a (1.25)	84.81a (1.91)	2.44a (0.17)	2.64a (0.25)	0.99a (0.06)
No intercropping	95.99a (1.61)	84.87a (1.85)	1.79a (0.04)	3.56a (0.09)	1.23a (0.02)	99.07a (0.52)	88.38a (0.91)	2.83a (0.09)	3.13a (0.14)	1.07a (0.04)
With intercropping	96.61a (1.31)	85.29a (1.68)	1.63a (0.09)	2.69b (0.07)	1.01b (0.02)	93.83b (1.12)	79.80b (1.75)	1.86b (0.08)	1.79b (0.13)	0.81b (0.03)

* means of individual factor with standard error in parenthesis.
Means of the same latter within the same column are not significantly different for each factor.

Table 2: Interactions of root collar diameter, crown width and height of *Moringa oleifera* planted at Gairo, Morogoro, and Ruvu Coast region in Tanzania.

	Age (months) 6			
	Gairo,		RUVU	
Treatment	RCD (cm)	Cw (m)	Ht (m)	RCD (cm)
2 x 2 m * no intercropping	3.22 (0.11)	1.18 (0.03)	2.60 (0.16)	2.70 (0.23)
2 x 2 m * intercropping	2.81 (0.13)	1.07 (0.03)	1.98 (0.14)	1.91 (0.19)
2.5 x 2.5 m * no intercropping	3.65 (0.17)	1.23 (0.03)	2.81 (0.14)	3.18 (0.18)
2.5 x 2.5 m * intercropping	2.46 (0.10)	0.93 (0.02)	1.82 (0.15)	1.70 (0.24)
3 x 3 m * no intercropping	3.83 (0.15)	1.27 (0.03)	3.08 (0.13)	3.51 (0.25)
3 x 3 m * intercropping	2.80 (0.11)	1.02 (0.03)	1.80 (0.15)	1.77 (0.25)
P>F Ratio	0.0251	0.0102	0.03	0.04
RMSE	0.49	0.10	0.40	0.62
CV	15.56	9.05	17.24	25.19

X All the interaction were not significantly different except for spacing with intercropping for HT (Ruvu Coast region) RCD and CW.

The outstanding performance in survival and growth of *Moringa oleifera* both in a semi arid Gairo and sub humid Ruvu confirms the wide plasticity of this species as observed in other studies (Folkard and Sutherland, 1996; Coote *et al.,* 1997; Panga, 2002; Manh et al., 2003). At both sites, spacing effects were not significant indicating that inter-tree competition had not yet set in while the presence of maize significantly retarded growth at both sites. The retardation of growth due to intercropping could be attributed to maximum plant inter-specific competition for growth resources as observed in other studies (Janick, 1972; Chamshama *et al.,* 1998; Nair, 1984 1993; Woodall *et al.,* 2003).

Maize production

Maize grain weights as affected by different spacing and pollarding treatments intercropped with maize are presented in **Table 3.** Treatments differed significantly (P<0.05) in season 3 at Gairo site while at Ruvu site nothing was harvested in seasons 2 and 3 other than stover. During season one at Gairo site grain weight ranged from 818.90 kg/ha for 100 cm pollarding height to 1343.19 kg/ha for no pollarding, while for Ruvu site grain weight ranged from 1702.13 kg/ha for 100 cm pollarding height to 2451.69 kg/ha for 50 cm pollarding height.

Table 3: Maize grain yield (Kg/ha) planted with *Moringa oleifera* at Gairo and Ruvu, Coast region in Tanzania.

	Gairo			Ruvu		
	Season 1	Season 2	Season 3	Season 1	Season 2	Season 3
Treatment	**Grain**	**Stover**	**Grain**	**Grain**	**Stover**	**Stover**
No pollarding	*1343.19a (131.10)	510.20b (81.80)	-	1853.02a (174.21)	631.18b (102.60)	206.41b (30.24)
50cm pollarding	956.11a (119.20)	722.75a (74.13)	2062.59a (322.10)	2451.69a (248.02)	1113.58a (135.73)	665.01a (66.92)
100cm pollarding	818.90a (113.75)	750.08a (53.54)	1712.41a (256.61)	1702.13a (213.10)	602.89b (83.23)	455.15ab (60.03)
150cm pollarding	1193.30a (200.65)	620.45ab (57.58)	1850.44a (211.25)	1779.64a (201.57)	603.19b (81.51)	596.72a (84.68)
2X2	996.14a (120.56)	680.01a (59.95)	1767.16b (229.32)	1840.56a (212.08)	518.44b (73.48)	446.88a (87.75)
2.5X2.5	1213.39a (151.65)	679.92a (56.13)	2500.81a (202.43)	2062.54a (229.88)	841.41a (101.64)	511.60a (80.42)
3X3	1024.09a (77.57)	592.69a (72.45)	1357.46b (211.08)	1936.76a (144.67)	853.28a (117.40)	483.98a (53.54)
With intercropping	1077.87 (77.57)	650.87 (36.12)	1875.15 (150.90)	1946.62 (112.59)	737.71 (61.47)	480.82 (42.48)

*means of individual factor with standard error in parenthesis.
Means with the same letter are not significantly different.

As observed for the on-farm trials, maize yield in this study was far below the levels observed in improved fallow trials in Gairo (Chingonikaya, 1999; Mgangamundo, 2000), an indication that other than competition for moisture and nutrients, pollarding did not provide adequate biomass to improve soil fertility for maize production and/or there was unsynchronized nutrient release from green manure due to fast decomposition common in Moringa. Up to 2 tons per hectare of foliar biomass is needed to increase maize yield to between 2 and 3 tons per hectare (Chingonikaya, 1999; Mgangamundo, 2000).

***M. oleifera* foliar and stem biomass**

Foliar and stem biomass for Gairo site is shown in **Table 4.** For pollarding treatments, significant effects were observed during the first assessment occasion where by biomass decreased with increasing pollarding height. Except for foliage at 36 months, the trend continued during subsequent assessments though significant differences were not observed. For spacing, both foliar and stem biomass showed significant differences during all assessment occasions. Generally biomass decreased with increasing spacing.

Table 4: Foliar and stem biomass production (Kg/ha) of *Moringa oleifera* planted at Gairo, Morogoro in Tanzania.

	Age (months)					
	12		24		36	
Treatment	**Foliage**	**Stems**	**Foliage**	**Stems**	**Foliage**	**Stems**
50cm pollarding	404.69a (28.09)	1089.55a (67.94)	716.82a (89.67)	4001.00a (612.48)	869.94a (78.71)	424.11a (40.75)
100cm pollarding	375.33a (38.60)	670.38b (62.86)	702.85a (75.99)	3531.65a (450.24)	945.20a (84.83)	398.04a (45.20)
150cm pollarding	220.53b (16.80)	278.99c (26.78)	628.02a (59.40)	2642.68a (274.90)	1062.82a (113.49)	362.16a (45.63)
2X2	413.43a (35.61)	832.01a (106.02)	888.42a (83.47)	4673.32a (590.44)	1175.10a (99.85)	535.12a (42.68)
2.5X2.5	343.03a (32.01)	665.90b (92.07)	650.28b (65.61)	3153.81b (383.42)	1001.12a (81.38)	369.30b (24.36)
3X3	244.07b (23.85)	541.01b (79.96)	508.98b (44.86)	2348.19b (223.11)	701.75b (63.60)	279.89b (38.87)
No intercropping	368.99a (29.61)	748.87a (75.42)	672.08a (60.41)	3552.07a (410.42)	932.60a (72.49)	397.06a (39.03)
With intercropping	298.04b (25.39)	610.41b (80.10)	693.04a (63.39)	3231.48a (372.58)	986.04a (81.40)	392.47a (32.37)

*means of individual factor with standard error in parenthesis.
Means with the same letter are not significantly different.

At Ruvu site pollarding effects on foliar and stem biomass were not significantly different except for stem biomass at 24 months. However, the 50 cm pollarding height, maintained consistently higher biomass compared to the other treatments (**Table 5**). Spacing effects were significant at all assessment occasions, with biomass decreasing with increasing spacing (**Table 5**). For intercropping treatments at Ruvu, no significant differences were observed at all assessment occasions though both foliar and stem biomass was higher for monoculture compared to intercropped plots.

Table 5: Foliar and stem biomass production (Kg/ha) of *Moringa oleifera* planted at Ruvu, Coast region in Tanzania.

	Age (months)			
	12		24	
Treatments	**Foliage**	**Stems**	**Foliage**	**Stems**
50cm pollarding	586.07a (69.60)	3719.39a (406.51)	773.54a (87.52)	9205.32a (994.78)
100cm pollarding	481.15a (50.97)	2857.50a (377.59)	727.87a (97.39)	5087.18b (404.93)
150 cm pollarding	576.04a (85.01)	2142.75a (324.99)	731.08a (73.56)	5836.99b (772.95)
2X2	744.61a (85.80)	3842.52a (391.01)	961.04a (68.83)	8931.54a (945.37)
2.5X2.5	541.97b (41.86)	2803.60b (403.42)	777.61a (104.84)	6246.43b (771.70)
3X3	356.69c (38.99)	2073.51b (279.55)	493.83b (19.61)	4951.52b (585.61)
No intercropping	595.99a (63.17)	3381.03a (335.10)	813.91a (83.63)	7413.38a (810.72)
With intercropping	499.52a (48.96)	2432.06b (287.34)	674.41a (49.97)	6006.28a (560.93)

*means of individual factor with standard error in parenthesis.
Means with the same letter are not significantly different.

The decrease in biomass with increasing spacing observed at Gairo and Ruvu has also been reported by Sa´nchez *et al.* (2006). When assessing biomass production of *Moringa* species in Nicaragua, Sa´nchez *et al.* (2006) reported that at 12 months (750,000 plants ha^{-1}) high biomass 88,000 $kgha^{-1}$ was obtained while as the plants density decreased (500,000 plants ha^{-1}) much lower biomass was obtained (46,200 kg $ha^{-1}year^{-1}$). Bernardo *et al.* (1999) also noted that as spacing increases, total biomass production per hectare decreases.

There are however studies that have not shown spacing effects on biomass of Moringa (Manh *et al.,* 2005). This could be due to site and management differences.

Intercropping effects on biomass were only significant during the first assessment occasion whereby intercropped plots had lower foliar and stem biomass compared to non-intercropped plots. No apparent trend was evident during subsequent assessments. When interactions were considered, significant effect was depicted only for stem biomass at Ruvu site **(Table 6).** Monoculture treatments have shown to have bigger values of stem biomass production except for 150 cm pollarding 2.5 x 2.5 m (174.12 kg/ha) compared with intercropped treatments. After maize harvesting, Moringa stayed for about 7 months before the next biomass harvest, and this time most likely allowed recovery from maize competition effects resulting in non-significant effects between intercropped and control plots.

Table 6: Interactions of stem biomass (Kg/ha) of *Moringa oleifera* planted at Ruvu Coast region in Tanzania.

Age (months) 12			
Treatment	**Stem biomass**	**Treatment**	**Stem biomass**
50 cm pollarding * 2 x 2 m * no intercropping	5669.29 (1057.51)	50 cm pollarding * 3 x 3 m * no intercropping	2790.65 (279.72)
50 cm pollarding * 2 x 2 m * intercropping	4648.83 (208.70)	50 cm pollarding * 3 x 3 m * intercropping	1955.03 (258.87)
50 cm pollarding * 2.5 x 2.5 m * no intercropping	4838.07 (639.24)		
50 cm pollarding * 2.5 x 2.5 m * intercropping	2414.46 (956.06)		
100 cm pollarding * 2 x 2m * no intercropping	3641.14 (478.56)	100 cm pollarding * 3 x 3 m * no intercropping	3212.33 (1082.19)
100 cm pollarding * 2 x 2 m * intercropping	2149.61 (1053.59)	100 cm pollarding * 3 x 3 m * intercropping	1870.68 (713.02)
100 cm pollarding * 2.5 x 2.5 m * no intercropping	2616.55 (1024.04)		
100 cm pollarding * 2.5 x 2.5 m * intercropping	3654.67 (1322.78)		
150 cm pollarding * 2 x 2 m * no intercropping	4616.71 (456.52)	150 cm pollarding * 3 x 3 m * no intercropping	174.12 (625.56)
150 cm pollarding * 2 x 2 m * intercropping	2329.55 (443.75)	150 cm pollarding * 3 x 3 m * intercropping	1138.24 (468.17)
150 cm pollarding * 2.5 x 2.5 m * no intercropping	1570.40 (264.29)		
150 cm pollarding * 2.5 x 2.5 m * intercropping	1727.45 (495.03)		
P>F Ratio	0.0242		
RMSE	830.58		
CV	28.58		

*means of individual factor with standard error in parenthesis.

Means with the same letter are not significantly different. All the interaction were not significantly different except for pollarding, spacing and intercropping for Stem biomass at Ruvu site.

Soil chemical characteristics

The selected soil chemical characteristics for Gairo site are presented **(Table 7).** Significant effects were not observed across all treatments. There was an increase (2006 – 2007) in soil pH and available Nitrogen in all treatments. Soil pH ranged between 5.47 for 100 cm pollarding height in 2006 to 6.17 for 2.5x2.5 m in 2007. Available Nitrogen ranged between 0.01% to 0.02%. Available Phosphorus showed an increase in 50 cm pollarding, monoculture and 2.5 x 2.5m. However, it decreased in 100 cm pollarding, 150 cm pollarding, 2 x 2m, 3 x 3m and intercropping. Available P ranged from 7.16 ppm to 8.24 in 2006 and 4.78 ppm to 10.69 ppm in 2007. Electrical conductivity decreased in all treatments and ranged between 0.06 $mScm^{-1}$ to 0.08 $mScm^{-1}$ in 2006 and 0.04 $mScm^{-1}$ to 0.05 $mScm^{-1}$ in 2007. Despite the fact that there was an increase in both Nitrogen and phosphorus their values are still very low if compared with soils under improved condition at the same site (Mgangamundo, 2000). This indicates that pollarding did not provide adequate biomass to improve soil fertility for maize production.

Table 7: Soil chemical characteristics at 0 -15 cm depth of *Moringa oleifera* planted at Gairo, Morogoro in Tanzania.

Treatments	pH		N%		P (ppm)		EC (mScm^{-1})	
	2006	2007	2006	2007	2006	2007	2006	2007
No pollarding	-	6.14a (0.09)	-	0.02a (0.00)	-	5.99a (0.88)	-	0.05a (0.01)
50cm pollarding	*5.62a (0.07)	6.08a (0.06)	0.01a (0.00)	0.02a (0.00)	8.19a (0.79)	10.69a (5.24)	0.06a (0.01)	0.04a (0.00)
100cm pollarding	5.47a (0.05)	5.99a (0.10)	0.02a (0.00)	0.02a (0.00)	7.52a (0.89)	6.28a (0.55)	0.07a (0.01)	0.04a (0.00)
150cm pollarding	5.54a (0.02)	6.04a (0.06)	0.02a (0.00)	0.02a (0.00)	7.16a (0.66)	5.31a (0.37)	0.06a (0.01)	0.04a (0.00)
2x2 m	5.52a (0.05)	5.97a (0.05)	0.02a (0.00)	0.02a (0.00)	7.33a (0.87)	4.78a (0.36)	0.06a (0.01)	0.04a (0.00)
2.5x2.5 m	5.61a (0.07)	6.17a (0.07)	0.02a (0.00)	0.02a (0.00)	8.24a (0.74)	10.69a (4.08)	0.08a (0.01)	0.05a (0.00)
3x3 m	5.50a (0.04)	6.03a (0.08)	0.02a (0.00)	0.02a (0.00)	7.31a (0.72)	5.90a (0.45)	0.06a (0.00)	0.04a (0.00)
No intercropping	5.53a (0.05)	6.06a (0.05)	0.01a (0.00)	0.02a (0.00)	7.71a (0.62)	8.68a (2.70)	0.06a (0.01)	0.04a (0.00)
With intercropping	5.55a (0.04)	6.06a (0.06)	0.02a (0.00)	0.02a (0.00)	7.52a (0.66)	5.52a (0.44)	0.07a (0.01)	0.04a (0.00)

*means of individual factor with standard error in parenthesis.
Means with the same letter are not significantly different.

CONCLUSION

Generally the study showed varied but good performance of *M. oleifera* in the two sites in survival, height, root collar diameter and biomass production. Lower pollarding height (50 cm) and a spacing of 2.5x2.5 m led to more maize production. Pollarded foliar biomass was inadequate to improve soil fertility. Intercropping with maize was not detrimental to Moringa biomass production.

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