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Effect of Varieties and Intra Row Spacing of Common Bean (Phaseolus Vulgaris) Intercropped With Maize (Zea Mays) on Yields at Guduru Animals Production and Research Center, Western Ethiopia

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ABSTRACT

Maize is one of the cereals crop dominantly grown in tropic and mainly used as food for human being, feed for live stock and the by product also used for construction and fuel. Common bean crop is one of the pulse crop highly cultivated around the low land areas of tropics. Afield experiment was conducted in Guduru animal production research site, during 2015 cropping season to determine the effect of varieties and intra row spacing of common bean intercropped with maize on growth and yield component of the associated crops. Maize variety 540 at 100% (44,444 plants ha^{-1}) was intercropped with four varieties of common bean (Ibbado, Omo, Nasire and Tibe) in a factorial combination with three intra row spacing (5cm, 10cm and 15cm) of the recommended sole common bean and maize. The field was laid out as randomized complete block design with three replications. Common bean varieties were significantly ($p< 0.01$) affected on ear length, dry biomass, and grain yield and harvest index of the associated maize. Intra row spacing was shown significant effect ($p<0.05$) on days to 50% tessling, leaf area, dry biomass, grain yield and harvest index of maize crop intercropped with common bean. The highest grain yield (2597.5kg/ha^{-1}) was recorded when maize intercropped with common bean variety of Nasire at 5cm intra row spacing. While the interaction effect was significant effect on plant height, number of ear per plant, and thousand seed weight of maize crop.

Introduction

The main effect of common bean varieties had significant ($p<0.01$) effect on days to 50% flowering, Plant height, Number of branches, number of seed per pods, dry biomass, grain yield and harvest index when intercropped with maize. The intra row spacing of common bean was shown significant ($p<0.05$) differences on plant height, number of seed per pods, dry biomass, grain yield and harvest index of common bean intercropped with maize. Interaction effect was significant differences on days to 90% maturity, leaf area index, number of pods per plant, thousand seed weight of common bean intercropped with maize. The highest grain yield (2256kg/ha-1) was recorded when common bean varieties of Nasire intercropped with maize at intra row spacing of 5cm. The main effect of varieties and intra row spacing and interaction were significant ($p<0.05$) differences on total land equivalent ratio and total growth monetary value. The highest total LER (2.03) and (2.01) was observed when Omo variety of common bean intercropped with maize at intra row spacing of 5cm. The highest total GMV of (23102.1 ETB ha- 1) and (23471.9 ETB ha-1) were recorded when maize intercropped with bean variety of Nasire at intra row of 5cm. While the lowest total GMV (21,123.93kgha-1) was obtained when Tibe variety of common bean was intercropped with maize at 15cm intra row spacing. Therefore, maize (100%) intercropped with common bean variety of Nasire at 5cm intra row spacing was recommended for intercropping in the study area. However, the experiment has to be repeated across locations and over the growing seasons with consideration of farmer's preference of the common bean varieties to reach at conclusive recommendation were significantly affected by the interaction.

Maize (Zea mays L.) is important grain crop of the world and it ranks third, after wheat and rice in hectare and total production. In Ethiopia, maize is grown best in medium altitudes of the "Woina dega'' agro-ecologies in Ethiopia (Million and Getahun, 2001). The seed and by product of the crop is used as food for human, feed for livestock, fencing and fuel. Nationally the area occupied by the maize about 1,772,253.11hectares of land with an average yield of 2.2ton ha^{-1}. Maize was accounting 29% of total production of cereals in the country Mandefro et al., 2001 and Milliion and Getahun, 2001.

Common bean (Phaseolus vulgris) is belongs to family of leguminaceae. It is an important source of protein and cultivated as cash crop in eastern Ethiopia and rift valley areas (Chemeda, 2003). The crop is adapted to an altitude ranges1200-2000masl with mean maximum temperature of less than 30°c and greater than 10-12°c, respectively and a seasonal rainfall of 350-700mm are suited (Amare, 1992). Beans can be grown on light sandy soil to heavy soil of well-drained soils, as beans are sensitive to water logging (FAO, 2010). The area under common bean cultivation was 1, 489,304.45ha (16.4% of pulses) and the average national yield was estimated to be 1.5 tones /ha (EARO, 2004) in 2007, Ethiopia exported 78,350 tons of common bean and Generated49.7millionUSD(MOARD,2008).

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Intercropping is defined as growing of more than one crop species simultaneously in the same field during agrowing season. The cropping of component crops have advantages like greater stability of yield over the monoculture; better control of insect and diseases, one crop can provide physical supports to other crop; insurance against the vagaries of weather; and maintain soil fertility Baker, and Normal, 1995. Intercropping also hamper germination and growth of weeds (Palaniapan, 1989; Singh, 2015; Hauggaard, 2008).

However, farmers in the study area intercrop maize and common bean without consideration of the appropriate densities of the component crops to intercrop. Moreover, there is information gap to use appropriate varieties of common bean for inter cropping. Thus, this study was conducted with the following objective:

-To determine the effect of the density and varieties of common bean intercropped with maize on performance of the associated crops.

2. Material and Method

The experiment was conducted in Wollega University Shambu Campus, Guduru Animals production research site during, 2016GC.growing season. The study site is found at the altitude ranges of 2000masl.The area receives average annual rain fall ranging from 1410-1600mm. The annual temperature of the area ranges from 15-20°c. The soil characteristic of the study area is heavy clay texture (HGWZAB, 2008).

2.2. Experimental materials, treatment and design

The Improved varieties of maize "BH540' and Common bean (Omo, Ibando, Nasire and Tibe) varieties were obtained from Bako Agricultural Research Center. The treatment consist of maize planting at the density of 100% sole population (44,444) plants ha^{-1} with four common bean cultivars (Omo, Ibbando, Nasire and Tibe) at intra row spacing of 5cm, 10cm and 15cm while sole maize and sole common bean were planted at spacing of 75x30cm (44444 plants ha^{-1}) and 40x10cm (250000 plants ha^{-1}), respectively. The experiment was laid out in a randomized complete block design as factorial arrangement with three replications. Common bean varieties as factor A and population density of common bean as factor B. Sole crop of maize and four common bean varieties were included for comparison MoA, (2008).

2.3. Experimental producers

Land preparation was done in mid March 2015 and maize seed was sown in the first week of May 2015 and the common bean varieties were planted after three weeks of maize planting. Diammonium phosphate (46% p2O5 and 18%N) and Urea (46% N) both the rate of 100 kg ha^{-1} each were applied. DAP was applied at the time of sowing while urea was applied at the time of sowing and when the maize plants reached knee height. For sole common bean DAP was applied at the time of planting.

2.5. Data Collection

2.5.1. Growth parameter of maize

Plant height was measured in cm from five plants sampled randomly from the central rows at dough stage.

2.5.2. Yield component of maize

Number of era per plant was recorded from the five randomly sampled plants per net plot at harvest. Above ground biomass was recorded from five plants per plot at harvest after sun drying to a constant weight and converted in to hectare bases.

Grain yield was determine from the net plot area and converted to per hectares basis after adjusting the weight of the gram to 12.5% moisture content.

2.5.3. Growth parameters of common bean

Leaf area was determined from five randomly taken plants per plot at 50% flowering stages using pictorical diagram and leaf area index was calculated as the ratio of leaf area of plants to area occupied by the plants. Number of primary branch was counted from five randomly selected plants from the net plot at physiological maturity. Plant height of maize plant was measured randomly by selecting five plants from the net plot area when the plant physiological matured.

2.5.4. Yield components common bean

Numbers of pod per plants were recorded as the total numbers of pods per plant from five randomly selected plants from the net plot area. Number of seed per pods was recorded by counting the total number of seeds from ten randomly selected pods from each net plot. Grain yield (kg/ha) was determine from the net plot and expressed as kilogram per hectare after adjusting to 10.5% moisture content.

2.5.5.Productivity and Economic Evaluation of the Intercropping

Productivity of the intercropping system was determined by calculating the Land Equitant Ratio (LER) (Willey, 1979). Land Equivalent Ratio is a relative land area required as sole to produce the same yield as an intercrop system and Calculation as LER=$\frac{Yab}{Yaa}+\frac{Yba}{Ybb}$

Where Yab is yield per ha of maize in intercrop with common bean; Yaa yield per ha of sole maize; Yba were grain yield per ha of common bean in intercrop with maize; Ybb was grain yield per ha of sole common bean. LER values>1.00 indicate an agronomic advantage of intercropping over sole cropping. The economic evaluation was done using Gross Monetary Values (GMV) as described by Willey (1979). To calculate the GMV of component crops, the prevailing prices at local market.

2.6. Data Analysis

The collected data of the component crops were subjected to analysis of variance using SAS 9.2 version. The difference between treatments means were compared using Least Significance Difference test at 5% level of significance when ANVOA shows the presence of significant different.

3. Result and Discussion

3.1. Maize Growth parameters

The main effects of varieties, intra row spacing, interaction as well as cropping system of common bean had no significant effect on leaf area and leaf area index of maize crop inter cropped with common bean (Table 3).

Table 1. Interaction effect of common bean varieties and intra row spacing on plant height of maize intercropping with bean.

C. Bean		Intra row spacing	
Varieties	5cm	10cm	15cm
Omo	206^{i}	245^{d}	231^{e}
Ibbando	259^{b}	261^{a}	246^{c}
Nasire	246^{c}	226^{f}	222^{g}
Tibe	220^{h}	221^{h}	209i
			Pd x V
Lsd (0.05%)			1.07
Cv%			9.73

Intra row spacing and interaction were ($p<0.05$) significant effect on maize plant height, while plant height of

maize crop was highly significantly ($p<0.01$) affected by common bean varieties (Table1).

Means followed by the same letters are not significantly difference at 5% level.

The highest and lowest plant height of maize crop (261cm) and (206cm) was recorded when intercropped with common bean variety of Ibbando and Omo at intra row spacing of 10cm and 5cm respectively. Omo varieties of common bean is clamping nature and more competitive for natural resource.

3.1.3. Yield component of maize

Among the yield components of maize recorded number of ears per plant and 1000 kernel weight (g) were highly significantly ($p<0.05$) affected by the common bean varieties. Thousand kernel weights (g) of maize were highly significantly ($P<0.01$) affected by intra row spacing of common bean (Table 3). The highest number of ear per plant (1.73) was obtained when maize intercropped with common bean variety of Omo at 5cm intra row spacing. The highest and the lowest 1000 kernel weight (124.6 g) and (89.6g) were recorded when maize intercropped with common bean varieties of Ibbando, and Omo at intra row spacing of 15cm and 5cm respectively. Because Ibbando and Nasire varieties of common bean erect growth habit and complete their life cycle before maize crop produce tassel. The climbing nature of Omo variety influence the growth and yield of maize plant by completing nutrients element and over shading the maize plant. At wider plant spacing the maize plant was produced more kernel size and utilized resource effectively and delayed to mature. In contrary to the results of this study Tilahun (2002) reported non-significant effect of the associated bean varieties on thousand-kernel weight of maize at Haramaya.

Table 2. The interaction effects of common bean varieties and intra row spacing on number of ear per plant of maize.

Common		Intra row		
Bean varieties	25%	50%	75%	
Omo	1.60^{ac}	1.73^{a}	1.73^{a}	
Ibbando	1.46^{ab}	1.66^{ab}	1.60^{ab}	
Nasire	1.66^{ab}	1.66^{ab}	1.73^{a}	
Tibe	1.60^{ab}	1.40^{ab}	1.60^{ab}	
Interaction				Pd x v
Lsd 0.05%				0.94
Cv%				9.97

In this result Tamado and Eshetu (2002) from intercropping of maize and haricot bean reported that thousand kernel weight of maize was not significantly affected by the cropping system.

Means followed by the same letters are not significantly different at 5% level

3.2. Common bean component

3.2.2. Growth parameters

The main effect of common bean varieties, intra row spacing and cropping system was significant effect on plant height and number of primarily branches produced per plant. The longest and shortest plant height (154.88cm) and (48.88cm) was measured when common bean varieties of Omo and Ibbando intercropped with maize at intra row spacing of 5cm and15cm. The differences in plant height of common bean varieties are due to genetic variability and plant population. As the spaces between plants were narrow the height of common bean plant could be higher in order to get ample amount of solar radiation and other resource that help the growth and development of common bean plant. Even though the difference is not statics the sole cropping of common bean plant is shorter in plant height than intercropped common bean because in sole cropping the plant not suffered by completion, in addition clamping types of common bean like Omo variety didn't get support.

3.2.3. Yield component and yield

The analysis of common bean varieties, intra row spacing and interaction were shown significant effect on number of pods produced per plant, pods length (cm) and hundred seed weight (g). The number of pods produced per plant was highly significantly affected by planting density of common bean (Table 7). The highest numbers of pods (19.66) were counted when common bean variety of Nasire intercropped with maize crop at planting density of 25%.

But the lowest numbers of pods (6.66) were counted when Ibbando variety of common bean intercropped with maize. In general, the number of pods per plant decreased as the bean crop sown at narrow spacing. In line with this, in sorghum + mung bean and sorghum + pigeon pea intercropping, Subramanian and Rao (1988) reported that decrease in grain number per unit area was responsible for lower grain yields in intercrops than in sole crops. The plants produce more number of pods per plant when gets sufficient amount of nutrient element, light and wider spacing. In line with the result of Birke Tesfaye, 2007, reported that plant density was significant different on yield of sorghum intercropped common bean.

Table 3. Main effects of varieties and intra row spacing of common bean on ear length (cm), grain yield (kg ha-1), dry bio mass (kg/ha-1) and harvest index (%) of maize intercropped with common bean and grown under sole crop.

Treatment	Ear length	Grain yield	Dry biomass	Harvest index
Bean varieties	(cm)	(kg ha-^{1})	(kg ha-1)	%
M +Omo	87.1^{a}	2414.8^{ab}	9333.3^{b}	2.41^{a}
M + Ibbado	75.37^{b}	2528.1^{a}	19407.1^{b}	13.22^{a}
M + Nasire	74.73^{b}	2597.5^{b}	21629^{a}	12.33^{a}
M + Tibe	71.14^{c}	2236.9^{b}	20518^{ab}	10.58^{b}
LSD (0.05)	7.92	2.25	4.92	3.24
Bean intra row spacing				
M + 25%	78.35	2629.6^{a}	23388.7^{a}	11.5^{b}
M + 50%	78.25	2393.5^{ab}	19388.6^{b}	12.1^{b}
M + 75%	74.71	2311^{b}	17888.6^{c}	12.8^{a}
LSD (0.05)	ns	4.05	45.42	2.43
Cv%	9.58	12.2	3.8	13.01
Cropping System				
Intercrop mean	77.11	2444.3	20221.8	12.13
Sole mean	73.8	2400	233999	9.9
LSD (0.05)	NS	NS	NS	NS
Cv%	8.43	14.8	2.77	13.55

Means followed by the same letters are not significant different at 5% level of significance according to LSD test

Table 4. Interaction of common bean varieties and intra row spacing on number of pods per plant of common bean intercropped with maize.

		Intra row space		
C. bean varieties	5cm	10cm	15cm	
Omo	15.1[cd]	15.76[cd]	16.36[bc]	
Ibando	6.66[g]	8.33[f]	10e	
Nasire	19.66[a]	17.66[ab]	17.66[ab]	
Tibe	17[b]	16.33[bc]	17.66[ab]	
				pd xV
Lsd (0.05%)				1.33
Cv%				11.03

Means followed by the same letters are not significant different at 5% level.

The mean effect of common bean varieties and planting density and interaction were highly significant ($p<0.01$) effect on Number of seeds pods Dry bio mass, grain yield and Harvest index (Table 5). The highest number of seed per pods (8.44) was counted when Nasire variety of common bean intercropped with maize. The highest number of seed per pods (6.91) was observed at intra row spacing of 15cm.

Means followed by the same letters are not significant different at 5% level

The mean effect of common bean varieties and planting density and interaction were highly significant ($p<0.01$) effect on Number of seeds pods Dry bio mass, grain yield and Harvest index (Table 6). The highest number of seed per pods (8.44) was counted when Nasire variety of common bean intercropped with maize. The highest number of seed per pods (6.91) was observed at intra row spacing of 15cm.

Table 5. Interaction effect of common bean varieties and intra row spacing on pods length of common bean intercropped with maize.

		Intra row space		
C. bean varieties	5cm	10cm	15cm	
Omo	15.1cd	15.76cd	16.36bc	
Ibando	6.66g	8.33f	10e	
Nasire	19.66a	17.66ab	17.66ab	
Tibe	17b	16.33bc	17.66ab	
				pd xV
Lsd (0.05%)				0.69
Cv%				9.97

Table 7. Interaction effect of common bean varieties and intra row spacing on pods length of common bean intercropped with maize.

		Intra row space		
C. bean varieties	25%	50%	75%	
Omo	8.00[ab]	7.66[b]	8.50[a]	
Ibbando	4.33[e]	4.66[e]	5.33[d]	
Nasire	7.33[b]	7.00[bc]	7.33[b]	
Tibe	7.33[b]	8.00[ab]	7.66[b]	
				pd xV
Lsd (0.05%)				0.69
Cv%				9.97

Means followed by the same letters are not significant different at 5% level

Nasire variety is longer in pod length, smaller in grain size and the numbers of seeds produced in the pods are relatively higher than other variety. While the lowest numbers of seed per pods (4.66) were counted when common bean variety of Ibbando intercropped with maize at intra row spacing of 5cm. The differences in number of seed per pods are due to variation of genetic and intra row spacing between plant. Ibbando variety is erect type growth habit and bigger in seed size. In contrarily to this result (Yesuf 2003) reported that intra row spacing significantly affected number of seed per pod of common bean intercropped with sorghum where the lowest population density resulted in significantly higher number of seed per pod and the highest density gave least number of seed per pod.

The highest above ground dry biomass of common bean (7114 ha-1 kg) was recorded at 5cm intra row spacing (Table 15). This variation in dry biomass of common bean obtained because of plant spacing and morphological characteristic of bean plant. In agreement with green gram this result, Sisay (2004) recorded the highest above ground dry biomass from 100% green gram broadcast with sorghum followed by 80% green gram broadcast with sorghum.

3.3. Productivity and Economic Evaluation of Maize and Common bean Intercropping

3.3.1. Land Equivalent Ratio

The agronomic productivity of this experiment was evaluated by calculating total land equivalent ratio (LER) by summing up the partial land equivalent ratio (PLER) of common bean and maize as described by Willy (1979).

Table 6. Effect of common bean varieties and intra row spacing on Number of seed per pod, Dry bio mass and Grain yield of common bean intercropped with maize at Guduru site.

Treatment	No seeds/p pods	Bio mass (kg/ha)	Yield Yi (kg/ha) ha	Harvest index %
C.bean varieties				
Omo	8.11[a]	7430[a]	33.5ab	33.6ab
		31.		
Ibbando	4.66[b]	6466.3[b]	2044.2b	31.5ab
Nasir	8.44[b]	6617[b]	2256ab	
Tibe	8.11[a]	6810[b]	2083.7b	34.07a
Lsd (0.05%)	43.38	4.17	1.23	30.87b
Intra row				0.67
25%	6.08[b]	7143.4[a]	2236.9a	31.26a
50%	6.75[ab]	6846.2[ab]	2203.4a	32.19a
75%	6.91[a]	6503.1[b]	2103a	32.84a
Lsd (0.05%)	3.50	6.19	NS	NS
Cv%	12.4	7.47	9.29	9.29
Intercropping				
Inter crop	7.00	6880.7b	2180.9b	30.1
Sole	7.3	7283.3a	2455.6a	33.56
Lsd (0.05%)	NS	125.7	24.6	NS
Cv%	7.8	8.28	5.97	6.56

Means followed by the same letters are not significant different at 5% level of significance according to LSD test

The main effect of variety and intra row spacing of maize was significant (P<0.05) effect on total land equivalent ratio. The highest total land equivalent ratio (2.09) was recorded when maize was intercrop with common bean variety of Nasire at 5cm intra row spacing (Appendix Table 7). The lowest total LER of (1.86) was observed when maize intercropped with common bean variety of Tibe at intra row spacing of 15cm (Appendix Table 9). The intercropped crop components were utilized ample amount of resource and the plant shows well vegetative growth performance.

The value of LER above 1 indicates that the intercropping system utilizes the available growth resource more efficiency than sole cropped. In line with the results of this study, Ofori and Stern (1987) pointed out that the values of LER follow the density of legumes component, In contrast to this, Yesuf (2003) reported that the LER decreased with the increase planting density. Intercropping had higher LER (1.80) than sole crop (1.0). Again the result of this study in line with Getachew, 2006 reported that barely land equivalent ratio higher than sole cropping.

3.3.2. Gross Monetary value

The main effect of variety and intra row spacing of common bean and their interactions had significant (P<0.05) effect on Gross Monetary Value of maize (Table 9). The highest growth monetary value of maize (11,436.93birr) and (8296.16 birr) were counted when maize cultivated with common bean plant at 5cm and 10cm intra row spacing with Tibe variety respectively. The analyzed variance was shown significant differences on total growth monetary value. The highest Total Gross Monetary Value of (25303.33 ETB/ha) was obtained from common bean variety Nasire intercropped with maize at intra row spacing of 25%. While the lowest total Gross Monetary value (21123.93 ETB/ha) was obtained when bean variety of Tibe was intercropped with maize at intra row spacing at 15cm (Table 9).

The gross monetary value increased indicating the importance of increased bean population in the intercropping system in increasing the economic efficiency of the intercropping system as bean had high price (6 birr/kg) than maize (4birr/kg) in the local market. In this study all the intercrops gave higher gross monetary value than either of sole maize or sole bean (Table 9). In agreement with the result of this study, Tesfaye (2012) reported that the highest GMV (46,375.2ET B/ha) from additive mixture of faba bean and wheat variety HAR 2501 at the seed rate of 75% while the lowest GMV (32222.1 ETB/kg) was obtained from intercropping of faba bean and variety of HAR 2501 with seed rate of 50%.

Summary and Conclusion

Intercropping is one of the most important practices used to intensify crop production under limited arable lands and it is an important option for efficient utilization of resource especially under gradually deceasing cultivated land.

The main effect of common bean varieties, intra row spacing and interaction were significant effect on number of ear per plant and thousand seed weigh of maize. While ear length, grain yield, dry bio mass, harvest index was significantly affected by varieties and intra row spacing. The highest grain yield (2597.5kg/ ha-1) and (629.6kg/ha-1) were recorded when maize intercropped with common bean variety of Nasire at intra row spacing of 5cm.

The mean effect of common bean variety was highly significantly (p<0.01) difference on the number of pods per plant, pods length, hundred seed weight, but intra row spacing and interaction were significant influence on number of pods per plant, pods length, hundred seed weight. The highest number of pods per plant (19.66) was counted when common bean variety of Nasire intercropped with maize at 5cm intra row, and the longest pods length (8.0cm) were measured when common bean varieties of Omo and Tibe intercropped with maize at 5cm intra row spacing. Cropping system was significantly different on dry biomass and grain yield of common bean.

The highest grain yield (2340.5kg ha-1) was measured when Omo variety of common bean was intercropped with maize at 5cm intra row spacing.

The main effect of common bean varieties, intra row spacing and interaction were significant (P<0.05) effect on total land equivalent ratio. The highest and lowest LER of (2.03 and 2.01) were recorded when maize intercropped with bean varieties of Omo and Nasire respectively at intra row of 5cm, In general, as the intra row spacing of common bean increased, the total LER was decrease. The main effect of common bean varieties and intra row spacing of common bean had significant (P<0.05) effect on Gross Monetary Value. The highest total gross monetary value of (25,517.46 ETB/ha) was obtained from the common bean variety Nasire intercropped with maize at intra row of 5cm, while the lowest gross monetary value of (21,123.93ETB/ha) was obtained when bean variety of Tibe was intercropped with maize at intra row of 15cm. In this study all the intercrops gave higher gross monetary value than either of sole maize or sole bean. Nasire variety of common bean was more recommendable at 5cm intra row spacing. Therefore the study will be checked across location at different growing season.

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Appendix

Table 8. Effect of common bean varieties and planting density on yield, Land equivalent ratio, Growth monetary value of maize intercropping with common bean grown.

	Yield of	Yield of	LER	LER	Total			
Treament	**Maize**	**common**	**Maize**	**Common**	**LER**	**GMVM**	**GMVC**	**TGMV**
Common bean varieties								
M+ Omo	2414.8^{ab}	2240.5^{a}	1.02^{a}	1.00^{a}	2.03^{a}	9659.1^{a}	13443^{a}	23102.1^{a}
M +Ibando	2597.5^{a}	2044.2^{b}	1.02^{a}	0.94^{b}	1.96^{a}	9955.1^{a}	12265.5^{b}	22220.6^{ab}
M + Nasire	2528.4^{ab}	2256^{ab}	1.03^{a}	0.98^{a}	2.01^{a}	10113.5^{a}	13358.5^{ab}	23471.9^{a}
M + Tibe	2236.9^{b}	2083.7^{b}	0.94^{b}	0.94^{b}	1.89^{b}	8947.8^{a}	12501.7^{b}	21449.5^{b}
Lsd 0.05%	2.7	NS	5.13	NS	7.7	NS	NS	2.83
Planting density								
25%	2629.6^{a}	2236.9^{a}	1.04^{a}	0.98^{a}	2.02^{a}	10192.4^{a}	13421.4^{a}	23613.8^{a}
50%	2392.5^{ab}	2203.46^{a}	0.99^{ab}	0.97^{a}	1.97^{ab}	9570.2^{a}	13087.3^{a}	22657.5^{ab}
75%	2311^{b}	2103.03^{a}	0.97^{b}	0.95^{a}	1.93^{b}	9243.9^{a}	12618.2^{a}	21862.1^{b}
Lsd 0.05%	3.98	NS	4.4	NS	6.07	NS	NS	2.57
CV%	11.75	9.99	5.88	4.83	3.47	13.66	10.56	8.35
Intercrop v Sole								
Intercrop maize mean	2444.4		0.99		0.99	97777.6		97777.6
Intercrop bean mean		2181.1		0.72	0.72		13086.6	13086.6
Total intercrop								
Sole bean		2192.3		0.72	0.72		13153.8	13153.8
sole Omo		2340.54		0.68	0.68		14043.24	14043.24
Sole Ibbando		2103.53		0.75	0.75		12621.18	12621.18
Sole Nasir		2256.04		0.71	0.71		12621.18	12621.18
Sole Tibe		2083.67		0.76	0.76		13536.24	13536.24
Sole Maize		2400		1.01	1.01		9600	9600

Means followed by the same letters are not significant different at 5% level of significance according to LSD test..