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Evaluation of Maize-Intercropped with Forage Legumes Under Different Planting Patterns on Yield and Yield Components of Maize and Fodder in West Hararghe, Oromia

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Abstract
Intercropping is the main activity of the farmers in Hararghe Zones mainly due to land shortage. The study was conducted at Mechara Agriculture Research Center on station, in Daro Labu and Habro District at Farmers Training Center (FTC), West Hararghe Zone of Oromia for two consecutive years (2015/16 to 2016/17. The objectives to evaluate the influence of cropping patterns in intercropping forage legumes with maize on maize and legumes yield and yield components and to determine the appropriate cropping patterns in maize- forage legumes intercropping. The experiment was designed in a randomized complete block design (RCBD) with four replications. The treatments was sole maize (Melkasa-4), sole Dolichus lablab, sole Vetch, intercrop by pattern of Dolichus lablab at spacing 37.5cm between maize, Dolichus lablab intercrop at 25 cm spacing b/n maize, Vetch intercrop at 37.5 cm spacing b/n maize and Vetch intercrop at 25 cm spacing b/n maize. The highest mean value of maize seed yield (40.57qt ha^{-1}) was obtained from sole maize at Mecahara on station while the lowest seed yield was recorded from double rows Vetch intercropped with maize a tBareda farmer training center (17.4qnt ha^{-1}) and average values of maize seed yield (28.86qtha^{-1}) was obtained from maize-forage legumes intercropping in different planting patterns. The study result revealed that maize-forage legumes intercropping did not affect maize seed yield but maize seed yield decreases with double rows intercropping with legumes followed by single row. Therefore, it recommended that maize Dolichus lablab intercropping in single row was favorer for West Hararghe area and other similar agro ecologies.
Keywords: -Biomass, Forage, Seed yield, Intercropping, Legumes

1. INTRODUCTION

Intercropping provides opportunity to harness available resources by cultivation of two or more crops planted simultaneously in the same land that provides the possibility of yield benefit and minimize crops failure (Sarkar *et al.,* 2000, Bhatti *et al.,* 2006). A major benefit of intercropping is increase in production per unit area compared to sole cropping through the effective use of resources (water, nutrients, and solar energy), reduces weed competitions and stabilizes the yield (Nasri *et al*. 2014). Legumes contribute to maintaining the soil fertility via N fixation, which is increased in intercrops due to the more competitive character of the cereal for soil inorganic N. This leads to a complementary and more efficient use of N sources by the crops in the intercrop system (Nyasasi and Kisetu, 2014). Thus its design improved system for a given agro ecological situations based on their superiority over the existing system which is adapted by the farmers of the area in terms of their biological productivity and stability of production with the least harm of the ecosystem. Farmer generally takes decisions on the technologies to adopt on the bases of cost, risk and return calculation. In small-scale farms, the farmers raise as a risk minimizing measures against a total crops failures (Pour*et al*., 2016).

World population growing exponentially and it has to fulfill their food requirements. An attractive strategy for increasing productivity and labor utilization per unit area available land is to satisfy land use. Thus, the only way to increase agricultural production is to increase yield per unit area (Hirpa, 2013). This can increased by growing several crops simultaneously or in succession with each other in farm devoted to short maturing annual crops (Thayamini *et al*., 2010). Sometimes intercropping systemssuppressedgrowth and yield of legumes by the dominant crop (Hirpa, 2013). Biological of intercropping due to exploration of large soil mass compared to monoculture (Takele *et al*. 2017). This advanced agro technique has been practiced in past decades and achieved the goal of agriculture. Most studies on intercropping have focused on cereal based intercropping (Langat; *et al.,* 2006; Hugar and Palled, 2008) proved the success of intercropping. However, intercropping also has the advantage of improving forage quality in terms of nutritional contents. As Javanmard *et al.* (2009) report that intercropping of legumes with maize significantly reduced NDF andADF content, therefore,maize-legumes intercrops could substantially increase forage quantity and quality and decrease requirements for protein supplements as compared with the maize monocultures.

In Hararghe as whole, intercropping is the main and indigenous activity of the farmers in due to land shortage. Most of the farmers are practicing intercropping of different crops for different reasons liketo minimize total crop failure and efficient land utilization are the main target. Mixtures of maize-legume showed advantages in land use efficiency expressed as LER than monoculture maize (Javanmard*et al.,*2009). Inter-cropping or associated cropping is an indigenous technique of crop production, which is widely practiced in small-scale farm systems in the tropics. However, there is no knowledge on the impact of intercropping different crops in different planting patterns on yield and yield components of the main crops. Most of time practice, not complementary crop and inappropriate pattern. Therefore, in this experiment was to evaluate the influence of cropping patterns in intercropping forage legumes with maize on both maize and legumes yield and yield components and to determine the appropriate cropping patterns in maize- forage legumes intercropping at district of West Hararghe, Oromia.

2. MATERIAL AND METHODS

2.1. Description of Study Area

The study was conduct at Mecahara Agriculture Research Center on station Daro labu (S1) and Farmers Training Center (FTC) at Habro Districts (S2), West Hararghe Zone of Oromia regionduring 2015/16 to 2016/17 cropping season (May to January). The experimental sites are located at a distance of 434 km and 390 km to the east of capital city, Addis Ababa. From Chiro (Zonal Capital city) 111km and 67km for S1 and S2 districts respectively to the south on a gravel road that connects to Arsi and Bale Zones. These sites were selected because they represent major agro ecological conditions where intercropping is commonly practiced. Daro Labu and Harbro district is located atlatitude of40°19.114 and 8°48.13North and longitude of 08°35.589 and 40°32.3East respectively. It also has Altitude ranges from 1350 to2450 m.a.s.l and 1754 to 2383m.a.s.l. respectively (Climate data obtained from Mechara Metrological Station, 2009-2014 and Habro District Agriculture office, 2016).

The nature of rainfall is very erratic and unpredictable causing dangerous erosion. The area have a bimodal rain fall type ranging from 900 to 1300mm (average of 1094mm) for Mecahara Agriculture Research Center, on station (S1) and 600 to 1000mm (average of 800mm) for Habro District at Bareda Farmer Training Center(S2). The ambient average temperature was 20 and 21^{o}C for S1 and S2 respectively. The major soil type of the area is sandy clay loam which is reddish in color (reporting farming system of Daro Labu, unpublished) for S1and vertisol which black in color (Habro District Agricultural Office, 2016) for S2. The predominant production systems in the districts are mixed livestock-crop production system. The crops that growths in study area are cereals such as maize, sorghum, haricot bean, *teff* to large tree fruits like mango, banana, and Avocado especially coffee is the brand crop of the study area known as Hararghe coffee spatiality.

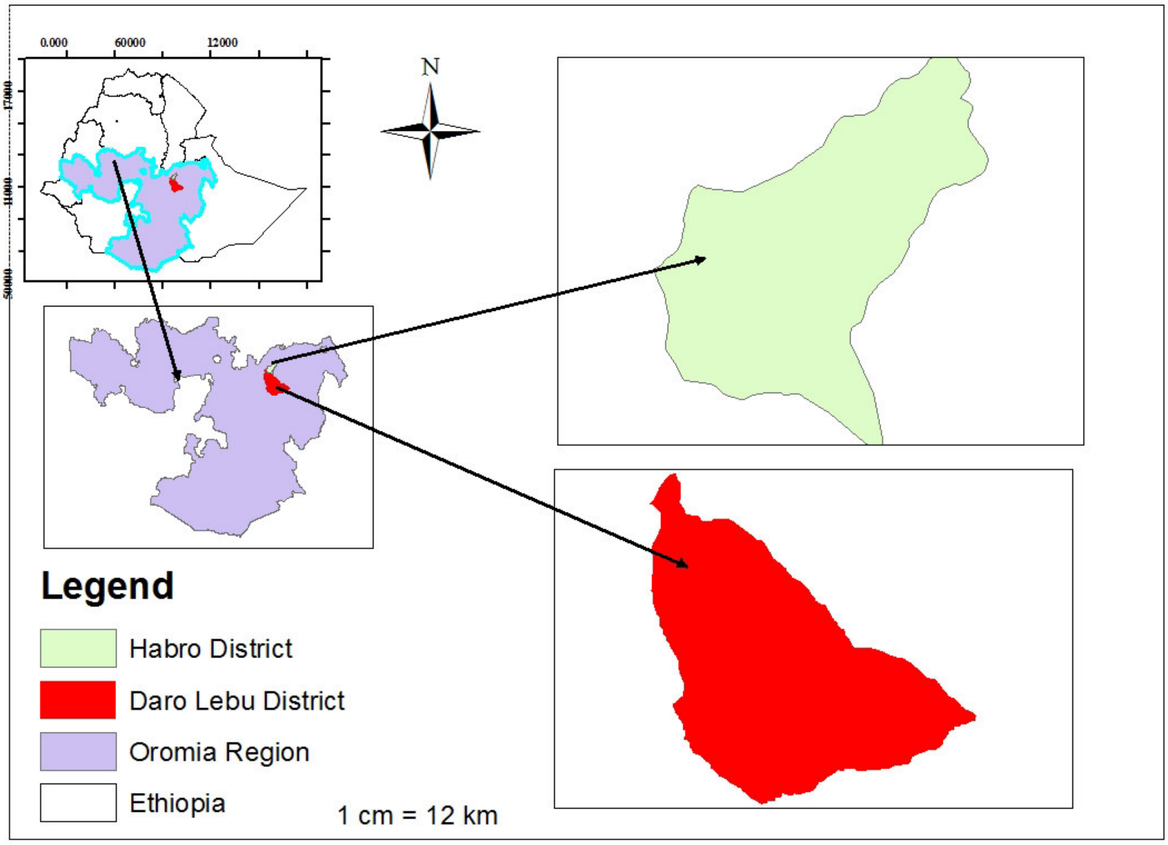

Figure 1: Map of study area

2.2. Treatments and Experimental Design.

The field was divided into four (4) blocks and the seven (7) treatments randomly assigned to the plots in each block. The treatments were includes; sole maize, sole *Dolichos lablab*, sole Vetch, intercropping in spacing of 37.5 cm between maize and *Dolichos lablab*, intercropping in spacing of 25 cm between of maize and lablab in two rows, intercropping in spacing of 37.5 cm between of maize and Vetch and in spacing of 25 cm between maize and Vetch in two rows. The experiment was conducted in randomized complete block design with four replications and seven treatments.

Treatments pattern arrangement in the experiment was;
T1=Maize + Vetch 37.5cm between Maize and Vetch rows
T2=Maize +Vetch 25cm between Maize and Vetch rows
T3=Maize +*Dolichus lablab* 37.5cm between Maize and D/lablab rows
T4=Maize +*Dolichus lablaba* 25cm between Maize and D/lablab rows
T5=Sole Maize
T6=Sole Vetch
T7=Sole *Dolichus lablab*

2.3. Agronomic Management practice

Planting of intercropped and sole cropped maize were carried out for two successive cropping seasons. The plot size were 4.5m x 5m (total area 22.5m^2) and each plots has six rows for sole and intercropped maize and five and ten rows for single and double intercrop legumes. Forage-legumes used for this activity was Dolichus lablab and Vetch sown after the maize to grow in knee stage. The Dolichus lablab was sown at the space of 20cm between plants while Vetch was sown by drilling techniques of spacing 30cm between rows at the seed rate of 30kg/ha. Maize was hand sown with spacing 75cm x 30cm between rows and plants by using fertilizer at the rate of 100 kg/ha DAP and UREA has been applied under maize after developed two to three ear in the rate of 50kg/ha for both sole and intercropped treatment before legumes has been sown. During sowing, two seeds were sown per hill and thinned to single plant per hill week after emergency. Hoeing and weeding were taken place manually a week after emergence. For all treatments, there is no any pesticide/ herbicide has been used. Both intercrop legumes (lablab and Vetch) was sown after 35 and 25 days respectively of first and second year. The plant per hill is similar to maize; two seeds per hill and thinned to single plant per hill week after emergency for lablab. It was hand sown with spacing of 37.5cm x 20cm and 25cm 20cm for single row between maize and double rows between maize respectively. Vetch was sown by drilling with spacing of 37.5cm between maize and 25cm between maize for two rows. After the crop attained full maturity stage, maize and legumes was harvested.

2.4. Data collection methods

2.4.1. Maize data

Maize Stover biomass was recorded from all plots at the stage of harvesting for seed yield. From all plots, five plants randomly selected and harvested above the ground. Then the plant has been weighted after the cob removed from the stalk and the stover biomass per hectare calculated from weight obtained from five plant time's plant number stand count at harvest. Number of days to 50% teaseling and number of days to physiological maturity of maize were monitored and recorded as days after emergency. Physiological maturity of maize was recorded when a black layer appeared at the tip of the maize kernel (detachment of kernel from the cob). Cob number per plant was randomly recorded from five plants and average has been taken. Stand count at thinning and stand count at harvesting was counted for all plots at the stage legume intercropping and harvesting respectively. Seed yield was harvested from all rows. The yield was adjusted and weighted at 12.5% of moisture content to calculate actual seed yield per hectare.

2.4.2. Legumes data collection

Legumes green fodder biomass was taken at 50% flowering from 0.25m^2 areas using metal quadrangle of 50cm * 50cm from each plots. It was recorded and weighted with digital sensitive balance. During data collection for green fodder biomass, great attention was given for number of plant included in metal quadrangle. Both sole and intercropping lablab in one row between maize has two plants per metal quadrangle while four plants in double rows per metal quadrangle. Vetch data was taken in the same with lablab except absence determination of plant numbers per metal quadrant angle since Vetch was drilled.

Data of days to 50% teaseling and days to maturity of legumes were monitored and recorded as days after emergency at harvesting. Pod number per plant and number of branch per plants was randomly recorded from five plants and average has been taken. Plant aspect and seed yield data were followed similar with maize.

2.5. Land equivalent ratio (LER)

Assessing yield advantages was calculated though land equivalent ratio**.** An index of intercropping advantage that indicated the amount of interspecific competition or facilitation in an intercropping system (Fetene 2003)

$$LER = \frac{Y_{is}}{Y_{ss}} + \frac{Y_{iv}}{Y_{sv}}$$

Where Y_{is} and Y_{ss} are the yields of intercrop and sole cropping of maize and Y_{iv} and Y_{sv} are the yields of intercrop and sole cropping of legumes. A LER more than 1.0 reveals an intercropping advantage or a demonstration that intersspecific facilitation is higher than interspecific competition so that intercropping results in greater land-use efficiency. LER less than 1.0 reveals mutual antagonism in the intercropping system. As a result, a LER less than 1.0 has no intercropping advantage and indicates that interspecific competition is more than interspecific facilitation in the intercropping system (Fetene, 2003; Wahla *et al*. 2009).

2.6. Statistical Analysis

Data were subjected to analysis of variance (ANOVA) using (SAS version 9.1.3). Significance differences between treatment means were delineated using Least Significance Difference (LSD) test at 5% probability level.

3. RESULTS AND DISCUSSIONS

3.1 Influence of forage legumes on maize trait

The general intercropping experiments analysis of ANOVA result is presented in Table 1. The mean values of maize traits by different planting patterns within forage legumes has been shown not significant difference p (>0.05) at both study site. This may be attributed to increased nutrients availability in the soil fixed by the legumes because of the legumes' rhizobium association property. Kwafo *et al.* (2011) reported the similar result intercropping forage legumes with maize did not significantly affect the growth and seed yield of maize in savanna zone Ghana. The combination of sole maize and maize intercropping within *Dolichos lablaba* and Vetch as animal feed in study area not indicated statistically significant different value at both locations across treatment arrangement. That means maize (Melkasa -4) intercropping with *Dolichus Lablab* and Vetch were no affect maize yields and yield component. Therefore, the average mean value of recorded data for all parameters across treatment have not shown significance difference P (>0.05).

3.1.1.Days of 50% flowering:

The mean number of days to flowering maize up to 50% within treatment at both site were not show significance difference p(>0.05) but numerically different table (1). The number of days maize (Malkesa-4) required to attain 50% flowering ranged from 56 to 61 days. The minimum days were record at T_3 (57.25 days) at Mechara and T_5 (56 days) at Habro district. This variation may be due to soil type difference.

3.1.2. Plant height

The result showed that plant height was not significantly (P > 0.05) affected by cropping pattern system (Table 1). The mean averages of maize height in different cropping pattern were 159.8 cm at Daro Labu and 131.06 cm at Habro district. The cultivation of maize attained maximum plant height 165.18 cm (T_3) Daro Labu an 133.3 cm (T_4) at Harbro. The minimum 153.17 cm (T_1) Daro Labu and 126.8cm (T_2) plant height at Harbro ditrict was record. As general the height of maize intercropping with legmen's forage is higher than sole sown maize this is due to more efficient use of N sources by the crops in the intercrop system (Nyasasi and Kisetu 2014).

3.1.3. Maize Stover

The stand harvest is potential yield component in seed and forage biomass yield. Stand count at harvest of maize was count total plants from each plot. Both the intercropping and individual effects of maize-forage legume intercropping and sowing patterns on stand count at harvest were not shown significant differenct (P>0.05) at both locations before harvesting and at harvesting. The analysis of variance shows that the average biomass ton per hector at harvesting stage of maize (stover) were not significant (P > 0.05) influenced by intercropping of legume in different patterns or legumes did not improve Stover yield of maize, but have significant different within the location. Similarly, Hongchun *et al.* (2013) reported that intercropping with maize did not disturb by peanut associated with mono cropping this may be due to legumes crops are naturally have the capacity of nitrogen fixation to soil and made conducive environment for soil microbial.

The average mean yield of maize stover were 21.54 t/ha Daro Labu and 13.68 t/ha at Habro district. The highest stover yield were recorded at sole maize (23.89 t/ha) followed by T_3 (22.62 t/ha) and the lowest stover yield were obtained at T_4 (19.33 t/ha) at Daro Labu. At Habro district highest value was recorded at T_1 (15.62 t/ha) followed by T_5 (14.62 t/ha) and lowest value were recorded at T_4 (11.56 t/ha). At both location T_4 (Maize +D/lablab 25 cm between maize and D/ lablab one row) least value of maize stover yield this was due *Dolichos lablab* canopy suppress the maize Stover yield, however, there have no significance variation within other treatment. Therefore, there were not have adverse effects on both seed and stover yields of maize and so would be suitable for intercropping with maize for livestock feed production. Similarly, result were reported by Kabirizi *et al. (*2005) and Abubeker *et al.* (2006) there were no differences in maize stover and seed yields between the mono crops and the intercrops

3.1.4. Cob number and Maize seed yield (qt/ha)

Analysis of maize cob number and seed yield as affected by legumes cropping pattern system is presented in

Table1. The result suggested that forage legumes for maize seed yield fixed significant contribution of nitrogen. Therefore, the mean value across all treatment at both location not show significance variation at P (>0.05) however numerically have different value. The cob numbers of maize were ranged from 1.04 to 1.2. The highest cob number might be from the low competition of crops caused from optimum combined population density of maize and *D/lablab* crops. Regarding of the seed yield of maize was ranged from 40.57 qu·ha^{-1} to 17.4 qu·ha^{-1}. In the production of maize, cob number have direct relation with seed yield.

The mean average cop number during conducted experiment at Daro Labu and Habro district were recorded 1.17 and 1.06 respectively. The mean average of seed yield of maize at both study site were no show significance variation at P (>0.05). Eventhough not shown statistically significant difference the mean value was recorded 39.00 qu.ha^{-1}at Daro Labu and 18.72qu·ha^{-1} at Habro district. The result was in line with Takele *et al*. (2017) who reported that the maximum seed yield of 4843.3 kg·ha^{-1} was obtained in maize + common bean cropping system. The highest seed yield was recorded at Daro Labu district. This is due to rainfall fluctuation during study mostly at Habro district. The maximum yield was obtained sole maize 40.57 qu·ha^{-1}followed by T_3 (39.16 qt/ha^{-1}) at Daro Labu district and also the seed yield of sole maize at Habro district is higher in T_5 (21.5 qu·ha^{-1}) followed by T2 (18.97 qu·ha^{-1}) but lower yield were recorded in T_3 (17.13 qu·ha^{-1}). The result suggested that maize seed yield was reduced with increasing competition of the component crops. However, while compared sole maize (T5) with forage legumes intercropped in maize was advantageous inconsideration of maize stover, maize yield, *Dolichos lablab* biomass, and seed yield.

Table1: Mean values of some traits of maize as affected by different planting patterns and legumes intercropping

Treatments	Locations													
	Mechara on station							Habro district (Bareda FTC)						
	D50%	PH (cm)	Cb/ plt	SCT	SCH	BM ha^{-1}	Sy qt ha^{-1}	D50%	PH(cm)	Cb/ plt	SCT	SCH	BM t ha^{-1}	Sy qt ha^{-1}
Overall Mean	60.6	159.8	1.17	99.23	89.62	21.54	39.00	57.45	131.06	1.06	85.8	65.9	13.68	18.72
Maize + Vetch 37.5 cm between maize and Vetch one row (T1)	61.25	153.71	1.14	94	89	20.23	37.96	58.63	129.5	1.03	85	65.13	15.8	18.97
Maize + Vetch 25 cm between maize and Vetch one row (T2)	60.75	159.21	1.16	97	89.75	21.64	38.2	57.25	126.8	1.1	88.86	59.25	14.15	17.4
Maize +D/lablab 37.5 cm between maize and D/lablab one row (T3)	60.0	165.18	1.18	95.97	90.75	22.62	39.16	57.38	132.9	1.06	85.13	69.38	11.56	17.13
Maize +D/lablab 25 cm between maize and D/lablab one row (T4)	60.13	162.56	1.2	94.5	90	19.33	39.14	58	133.3	1.08	87.13	66.38	12.4	18.59
Sole maize (T5)	60.68	158.4	1.15	99.88	89.13	23.89	40.57	56	132.9	1.04	82.88	69.63	14.62	21.5
CV	1.48	4.75	7.83	6.38	6.64	26.52	13.39	3.44	5.41	7.5	14.1	20.53	29.43	32.08
LSD (5%)	1.38	11.68	0.14	9.46	9.16	8.8	8.04	3.05	10.91	0.12	18.61	20.86	6.2	9.25
p-value	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Ns= Non significance, CV= coefficient of variation, LSD= least significance difference, D50%= Days of %0% flowering, P(cm)= Plant height in cent meter, BMtha^{-1} = Biomass in ton per hector, Gyqtha^{-1}= Seed yield in ton per hector, T= treatment

3.2. Influences of maize on forage legumes trait

General variance analysis of intercropping experiment result indicate significance difference among treatment at different level.

3.2.1. Days of 50 % flowering

Days of 50% have shown highly significance difference at p (< 0.0001). The overall mean of 50% flowering days was 78.94 at Daro Labu and 92.25 days at Habro district which were record long days at T_1 (87.25) and short days at T_7 (69) day at Daro Labu and took time at T_3 (105.25) and short time at T_6 (75) days. Intercrop practices in different pattern have impact on each other, as crop density is increase due to photosynthesis.

3.2.2. Number of legumes bear branch and Herbages yield

In current study, different pattern practice of forage legumes under maize indicated significance difference (P< 0.05) on number of branch or canopy and biomass yield of legumes forage at both location. The result of both parameter show direct relation within each other. As analysis variance indicated, the highest and lowest number of branch and herbage yield was recorded [14.66 (T6), 27.66 (T_3)] and [84.77 (T_4), 97.38 (T_7)] t/ha highest and [9.31(T_3), 11.84 (T_1)] and [15.23 (T_1), 20.6 (T_2)] t/ha lowest at Daro Labu and Habro district respectively (Table.2). The current result was in line with Jalal *et al.* (2017) who reported that there was a significant effect of treatments interaction on and biomass yield of bitter Vetch. Different researches results indicate that sole crop have greater biomass than intercropping. This idea reported illustrated by Temesgen *et al. (2015)* that high plant density might reduce light interception per plant and it is likely that mutual shading affect source capacity to supply a second ear with photo assimilate. But while consider the land economy when the value of land equivalent ration is greater than one intercropping have important for crop failure, quality, and quantity of yield increment. As Eskandari et *al*. (2016) report that intercropping improves forage quality compared with cereals monoculture, and produces more dry matter compared with legumes sole crop.

3.2.3. Number of pods and forage Legumes yields

One of the most yield determinant components is pods that legume plant produces. The result of pod number per plant for *Dolichos lablab* and Vetch intercrop with maize were illustrate in Table 2. The average pod number among treatment were indicate highly significant at (P<0.0001). The overall average pod number per plant *Dolichos lablab* and Vetch under sowing maize crop were 42.2 and 59.4 respectively. However, the highest mean pod number per plant were record at sole D/lablab (67.3) at Daro Labu and T_4 (86.8) at Habro district was recorded higher value. Compared with the intercropping patterns, sole cropping of Vetch had the highest pod numbers at Daro Labu, but highest for single rows at Habro district. This was may be due to good performance of maize at Daro Labu than Habro district that increases resources competition. Similar report by Jalal *et al.* (2017) found that intercropping patterns, sole cropping of bitter Vetch had the highest pod numbers. Regarding to seed yield of legumes forage of different pattern intercropping and sole sowing were shows highly significant p (<0.0001). The average yield of intercrop obtained in combined with sole forage legumes in the study districts were 3.72 qt/ha and 4.7 qt/ha at Daro labu and Habro respectively. The highest and lowest yield were recorded at T7 (9.63qt/ha, 7.25 qt/ha) and T_1 (0.31qt/ha, 1.96 qt/ha) at Daro Labu and Habro district respectively. The result of current study shows yield and yield components among forage legumes were different value in similar pattern. *Dolichos lablab* yield and yield component result was indicated more compatible than Vetch. This is due to the effect of canopy of maize on Vetch that reduces light interception per plant (photosynthesis) and the compatibility attribute of crop are different. Similarly according to Temesgen *et al., (2015)* reported that high plant density might reduce light interception per plant and it is likely that mutual shading affect source capacity to supply a second ear with photo assimilate.

Table. 2. Two years mean values of some traits of fodder legumes as affected by different planting patterns and maize intercropping

Treatments	Locations									
	Mechara on station					Habro district (Bareda FTC)				
	D50%	NoBr	BM t ha^{-1}	Pd No/plt	SY qt ha^{-1}	D50%	NoBr	BM t ha^{-1}	Pd No/plt	SY qt ha^{--1}
Maize + Vetch 37.5 cm between maize and Vetch one row	87.12^{a}	10.46^{c}	15.23^{b}	17.2^{b}	0.31^{c}	81.62^{c}	11.84^{b}	25^{b}	30.0^{c}	1.96^{c}
Maize + Vetch 25 cm between maize and Vetch one row	85.12^{a}	11.38^{bc}	20.39^{b}	14.1^{b}	0.34^{c}	81.62c	13.31^{b}	20.6^{b}	26.3^{c}	2.25^{c}
Maize +*D/lablab* 37.5 cm between maize and *D/lablab* one row	75^{c}	9.31^{c}	63.93^{a}	74.3a	4.89^{b}	105.25^{a}	27.66^{a}	78.1^{a}	105.7^{a}	6.27^{a}
Maize +*D/lablab* 25 cm between maize and *D/lablab* one row	76^{c}	10.53^{c}	86.77^{a}	65.3^{a}	5.44^{b}	108.25a	26.66^{a}	78.4^{a}	86.8^{b}	6.07^{ab}
Sole Vetch	81.12^{b}	14.66^{a}	23.65^{b}	16.5^{b}	1.70^{c}	75.88^{d}	15.05^{b}	30.9^{b}	28.1^{c}	4.38^{b}
Sole *Dolichus lablab*	69^{d}	13.40^{ab}	59.98^{a}	67.3^{a}	9.63^{a}	100.88^{b}	24.56^{a}	97.4^{a}	79.5^{b}	7.25^{a}
Mean	78.94	11.62	44.99	42.5	3.72	92.25	19.85	55.1	59.4	4.70
CV	2.9	16.2	50	22.1	32.0	2.5	20.1	38.1	13.4	25.4
LSD (5%)	3.449	2.833	33.912	14.16	1.796	3.448	6.018	31.63	12.02	1.799
p-value	***	**	**	***	***	***	***	**	***	***

CV= coefficient of variation, LSD= least significance difference, D50% = Days of 50% flowering, NoBr = Number of branch per plant, BMt ha^{-1} = Biomassin ton per hectare, Pd No/plt = pod number per plant, SYqt ha^{-1} = yield in quintal per hector, FTC= Farmer training center

3.3 Intercropping Advantage

The productivity advantage of Maize + Dolichous *Lablab* and Maize +Vetch intercropping system was assess with land equivalent ratio and monetary value of the treatment combination. As shown in Table. 3, cropping system showed significant (P < 0.05) effect on partial land equivalent ratio of maize, total LER, gross monetary values and monetary advantage of the Component crops.

3.3. 1. Partial and Total land equivalent ratio (LER)

Thea analysis results indicated that the amounts of relative land equivalent were calculate the Land Equivalent Ratio in all treatments was more than one (Table.3). This can be a usefulness indicator for maize and legumes forage intercropping have advantage. Because of morphological differences between two crops, creation of different stages and utilization of resources. The analysis variance of ANOVA show DPLER at p (<0.05) and VPLER at P (<0.001) at Daro Labu and VPLER at P (<0.05) Habro have significance variation, but for other parameters at both location no show significance variation. Treatment T_4 and T_3 gave the maximum amount of LER about 1.59, 1.55 at Daro Labu and 1.99, 1.84 at Habro district. The current result is comparable with Takele *et al*. (2017) maximum (2.2) total LER was recorded from Maize + Common Bean-Mung Bean. Pourtaghi (2004) announced in intercropping of Maize and Pinto bean and intercropping of sorghum and soybean, the highest value of LER is achieved at the highest density of both plants. Intercropping have the high proportion of LER was due to difference in time and place in ecological niche, consumption of nutrients and water and crop compatibility.

Table 3. Partial and total land equivalent ratio (LER) on Maize-Legumes intercropping.

Treatments	Location (Districts)									
	Daro Labu					Habro				
	MPLER	Vetch		D/Lablab		MPLER	Vetch		D/Lablab	
		VPLER	TVLER	DPLER	TDLER		VPLER	TVLER	DPLER	TDLER
Maize + Vetch 37.5 cm between maize and Vetch one row	0.985	0.22	1.21	-	-	0.88	0.48	1.45	-	-
Maize + Vetch 25 cm between maize and Vetch one row	0.975	0.24	1.22	-	-	1.2	0.63	1.37	-	-
Maize +D/lablab 37.5 cm between maize and D/lablab one row	1.01	-		0.54	1.55	0.99	-	-	0.92	1.84
Maize +D/lablab 25 cm between maize and D/lablab one row	1.00	-	-	0.59	1.59	0.84	-	-	0.81	1.99
Overall mean	0.99	0.49	1.2	0.71	1.57	0.98	0.7	1.41	0.92	1.92
S.E	0.14	0.68	0.12	0.16	0.14	0.36	0.17	0.23	0.29	0.63
CV	14.39	13.83	9.54	23.21	9.14	36.86	24.78	16.43	31.07	32.82
LSD	0.22	0.14	0.26	0.28	0.33	0.29	0.3	0.52	0.5	1.42
p-value	Ns	***	Ns	*	Ns	Ns	*	ns	Ns	Ns

Ns= Non significance, CV= coefficient of variation, LSD= least significance difference, MPLER; Maize partial land equivalent ratio, LPLER; Lablab partial land equivalent ratio, VPLER; Vetch partial land equivalent ratio, TLER; total land equivalent ratio, - = indicated plot were corresponding crop were not sown.

Conclusion

Maize-forage legumes intercropping in different patterns did not affect maize seed and Stover yield. The Influences of maize on forage legumes trait experiment result indicate significance difference among treatment at different level. Maize yield decreases with double rows forage than single row for both crops. Intercropping in single row increases pod/plant of legumes and cob/ maize than double rows. The LER from this findings showed that intercropping had a major advantage over sole cropping. Farmers practicing Maize-legume intercropping could gain more in terms of food and animal feed than those practicing mono cropping.

Recommendations

From this finding, Maize D/lablab and Maize Vetch intercropping in single row have advantage than all intercropping patterns for popularized at farmer level for food- feed production.

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