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Effect of cassava legumes intercropping on yield and yield components of compound crops in Jinka on station, Southern Ethiopia

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ABSTRACT

A field experiment was carried out during the 2017-18 cropping season at Jinka Agricultural Research Center on station, South Omo zone, Southern Ethiopia, to determine suitable legumes in cassava legume intercropping on yield and land use efficiency of both crops. The experiment consisted of 7 treatments (cassava with haricot bean, cowpea, and pigeon pea as intercrop compared with cassava, haricot bean, cowpea and pigeon pea as sole) laid in RCBD in three replications. Statistical analysis showed that, intercropping cassava with haricot bean, cowpea and pigeon pea resulted in 54, 56 and 21% greater land use efficiency than for either crop grown alone. The highest MAI was obtained by growing cassava with haricot bean (18310.8) followed by cassava with cowpea (14524.4) whereas relatively the lowest was cassava with pigeon pea (6005.6). Based on the present finding, intercropping of cassava with haricot bean had more economic advantage (52219.8 Ebirr) than the other crop combination or grown alone. Therefore, intercropping cassava with grain legumes such as haricot bean and cowpea is important to cassava farmers since it would provide additional crop yield during the early cassava growth stage with the same piece of land and more profitable related to cost benefit. Therefore, use of cassava intercropping with haricot bean can be recommended for cassava producing farmers at Jinka and its vicinity.

Keywords: Inter cropping, Cassava, Legumes, Yield

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Introduction

Cassava (*Manihot esculenta* Crantz) is cultivated mainly for its starchy roots and the most important food staple in the tropics, where it is the fourth most important energy source (Alves, 2002). It is generally cultivated by small scale farmers as a subsistence crop in a diverse range of agricultural and food systems (Alves, 2002). The success of cassava in Africa, as food security crop, is largely because of its ability and capacity to yield well in drought prone, marginal wasteland under poor management where other crops would fail. Cassava is a tropical root crop, requiring at least 8 months of warm weather to produce a crop. It is traditionally grown in a savanna climate, but can be grown in extremes of rainfall. In moist areas, it does not tolerate flooding. In droughty areas, it loses its leaves to conserve moisture, producing new leaves when rains resume. It takes 18 or more months to produce a crop under adverse conditions such as cool or dry weather. Cassava does not tolerate

freezing conditions. It tolerates a wide range of soil pH 4.0 to 8.0 and is most productive in full sun.

In Ethiopia, cassava grows in some areas of Southern regions. According to Feleke (1997), cassava was introduced to drought prone areas of Southern part of the country such as Amaro, Gamogofa, Sidama, Wolaita, Gedeo and Konso primarily to fill food gap for subsistence farmers due to failure of other crops as result of drought. In these areas, farmers usually grow cassava in small irregular scattered plots either sole or intercropped mainly with taro, enset, maize, haricot bean and sweet potato (Eyasu, 1997). The average total coverage and production of cassava per annum in Southern region is 4942 ha and 53036.2 tones, respectively (SNNPR, 2000).

Intercropping is the practice of growing two or more crops simultaneously in the same piece of land (Geiler et al., 1991; Willey, 1979). The

system has been shown not only to be more efficient than sole cropping (Remison, 1978; Willey, 1979) but also to improve the overall ecology (Adelana, 1984). Smallholder farmers in developing countries mostly practice it. It is a common feature of production in Nigeria (Fawusi, 1985; Muoneke and Asiegbu, 1997). Legumes/cassava mixed cropping pattern is widely practiced by farmers in South Ari woreda, South Omo, Southern Nations Nationalities and Peoples Region of Ethiopia. The crops are grown in mixture without proper arrangements to utilize growth resource.

Limited availability of additional land for crop production, decreased soil fertility and declining yield for major food crops have been cited as the major concerns for agriculture's ability to provide nourishment for the increasing population (Sinclair and Gardner, 1998). An advantage commonly claimed for intercropping systems is that, they offer greater yield stability than sole cropping (Mead and Willey, 1980). The system of intercropping is largely practiced in various ways based on the extent of spatial arrangement of the crops on the field. For subsistence farmers, greater stability in the production of food crops in inter-cropping systems is particularly meaningful, since this characteristic of the production system tends to better insure their sustainability and substantially reduces the risk of total crop loss.

Cassava is a long duration crop that takes more than 9 months for harvest. It is planted at intra and inters row spacing of 100-100 cm and takes more than 3 to 4 months to develop enough canopies. The available sunlight, water and nutrients between rows can be profitably utilized for short duration intercrops. The main objective of this study was to determine cassava legume intercropping advantage on yield and yield components of the component crops at Jinka on station.

Materials and Methods

Description of the study area

This experiment was conducted at Jinka Agricultural Research Center on station during 2017-18 cropping season. Jinka Agricultural Research Center in the South Omo zone, located about 750 km from the capital city of the country, Addis Ababa, and 530 km from SNNPRS capital city, Hawassa, It lies at 5° 47' 3" N and 36° 33' 25" E at an altitude of 1418 masl. The study area has a mean annual rainfall and temperature of 1274 mm and 21.1°C, respectively.

Experimental treatments and procedures

Field experiment conducted using 7 treatments and laid in randomized complete block design in 3 replications. The treatments involved were cassava with haricot bean, cowpea, and pigeon pea as intercrop compared with cassava, haricot bean, cowpea and pigeon pea as sole.

The study used cassava [*(Manihot esculenta* Crantz) cultivar Qulle] and three legume varieties including haricot bean (Hawassa dume), cowpea (black eye bean), and pigeon pea (local). Cassava planted using 1 m × 1 m of inter and intra row spacing and two rows of 50 cm apart were left made between the two cassava rows to plant legumes. Seeds of legumes (haricot bean, cowpea and pigeon pea) placed at intra row spacing of 10, 10 and 15 cm, respectively.

Agronomic data collection and measurement

Data of each crop were taken from each plot. Root yield of cassava were weighed using spring balance after harvest, and grain yield of legumes was also weighed using ordinary balance. The collected data were subjected to ANOVA using SAS computer software (SAS Institute, 2000)

Land use efficiency was determined by calculating land equivalent ratio (LER) using (Mead and Willey, 1980). Land equivalent ratio of cassava is calculated as intercrop yield of cassava/pure stand yield of cassava and that of legumes is calculated as intercrop yield of legumes/pure stand yield of legumes. The overall LER is simply the sum of LER of cassava and LER of legumes. The competitive value is determined by calculating the ratio of the individual LER's of the two crops.

$$LER = Yab/Yaa + Yba/Ybb$$

Where,

Yab = Intercrop yield of crop "a"

Yba = Intercrop yield of crop "b"

Yaa = Pure stand crop yield of "a"

Ybb = Pure stand crop yield of "b"

LER= 1: no advantage of intercrop

LER<1: intercropping reduce total yield

LER>1: intercropping increase land productivity than sole cropping.

Finally, the monetary advantage index (MAI) was calculated since none of the above competition indices provides any information on the economic advantage of the intercropping system.

The calculation of MAI was as follows:

$$MAI = (\text{value of combined intercrops}) (LER-1)/LER$$

Results and Discussion

Effect of intercropped grain legumes with cassava on yield of legumes

The yield of haricot bean, cowpea and pigeon pea were reduced by 605.24, 183.69 and 602.6 kg ha⁻¹, respectively when intercropped with cassava (Table 1). This could probable be due to shading

effect of these legumes by cassava which resulted in the reduction of photosynthesis which invariably affected the yield of legumes. This result is in line with the finding of [Legese and Gobeze \(2013\)](#). They observed that, the yield of cowpea was not favored by intercropping with cassava.

Table 1. Effect of intercropped grain legumes with cassava on yield of legumes (kg ha⁻¹).

Treatments	Sole yield	Intercrop yield
Haricot bean	2584.04	1978.80
Cowpea	1210.49	1026.80
Pigeon pea	2070.60	1468.00

Effect of intercropped grain legumes with cassava on root yield plant⁻¹, root yield total biomass of cassava

There was no significant effect of intercropping on root yield plant⁻¹ of cassava plant (Table 2). Cassava yield was significantly influenced by

cropping system. The highest root yield was obtained by sole cropping system 30.46 t ha⁻¹. The root yield of cassava is higher when intercropped with haricot bean 23.60 t ha⁻¹ followed by that of cowpea 21.84 t ha⁻¹ and pigeon pea 15.24 t ha⁻¹ (Table 2).

Table 2. Effect of intercropped grain legumes with cassava on yield and yield components of cassava.

Treatments	RYPP (kg plant ⁻¹)	RY (t ha ⁻¹)	TBM (t ha ⁻¹)
Sole cassava	6.21	30.46 ^a	82.46 ^a
Cassava + Haricot bean	5.90	23.60 ^b	58.57 ^b
Cassava + Cowpea	5.17	21.84 ^b	44.64 ^c
Cassava + Pigeon pea	4.20	15.24 ^c	36.21 ^d
LCD 5%	NS	6.21	8.12
CV (%)	4.6	21.3	37.5

Mean values within column followed the same letters are not significantly different ($P < 0.05$), RYPP=Root yield plant⁻¹, RY=Root yield, TBM=Total biomass.

Land Equivalent Ratio (LER) and Monetary Advantage Index (MAI) of intercropped grain legumes with cassava

The land equivalent ratio (LER) was greater when cassava intercropped with legumes. The highest LER was obtained by growing cassava with cowpea (1.56) followed by cassava with haricot bean (1.54) whereas relatively the lowest was cassava with pigeon pea (1.21).

The highest MAI was obtained by growing cassava with haricot bean (18310.8) followed by cassava with cowpea (14524.4) whereas relatively the lowest was cassava with pigeon pea (6005.6). Intercropping of cassava with haricot bean was more economic advantage (52219.8 Ebirr) than the other crop combination or grown alone (Table 3).

Table 3. Land Equivalent Ratio (LER) Monetary Advantage Index (MAI) of intercropped cassava with legumes.

Treatments	C RY (t ha ⁻¹)	LGY (kg ha ⁻¹)	LER	MAI	Value ha ⁻¹ (Eth. Birr)
Sole cassava	30.46	-	-	-	40,690.00
Sole haricot bean	-	2584.04	-	-	21,964.34
Sole cowpea	-	1210.49	-	-	9,078.67
Sole pigeon pea	-	2070.60	-	-	16,564.80
Cassava + Haricot bean	23.60	1978.80	1.54	18310.8	52,219.80
Cassava + Cowpea	21.84	1026.80	1.56	14524.4	40,461.00
Cassava + pigeon pea	15.24	1468.00	1.21	6005.6	34604.00

CRY=cassava root yield, LGY=legumes grain yield and LER=land equivalent ratio Monetary Advantage Index (MAI)

Intercropping cassava with haricot bean, cowpea and pigeon pea, reduces cassava yield by 6.86, 8.62 and 15.22 t ha⁻¹, respectively. However, intercropping cassava with haricot bean, cowpea and pigeon pea resulted in 54, 56 and 21% greater land use efficiency than for either crop grown

alone. This result is in line with the findings of [Mason *et al.*, 1986](#)). They found out that intercropping cassava with cowpea reduces cassava yield by 14 to 24%. [Mason and Lehiner \(1988\)](#) also reported that, intercropping cassava with cowpea reduces cassava yield by 19 to 38%.

However, intercropping cassava with cowpea resulted in 20 to 100% greater land use efficiency than for either crop grown alone (Leihner, 1983). This finding supports the result of this study. The land use efficiency improved by 56% when cassava intercropping with cowpea and that of haricot bean by 54% indicated that, the actual productivity was higher than the expected when cassava was intercropped with legumes. This result is in line with the finding of Okoli (1996). He found out that, cassava cowpea intercropping system increased land use efficiency by 9 to 40%. The same result was reported by Mason *et al.* (1986). They reported that, cassava/legume intercropping system resulted in greater land use efficiency.

Based on the present finding, the land use efficiency improved by 56% when cassava intercropping with cowpea and that of haricot bean was by 54% and the lowest was with pigeon pea and is by 21% which indicated that the intercropping productivity was higher than sole when cassava was intercropped with legumes. The highest MAI was obtained by growing cassava with haricot bean (18310.8) followed by cassava with cowpea (14524.4) whereas relatively the lowest was cassava with pigeon pea (6005.6). Intercropping of cassava with haricot bean more economic advantage (52219.8 Ebirr) than the other crop combination or grown alone.

Conclusion and Recommendation

Intercropping cassava with legumes is important to cassava farmers since it would provide additional crop yield during the early cassava growth stage with the same piece of land and more profitable related to cost benefit. Obtaining additional food grain is an attractive option for the farmers having land shortage to plant cassava and legume separately. The benefit of obtaining additional legume grain would have positive advantage on food security and land use efficiency.

Therefore, use of haricot bean intercropping with cassava can be recommended for cassava producing farmers at Jinka and its vicinity. However, since, this study was based on only one location; it requires further study by considering other factors.

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