

## Intercropping advantages of coffee with Korarima (*Aframomum korrarima*) in Southwestern Ethiopia

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Received: September 03, 2022; Published: September 21, 2022

### Abstract

*Intercropping advantages of coffee with Korarima (Aframomum korrarima) was conducted at Bonga agricultural research center with the objective of determining optimum intercropping ratio of coffee to korarima and to draw recommendation on biologically and economic sound Arabica coffee intercropping with korarima and their ratio. The treatments consisted of sole plots of coffee and korarima and rows of coffee to korarima in 1:1, 1:2 and 2:1 ratios respectively and korarima was planted in staggered fashion between rows of coffee bushes at recommended spacing. The experiment was laid out in a randomized complete block design with three replications. The recorded data were subjected to analysis of variance using SAS version-9.3 software. In 2017/18 cropping calendar sole coffee gave maximum yield however, no significant difference for korarima. At 2018/19 high coffee yield was obtained from Staggered and 2:1 rows of coffee to korarima ratio which is statistically similar with sole coffee. Similarly, staggered fashion and 1:2 gave maximum yield of korarima. In 2019/20 high yield of korarima was obtained from staggered fashion and 1:2 coffees to korarima intercropping ratio. Productivity of land was better at staggered planting fashion of korarima between rows of coffee have higher productivity of land as compared from other treatments. As a whole the research findings reveal that coffee intercropping with korarima with staggered planting fashion was found to be economically and agronomical more beneficial than mono-cropping in south western Ethiopia.*

**Keywords:** Coffee yield; Intercropping; Land equivalent ratio; Sole cropping

### Introduction

Intercropping is the practice of growing more than one crop in the same field at the same time (Wezel et al., 2014). The most common goal of intercropping is to generate a wide variety of yields per land surface (Mendez et al., 2010) by using resources that would otherwise be taken up by a single crop (Schroth & Ruf, 2014). Intercropping exhibits greater yield stability and less productivity decline during a drought than in the case of a single crop; it also regulates the problem of water stress by keeping humidity within crops (Altieri & Koohafkan, 2008).

Coffee production system provides income for rural communities whose land is limited and helps farmers to reduce the risk associated with drought (Perfecto & Vandermeer, 1996), pest attack (Soto-Pinto et al., 2002). In addition to income generation and food security, the intercropping system in coffee plantations is an approach to producing organic coffee that provides a number of assets that are important for optimal livelihood in rural communities (Bacon, 2008). The patterns of different cropping systems are highly variable as diverse as are the crops themselves and the climates, habitats, levels of mechanization, and human customs under which crop production is undertaken.

**Citation:** Ashenafi Abriham. (2022). Intercropping advantages of coffee with Korarima (*Aframomum korrarima*) in Southwestern Ethiopia. *Journal of Agriculture and Aquaculture* 4(4).

In Ethiopia coffee is grown as garden plantation being intercropped with different crops such as sweet potato, banana, Chat (*Chata edulis*) and some other fruit crops (Damenu, 2008). Korarima is like coffee economically important species used as traditional medicine and food preservative, to flavor coffee and bread, as source of income from local and export markets, for soil conservation (Eyob et al., 2007). It is a shade loving plant grows in almost the same habitats as wild Arabica coffee in high rain forests areas of the country (Jansen, 2002). In the south western part of Ethiopia under natural forest condition coffee with korarima diversified cropping system is common. Therefore, the objective of this study was to determine optimum intercropping ratio of coffee to korarima and to draw recommendation on biologically and economic sound Arabica coffee intercropping with korarima (*Aframomum korrarima*) and their ratio for southwest Ethiopia.

## Material and Method

This experiment was conducted at Bonga Agricultural research center from 2015/16- 2019/20 cropping calendar. The treatments consisted of sole plots of coffee and korarima and rows of coffee to korarima in 1:1, 1:2 and 2:1 ratios respectively and korarima was planted in staggered fashion between rows of coffee bushes at recommended spacing of 2m x 2m. The experiment was laid out in a randomized complete block design with three replications. Local korarima clone with coffee variety having compact canopy recommended for the area was intercropped. Coffee and korarima seedlings were raised in polythene tubes and then simultaneously transplanted to the prepared field. In sole plots and in intercropped experimental unit both crops were planted at a spacing of 2m x 2m, except staggered plots (in which rows planted with coffee and korarima planted separated by 2m). In the course of study coffee trees were trained in single stem and capped at 2m height. Undesirable suckers, lateral growth of long drooping primaries, secondary branches growing within 15 cm were controlled and removed throughout the course of the experiment. Except experimental variables other management practices were applied for both crops as of the recommendation.

Coffee yield and korarima yields were taken from central rows of each treatment. Land equivalent ratio (LER) which one of the best indices that have been suggested for evaluating productivity and efficiency per unit area of land in any intercropping system (Willey, 1979), were calculated using the following formula.  $LER = (Y_{ij}/Y_{ii}) + (Y_{ji}/Y_{jj})$  where  $Y_{ii}$  and  $Y_{jj}$  are sole crop of coffee and korarima

while  $Y_{ij}$  and  $Y_{ji}$  are intercrop yield of coffee and complementary crop respectively.

## Data Analysis

The data were subjected to Analysis of variance (ANOVA) using statistical analysis Software (SAS version 9.3). The mean separation was done using Fisher's Least Significant Difference (LSD) test at 5% probability level.

## Result and Discussion

On 2017/18 cropping calendar sole Coffee gave maximum yield (302. Kg/ha) while the minimum coffee yield obtained from 1:1, 2:1, 1:2 and staggered were 93.83kg/ha, 125.21kg/ha, 68.6kg/ha and 128.09kg/ha respectively which is statistically similar. In 2018/19 the maximum coffee yield obtained from staggered (228.55kg/ha) and 2:1 coffee to korarima intercropping (195.9kg/ha) which is statistically similar with the yield obtained from sole coffee (180.25kg/ha). However, the minimum yield 99.30kg/ha obtained from 1:2 coffees with korarima intercropping. The ANOVA table in 2019/20 indicated that treatments were not significantly different. Plants intensively compete for moisture, nutrients, space and light at latter rather than early growth stage. Decreased coffee yield trend showed over the years (2017/18 to 2019/20) might be related with competition.

Similarly yield of korarima in 2017/18 were statistically similar for all treatments however, in 2018/19 staggered planting fashion gave maximum (250.43kg/ha) yield which was statistically similar with 235.44 kg/ha which obtain from 1:2 coffee to korarima on other hand the least korarima yield (123.81kg/ha) was harvested from 1:1 coffee to korarima ratio. The higher yield 133.4kg/ha and 109.45 kg/ha was obtained from staggered and 1 to 2 coffee to korarima ratio respectively in 2019/20. Meanwhile the minimum korarima yield (17.27kg/ha) was obtained from 1:1 coffee to korarima ratio. Korarima is shade loving plant under natural forest condition. The average minimum yield obtained from 1:1 coffee to korarima ratio was associated with poor level of shade.

Productivity of land was better at staggered planting fashion of korarima between rows of coffee bushes have higher productivity (105% yield advantage) of land as compared from other treatments. Followed by staggered planting fashion, 2:1 coffee to korarima ratio gave 86% of yield advantage while the least yield advantage (41%) obtained from 1:1 coffee to korarima ratio. Even though land equivalent ratio was high for all treatments, the yield shows instability of

yield and productivity over the years, due to variation in computing capacity for light and nutrient between component crops and non-uniform shade level of the fore

Mean Coffee yield kg/ha as affected by coffee with Korarima intercropping ratio

Treatment	2017/18	2018/19	2019/20	Mean
sole Coffee	302.30a	180.25ab	37.78	173.44a
1:1 c to k	93.83b	114.14bc	39.94	82.64c
2:1 c to k	125.21b	195.90a	71.91	131.01b
1: 2 c to k	68.60b	99.30c	16.19	61.36c
Staggered	128.09b	228.55a	47.22	134.62ab
C.V (%)	39.82	22.04	41.48	37
LSD(±)	107.68	67.911	Ns	41.94

Mean korarima yield kg/ha as affected by coffee with Korarima intercropping ratio

Treatment	2017/18	2018/19	2019/20	Mean	LER
1:1 c to k	809.4	123.81d	17.27c	316.82b	1.41
2:1 c to k	695.8	216.21b	69.28b	327.09ab	1.86
1: 2 c to k	873.1	235.44ab	109.45a	405.99ab	1.48
Staggered	765.5	250.43a	133.40a	383.11ab	2.05
Sole Korarima	1149.7	148.43c	64.51b	454.21a	-
C.V (%)	44.27	5.42	21.32	36.82	
LSD(±)	ns	19.892	31.62	134.23	

Coffee with korarima Intercropping effect on productivity of land

Treatment	2017/18	2018/19	2019/20	Mean
1 to 1	1.01	1.47	1.75	1.41
2 to 1	1.02	2.54	2.02	1.86
1 to 2	0.99	2.14	1.32	1.48
Staggered	1.10	2.96	2.09	2.05

## Summary

In all cropping calendar sole coffee and korarima gave significantly maximum yield than intercropped. Among intercropped, the higher coffee yield was obtained from staggered planting pattern. However, at 2:1, 1:2 coffee to korarima ratio and staggered planting fashion, the higher korarima yield was harvested. The productivity of land shown that the maximum (105%) yield advantage obtained from staggerd planting fashion. Finally, this research revealed that coffee

to korarima intercropping is more beneficial than coffee or korarima mono cropping and that agricultural intensification of cash crops in smallholder system should not solely on the mono crop pathway.

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