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Effect of Integrated Weed Management on Coffee Growth and Yield at Metu and Haru in South west and West Ethiopia

Tigist Bidira Fantahun Asfaw Asfaw adugna Terfa Likasa Tadesse Eshetu
Jimma Agricultural Research Center of EIAR, Jimma-Ethiopia

Abstract
A field experiment was conducted to evaluate different single and integrated weed management methods on the growth and yield of coffee at Metu and Haru sub centers of Jimma Agricultural Research Center (JARC) between 2014-2018 cropping seasons. At Metu eight treatments were compared in randomized complete block design with three replications. The treatments included the following: (T1) One slash in May + one slash in August,(T2) Three slashing (May+Jully+Augesst), (T3) Roundup 3L/ha. sprayed in may followed by one slashing in July followed by vetivar grass mulching in September , (T4) Roundup 3L/ha.sprayed in May followed by soybean intercropping in July followed by mulching in September , (T5) Roundup 3L/ha. sprayed in May haricot bean intercropping in June followed by mulching in September , (T6) Roundup 3L/ha (only for the first year) Desmodium cover crop all year round permanently , (T7) Vetch cover crop in June followed with one hand weeding , and (T8). Weed free (plots kept weed free all year round). At Haru nine treatments were compared in randomized complete block design with three replications. The treatments included: (T1)one to two times slashing (farmers practice), (T2) three slashing in May, June and July, (T3) four slashing in May, June, July and August, (T4) Round up 3L/ha. sprayed in May followed by slashing followed by mulching followed by slashing and followed by mulching: (T5) slashing followed by Roundup 3L/ha. followed by coffee husk mulching: (T6) Roundup 3L/ha followed by desmodium cover cropping: (T7) Roundup 3L/ha followed by vetch cover cropping: (T8) Roundup 3L/ha followed by soybean intercropping followed by mulching: and (T9) Weed free (plots kept weed free all year round).. The result raveled that at both locations the major weed species included perennial sedges, perennial grasses, and annual broad leaf At Metu herbicide followed by soybean intercropping and followed by mulching in September gave a mean yield of 13.6 quintal clean coffee. Similarly, desmodium cover cropping provided excellent weed control and resulted in mean yield of 13.7 q/ha clean coffee .Desmodium showed a high smothering effect of the highly competitive perennial sedges and grasses by inhibiting the incoming light reaching the soil compared with other treatments and the weed free treatment.. At Haru Roundup 3L/ha followed by slashing followed by mulching followed by slashing and followed by mulching gave consistently very high coffee yield with a mean yield of 21 quintal /ha. compared with other treatments. The weed free treatment gave low yield at both locations. Vetch and desmodium did not well established at Haru compared with Metu.
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Introduction

Arabica Coffee is the major export crop in Ethiopia and its contribution to the national economy is tremendous. It is the leading commodity in Ethiopia's industry and foreign exchange earner from which millions of workers and growers derive their livelihood. Weeds are among the major factors limiting coffee production in the country. The majority of coffee farmers heavily depend on manual slashing and digging which encourage the multiplication and spread of the noxious competitive perennial weeds (Mesfin, 1990; Tadesse, 1994). The adapted weed management system in coffee fields can have major effects on soil environment, affecting physical, chemical and biological conditions; resulting load bearing capacity affecting yield and quality of coffee. Weeds are plants which grow where they are not wanted. By their nature, weeds are very prolific in multiplication and excessively competitive for soil moisture, light and nutrients. If allowed to grow in coffee, they use up soil moisture and essential nutrients which the coffee plants would otherwise require. They also interfere with other coffee management practices.

The effects of weeds on coffee growth and yield are not likely to be noticed immediately. However, it is known that coffee trees which have been left under weeds will show great water deficit during dry spells, show deficiencies of essential nutrients and also coffee which has been left under weed competition will produce fewer and smaller beans which affect the coffee quality (Kenya coffee, 1995). In Kenya, loss in yield can be over 50% leading to total loss in the long run (Kenya coffee, 1995). In Ethiopia, the warm wet and humid conditions prevailing in the coffee growing areas o south west Ethiopia not only result diverse weed flora ranging from soft annuals to extremely difficult to control perennials but also encourage the continuous growth of weeds all year round.

According to Tadesse, 1998 yield loss as a result of weed competition can reach as high as 65 % to complete crop failure depending on the type of weeds, coffee growth stage of coffee trees and the prevailing growth conditions. Any weed control practice should aim at marinating or improving soil structure, should be adaptable to local conditions and should not encourage the colonization of a particular weed(s).

Integrated weed management uses all available knowledge to manage weeds and prevent them from causing economic loss without adversely affecting the environment (Opile, 1995). Cover cropping, mulching, slashing and digging, shading, land preparation methods and herbicides can be logically integrated depending on the environmental situation where the coffee is growing to obtain maximum benefits from IWM program. For successful management of weeds integrated strategies are more useful and safe. While in some production systems, herbicides may provide the main means of control; these alone are unlikely to be successful unless combined with slashing and hand weeding around coffee trees good land preparation etc. No one weed control method is likely to control all weeds, and in the long term this can lead to a build-up of certain species. The combination of direct weed control methods, such as herbicides or slashing and hand weeding around coffee trees, with indirect methods such as cover cropping mulching and intercropping (competitive crops) will help prevent this situation. Coffee is very slow growing perennial crop and at the same time the space between coffee trees is wide and remains open for quit along period. This situation along with the conducive environmental condition encourages frequent flush growth of weeds, which can seriously compete with the crop (Tadesse and Tesfu, 2015). The objective of these activities was, therefore, to evaluate different integrated weed management methods on growth and yield of coffee at Metu and Haru.

Materials and Methods

Description of the study areas

The experiment was conducted at Metu and Haru sub centers of Jimma Agricultural Research Center between 2014 -2018. Metu is located 600 and 255 km from AddisAbaba and Jimma cities,respectively in Illubabor zone of Oromia regional state,. Metu is located on latitude 8º 19 0 " N longitude 35º 35 0"E at an altitude of 1558 m.a.s.l. The mean annual temperature ranges from12.7 and 28.9 º C with annual rainfall of 1829mm/annum. The major soil type is Nitosols with Ph of 5.24 and phosphorus level of 9.36ppm (Paulos, 2001).Haru center represents the sub-humid tepid to cool mid highlands coffee agro-ecological zone in West Ethiopia. It is found at 28 km from Gimbi town and 466 km from Addis Ababa in western Ethiopia. The area is geographically located between latitude of 8°54' 30" North and longitude of 35°52'0" East at an elevation of 1750 m.a.s.l. The area is characterized by uni-modal rainfall pattern with an average annual rainfall of 1700 mm. The rainy season starts in March or May and extends up to October. The mean maximum and minimum air temperature is 27.8 ºC and 12.4 ºC, respectively. The soil type of the center is acrisols and sandy clay loam

Experimental materials and design

Twenty coffee trees with a spacing of two meters were planted for each treatment**.**

Treatments at Metu:

(T1)One slash in May + one slash in August, (T2)Three slashing (May+Jully+Augesst), (T3)Round up 3L/h. in may followed by one slashing in July followed by mulching in September with 5 tone/ha of vetivar grass. (T4) Round up 3L/h in may followed by soybean intercropping in July followed by mulching in September with 5 tone/ha of vetivar grass (T5) Round up 3L/h May haricot bean intercropping in June followed by mulching in September with 5 tone/ha of vetivar grass (T6)Round up 3L/h (only for the first year) Desmodium cover crop all year round permanently (T7) Round up 3L/h Vetch cover crop in June followed with one hand weeding and (T8) weedy free control (plots will be kept free of any weed growth throughout the season). Round up is sprayed only for the first year in those treatments which contain herbicide spray. . Knapsack sprayer was used for herbicide spraying and the volume of water used was 200L/ha

Treatments at Haru: (T1) One to two slashing (T2) Three slashing (May+Jully+Augesst) (T3) Four slashing (May+June+July+August) (T4) Round up 3L/h in May followed by slashing followed by mulching (5 tone vetivar grass) followed by slashing followed by mulching (5 tone vetivar grass) (T5) Slashing followed by herbicide application followed by coffee husk mulching (5 tone/ha.) (T6) Round up 3L/h followed by desmodium cover cropping all year round permanently (T7) Round up 3L/h followed by vetch cover cropping (T8) Roundup 3L/ha (only for the first time) followed by vetch cover cropping (T9) weed free control (plots will be kept free of any weed growth throughout the season). Round up is sprayed only for the first year in those treatments which contain herbicide spray. Knapsack sprayer was used for herbicide spraying and the volume of water used was 200L/ha.

Yield components

Canopy Diameter (cm): Canopy diameter was determined by randomly selecting five plants and measuring the canopy in two opposite directions and the average was recorded as final canopy diameter of the respective treatments

Girth Diameter(cm): Girth diameter was determined by randomly selecting five plants and measuring at ground level using caliper.

Length of Primary branch (cm): Length of primary branch was determined by randomly selecting five plants

and measuring the branch from the main stem up to the tip of the primary branch
Plant height (cm): The height of coffee plants was determined by randomly selecting five plants and measuring the height of main stem (trunk) starting from the ground surface to the tip of the plant.

Weed growth and weed control efficiency
The major weeds were recorded in the experimental field and identification of species was done by visual observation and by the aide of weed identification guides. Noxious and important weeds were classified on the basis of abundance and the difficulty of control the particular weed species. Those weed species with underground and rhizome and tuber structures and those weed species with aboveground running structures were considered as noxious weed species in coffee. Yield loss (YL) was calculated using the following formula (Panda, 2010)
YL= Y1-Y2/Y1X100
Weed control efficiency (WCE) was calculated using the following formula (Devasenapathy et al, 2008)
$$WCE = \frac{WDC - WDT}{WDC} \times 100$$
Where WDC= weed dry mass from the control plot (untreated), WDT= weed dry matter from treated plot
Where WDC= weed dry mass from the control plot (untreated), WDT= weed dry matter from treated plot

Weed dry weight
Weed dry weight was determined using 1mx1m quadrate by placing on the plots at the end of the growing period. All weeds within the quadrate were harvested at ground level and sun dried.
Yield: Total fresh cherry (gm/tree) and dry cherry were collected, both total fresh cherry and buni were converted into clean coffee in qt/ha as final green bean yields in each harvesting season

Data analysis
The experimental data were analyzed using by Gomez and Gomez (1984) using SAS version 9.0 computer software program (SAS, 2002). Difference between means was assessed at 5 % probability level..

Results and Discussion
Weed species
The major weed species recorded growing abundantly in the experiment site include*: Digitariaabyssinica, Cyperusesculentus, cyperesrotundus, Cyperuscyperides, Kyllingabulbosa, Cynodon spp., Commelina benghalensis, Hydrocotyle Americana, Bidenspilosa, Ageratum conyzoides, Galinsogaparviflora, Paspalumspp*and some annual grasses and broad leaf weeds. According toTadesse (1998) these weeds are highly competitive that at worst conditions coffee bushes can be completely smothered and yield reduction can reach as 65%
Table1. List of the noxious and important weed species at Metu

Botanical name	Family	Growth nature	Common name	Economic importance
Cynodonspp	Poacea	Perennial	Star grass	Noxious
Cyprus Cypriodes	Cyperacea	Perennial	Small flower ubrelasedg	Noxious
Cyprus rotundus	Cyperacea	Perennial	Purple nutseadg	Noxious
Digitareaabysinica	Poacea	Perennial	Blue couch grass	Noxious
Echinocloaspp	Poacea	Perennial		Noxious
Paspalumconjugatum	Poacea	Annual	Buffalo grass	Noxious
Commelinabenghalensis	Commelinacea	Perennial	Tropical spider wort	Noxious
Hydrocotyleamericana	Araliaceae	Perennil	Wax weed	Important
Bidenspilosa	Asteracea	Annual	Black jac	Important
Ageratum conyzoides	Asteracea	Annual	Goat weed	Important
Plantagolanceolata	Plantaginaceae	Annual	English plantain	Important
Galinsogaparviflora	Asteracea	Annual	Gallant soldier	Important
Conyzaalbida	Asteracea	Annual	Hairy horse weed	Important
CynoglosumlanciolatumForssk	Boraginaceae	Annual	lanceleaf	Important
Cusctacapestries L.	Convolulaceae	Perennial	dodder	Important
Convolulesarvensis L.	Convolulaceae	Perennial		Important
Amarantusdubius Mart	Amaranthacea	Annual	pigweed	Minor

Table 2.List of the noxious and important weed species at Haru

Botanical name	Family	Growth nature	Common name	Economic importance
Cynodonspp	Poacea	Perennial	Star grass	Noxious
Cyprus Cypriodes	Cyperacea	Perennial	Small flower ubrelasedg	Noxious
Digitareaabysinica	Poacea	Perennial	Blue couch grass	Noxious
Paspalumconjugatum	Poacea	Annual	Buffalo grass	Noxious
Commelinabenghalensis	Commelinacea	Perennial	Tropical spider wort	Noxious
Hydrocotyleamericana	Araliaceae	Perennil	Wax weed	Important
Bidenspilosa	Asteracea	Annual	Black jac	Important
Ageratum conyzoides	Asteracea	Annual	Goat weed	Important
Plantagolanceolata	Plantaginaceae	Annual	English plantain	Important
Galinsogaparviflora	Asteracea	Annual	Gallant soldier	Important
Conyzaalbida	Asteracea	Annual	Hairy horse weed	Important
CynoglosumlanciolatumForssk	Boraginaceae	Annual	lanceleaf	Important
Cusctacapestries L.	Convolulaceae	Perennial	dodder	Important
Convolulesarvensis L.	Convolulaceae	Perennial		Important
Amarantusdubius Mart	Amaranthacea	Annual	pigweed	Minor

Weed control Efficiency

At Metu the result showed that there were significant differences between treatments in terms of suppressing weed growth and increasing weed control efficiency (Table 1). The highest mean weed control efficiency (71.2) was obtained from Desmodium cover cropping followed by vetch cover cropping with 57 % weed control efficiency. Coffee intercropped with soybean also showed good weed suppression and resulted in 50% weed control efficiency compared with farmers weed control strategy.Desmodium cover gave inferior weed control efficiency during the first year of the experiment. This is because Desmodium requires over one year period until it fully establishes and cover the soil. This is evident from the result that starting the second year the weed control efficiency of Desmodium was 91.1%, 87.5% and 100%, for the second, third and the fourth year of the study period, respectively. As weed management is the most important agronomic practice in coffee which entails high cost of production Desmodium and vetch cover crops have shown their potential to suppress highly competitive weed species in coffee. The major action of these two species against weed growth is by covering the soil and inhibiting light irradiance reaching the soil. In the south west coffee growing areas where weed infestation and subsequent weed competition for essential growth requirements is so high, the role that Desmodium and vetch cover cropsplay to manage the highly competitive perennial and annual weeds is vital. Hence, these cover crops could be good components in integrated weed management program in coffee production. In addition, intercropping soybean between the coffee rows apart from providing additional soybean yield can also suppers weed growth and lessen the farmer's effort of weed control in coffee. Both the cover crops and soybean minimize the risk of the spread of the deadly coffee wilt disease which is mainly spread from tree to tree through would of coffee trees by minimizing or totally avoiding slashing of weeds by bushman knife.

Weed control efficiency

Table 3.Influence of weeding methods on weed dry weight and weed control efficiency at Metu

Treatment	Yer1		Year2		Year3		Year4		
	WDW	% WCE	WDW	% WCE	WDW	% WCE	WDW	% WCE	Mean % WCE
1	3.4	-	2.2	-	5.6	-	2.6	-	-
2	3.4	0.0	1.9	13.6	4.4	21.4	2.6	0.0	8.8
3	3.0	11.8	0.9	59.1	3.6	35.7	1.7	34.6	48.7
4	3.0	11,8	0.4	81.8	1.5	73.2	1.7	34.6	50.3
5	3.3	3.0	0.5	77.2	2.2	60.7	1.5	30.8	45.7
6	3.2	6.0	0.2	91.1	0.7	87.5	0.0	100.0	71.2
7	1.0	70.6	0.5	77.3	3.7	33.9	1.4	46.2	57.0
8	0.0	100.0	0.0	100.0	0.0	100.0	0.00	100.0	100.0
CV%	13.6		48.4		25.1		42.0		
LSD (5%)	2.7		0.2		0.7		1.1		

Table 4.Effect of weed management treatments on plant height, girth, canopy diameter and length of primary branch at Metu. Mean of four years

Treatment	PH(cm)	G (cm)	LPB (cm)	CD (cm)
1	161.6	4.2	61.3	93.9
2	164.3	4.5	66.9	96.8
3	169.5	4.5	66.4	103.8
4	172.4	4.7	66.4	101.8
5	164.7	4.5	63.7	95.1
6	163.3	4.4	61.1	97.7
7	165.1	4.3	60.9	91.8
8	159.0	4.1	66.1	97.1
CV(%)	16.0	17.6	14.0	15.0
LSD (5%)	10.0	0.4	8.5	10.3

PH=Plant Height G= Girth LPB= Length of Primary Branch
CD= Canopy Diameter

Table5 .Effect of weed management treatments on plant height, girth, canopy diameter and length of primary branch at Haru. Mean of four years

Treatment	PH(cm)	Girth (cm)	LPB (cm)	CD (cm)
1	141.1	3.1	54.2	120.9
2	142.9	2.9	62.0	126.3
3	138.6	3.3	59.5	132.5
4	157.0	3.5	66.4	135.7
5	136.4	2.7	62.6	121.5
6	134.2	2.7	58.1	111.1
7	138.6	2.8	61.7	105.5
8	152.8	2.9	61.6	125.1
9	141.5	3.0	63.1	133.8
CV(%)	13.6	30.0	13.8	14.8
LSD (5%)	12.9	0.29	7.7	14.0

Coffee Yield

Metu

The effect of treatments on clean coffee yield is presented in Table 6. Five years mean result revealed that there was a significant difference between treatments for coffee yield. The highest yield was recorded from desmodium cover cropping all year round permanently and from that treatment where Roundup at 3L/ha sprayed for the first year only followed by soybean intercropping followed by mulching in September with 13.7 and 13.6 q/ha clean coffee, respectively. This might be because soybean intercropping and desmodium cover cropping have effectively controlled the growth and proliferation of noxious perennial weeds which are highly competitive for essential growth requirements. Soybean intercropping also gave additional advantage of 12q/ha soybean yield. Intercropping is another way of increasing yields per unit area, particularly in small farm areas. Using this method farmers may have more than one crop on the same filed. Increased crop density by the presence of two crops reduces the space for weeds to grow. Coffee is very slow growing perennial crop and at the same time the space between coffee trees is wide and remains open for quite a long period until canopy closes the open space. This situation along with the conducive environmental condition encourages frequent flush growth of weeds, which can seriously affect the quality and yield of coffee (Tadesse and Tesfu, 2015). The clean weeding treatment gave very low yield although the plots remained weed free all year round. This might be because of the fact that under Metu condition of high rainfall the soil is exposed to high erosion leading to removal of essential nutrients for the coffee growth and development.

Similarly, Lumbanraja et al (2004) in Indonesia reported that after four years of investigation, Total C, Total N, available P and exchangeable Mg. were significantly reduced in coffee with no cover compared with coffee covered under Paspalumconjugatum.

In Ethiopia on average, 98% of the diseased and 95% of healthy trees were noted to have one to three wounds per coffee stem (Girma, 2004). The wounds arose practically from the intensive slashing of weeds in coffee fields by bush man knife , which is the most common method of weed control in coffee (Getachew, 1991; Tadesse, 2001). Getachew (1991) noted that weeds are slashed frequently, sometimes more than ten times a year, depending on

the dominating weed flora in plantation coffee, and most of the coffee trees were found to have at least one wound. Growing cover crops such as *Desmodium*sp. is recommended for the management of coffee wilt disease as it is very efficient in suppressing weeds by inhibiting the incoming irradiation hence reducing the frequency of slashing which predisposes coffee trees for coffee wilt disease

The majority of small holder coffee farmers heavily depend on manual slashing and digging of the perennial weeds as a means of weed control. As a result the traditional practices of slashing and digging encourage the multiplication and spread of the noxious weeds in coffee (Mesfin, 199o and Tadesse, 1994). Under this circumstance the deadly disease coffee wilt has now become a major treat of coffee production in all coffee growing areas of the country. Hence, intercropping soybean in between the coffee trees is recommended for weed control and minimizing the frequency of slashing weeds in coffee. On the other hand intercropping desmodium in between the coffee trees is also recommended for efficient weed control without affecting coffee yield under Metu area.

Haru

Five years mean result at Haru showed that there was a significant difference between treatments. The highest mean yield of 21q/ha clean coffee was recorded from slashing followed by mulching followed by slashing and followed by mulching. This treatment consistently gave very high coffee yield compared with all other treatments for five consecutive years suggesting that integrating slashing with mulching has proved to be good agronomic practice in controlling weeds and increasing coffee yield under Haru condition.

Mulching involves covering the soil with organic or synthetic materials to control weeds. It is most important in maintaining soil structure, erosion reduction and increasing soil nutrients. Its limitations include difficulty in controlling established weeds, frequent replacement in case of breakdown, availability, difficulty in handling some weeds and high cost, including extra cost for disposal. In fact mulches are more effective for small annual weeds than perennials. However, when integrated with slashing apart from reducing the frequency of slashing it provides good control of the noxious perennial. Under the present study slashing integrated with mulching has proved to be good practice in controlling weeds and increasing coffee yield. Hence, slashing followed by mulching followed by slashing followed by mulching is recommended for weed control and high coffee yield under Haru condition.

Table 6.Effect of weed management methods on yield of Arabica coffee at Metu (Five years crop)

Treatment	Yield Q/ha						Q/ha. soybean	Common bean
	2014	2015	2016	2017	2018	Mean		
One slash in May + one slash in August	3.5	6.5	6.9	11.5	6.5	7.0		
Three slashing (May+Jully+Augesst)	7.4	10.1	10.4	12.6	8.0	9.7		
Roundup 3L/ha. in may followed by one slashing in July followed by mulching in September	10.3	10.8	9.7	12.5	6.8	10.0		
Roundup 3L/ha. (only for the first year) in May followed by soybean intercropping in July followed by mulching in September	15.6	9.5	18.6	14.8	9.4	13.6	12.8	
Roundup 3L/ha. in May haricot bean intercropping in June followed by mulching in September	8.4	6.7	16.8	11.7	8.5	10.4		11.1
Roundup 3L/ha in May. (only for the first year) Desmodium cover crop all year round permanently.	7.6	16.4	13.6	21.4	9.6	13.7		
Vetch cover crop in June followed with one hand weeding	6.3	6.4	11.3	11.5	9.2	9.0		
Weed free	12.0	6.0	9.6	7.1	8.5	8.7		
CV%	23.0	19.2	24.0	15.8	17.6			
LSD5%	2.4	3.7	3.7	3.5	ns			

Table 7.Effect of weed management methods on yield of Arabica coffee at Haru

	Yield Q/ha					
Treatment	2014	2015	2016	2017	2018	Mean
One to two slashing	1.5	13.1	8.1	7.6	24.5	10.9
Three slashing (May+Jully+Augesst)	1.4	13.8	9.9	7.2	28.5	12.2
Four slashing(May+June+July+August)	1.4	19.7	11.2	6.5	28.4	13.5
Roundup 3L/ha (only for the first time)Slashing followed by mulching followed by slashing followed by mulching	4.7	22.1	25.9	11.8	40.5	21.0
Slashing followed by herbicide application followed by coffee husk mulching	1.1	17.3	14.5	9.5	29.0	14.3
Roundup 3L/ha (only for the first time)followed by desmodium cover cropping	0.6	11.4	6.8	5.8	25.2	9.9
Roundup 3L/ha (only for the first time) followed by vetch cover cropping	2.0	12.5	5.5	6.4	15.7	8.4
Roundup 3L/ha (only for the first time) followed by soybean intercropping followed by mulching	2.0	10.6	7.2	5.5	21.3	9.3
Weed free	1.5	11.9	10.6	9.6	24.1	11.5
CV%	22.3	20.1	26.3	32.9	20.0	
LSD5%	1.5	4.2	4.1	2.1	5.1	

Conclusion and recommendation

The present study has showed that at Metu, spraying Roundup at 3L/ha. followed with soybean intercropping and mulching with vetivar grass at 5tone/ha. after soybean was harvested effectively suppressed weed growth and gave a mean yield of **13.6 q/ha** clean coffee compared with **8.7** quintal clean coffee obtained from the weed free treatment. This is **36%** yield advantage over the weed free treatment where the plots remained free of weeds all year round. Apart from suppressing weed growth and increasing coffee yield a mean yield of **12.8** q/ha soybean was obtained compared with weed free treatment. Desmodium cover cropping also gave a mean yield of **13.7 q/ha** clean coffee compared with the weed free treatment which is **36, 5%** yield advantage. Desmodium was highly efficient in suppressing the noxious difficult to control stoloniferous and rhizomatous perennial grasses and perennial broad leaf weeds. Desmodium completely covered the soil and plots remained free of weeds all year round.

At Haru, slashing integrated with mulching (slashing followed by mulching followed by slashing and followed by mulching) consistently gave very high coffee yield with mean yield of **21 q/ha** clean coffee compared with the weed free treatment with mean yield of **11.5 q/ha**. which is **45.2%** yield advantage over the weed free treatment. At Haru, the result clearly demonstrated the advantage of integrating slashing and mulching for high coffee yield. Desmodium and vetch showed poor establishment at Haru compared with Metu and as a result satisfactory result was not obtained.

Based on the present result the following is recommended:

Metu and Jimma areas,

1. Roundup spraying at 3 L/ha. (only for the first year) followed by soybean intercropping followed by vetivar mulching at 5tone/ha in September.
2. Roundup spraying at 3L/ha. (only for the first year) followed by desmodium cover cropping. One or two times hand weeding should be done until the desmodium fully cover the coffee field.

Haru:

1. Roundup 3L/ha (only for the first year) followed by slashing followed by mulching followed by slashing and followed by mulching in September.

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