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# Evaluating the Efficacy of Newly Introduced Herbicides against Coffee (*Coffea arabica* L.) Weeds in Sidama, Southern Ethiopia

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## ABSTRACT

Weed is the major limiting factor of coffee production in Ethiopia. Weeds in coffee cause 65% yield reduction in the country. Now a day, the expensiveness of weed management has been a principle issue in economic analysis of coffee production in Ethiopia. Herbicide is a best weed management option in coffee production. Thus, newly introduced herbicides verification trial was conducted in Hawassa Agricultural Research Center on site and Wondo Genet District in 2023 cropping season to evaluate the efficacy of newly introduced herbicide. The experiment consist one (1) treatment Glyphosate 480g/l SL test herbicides and Gly care 480%g/l SL, as standard check and weedy control as negative control. The herbicides effectively reduced weed density and provide good weed control efficiency compared with weedy control. The tested herbicide Glyphosate 480%g/l SL, have been full declination on weed control as compared with standard control herbicide with one time application for one season. This result suggested that one time application at vigorous weed growth is mandatory to achieve full control throughout season equivalent with standard control herbicide. Therefore Glyphosate 480g/l SL at 3 L/ha within 250L/ha water with one time application per season is recommended to control weeds in coffee. According to this study, although both the evaluated herbicides can control coffee weeds and the duration of their control is not different. The standard check (Gly care 480% g/l SL) and the test herbicide (Glyphosate 480% g/l SL) were control weed species within 7 to 14days.

***Keywords:*** Coffee, Ethiopia, herbicide efficacy, SERU 480 %, weed species, verification

## 1. Introduction

Coffee (*Coffea arabica* L.) is the backbone of the economy of a country and the second most traded commodity in terms of volume and value, behind oil (Girma, 2011). Therefore, it is essential to maintain a balance in trade between developed and developing countries. It offers over 25% of Ethiopia's population's income and accounts for 70% of foreign exchange profits and 10% of government revenue (Tsegaye *et al*., 2000). The most consumed type of coffee is arabica, making up for more than 70% of production volume and 90% of worldwide trade value (Tadasse, 2015).

The country's economy and culture are strongly influenced by coffee. Ethiopia's main export crop is arabica coffee, which makes a significant economic contribution to the country. It is the most important product for Ethiopian industry and a major source of foreign exchange that supports the livelihoods of millions of laborers and farmers. Numerous obstacles, including weed control, recurring pests and diseases, depleting soil capacity, and unfavorable weather patterns, have an impact on coffee output. One of the main things preventing the entire country from producing as much coffee is weeds. Depending on the type of weed, the stage at which coffee trees are growing, and nearby growth conditions, weeds in coffee have been shown to reduce yield by 65% and even to result in crop failure (Tadesse E, 1998). Despite, majority of coffee farmers heavily depend on manual slashing and digging which encourage the multiplication and spread of the noxious competitive perennial weeds (Tadesse E, 1994). Weeds infestation is the main bottleneck in crop production in Ethiopia, especially during the

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rainy season. The climate encourages rapid and abundant growth of weeds and consequently, all crops are heavily infested with weeds. Farmers in the country are aware of a weed problem in their fields but often they cannot cope-up with heavy weed infestation during the peak period of agricultural activities because of labor shortage, hence, most of their fields are weeded late or left un-weeded. Currently, expensiveness of weed management has been a principle issue in economic analysis of coffee production particularly in large scale farm in Ethiopia. This is because of the weed species those are found as dominant and prevalent in the areas where they favorably and quickly re-appear within the season. Hence, uses of effective systemic herbicides for controlling deep seated rhizomes, bulbs and tubers and above ground running stolen of the perennial sedge and grass weeds is vital. Under such circumstance evaluation different herbicides with different groups & mode of action is essential. Herbicide an essential part of weed management practice in coffee production at Southwest Ethiopia. It also can offer an advantage of taking less time, demanding less labor and avoid potential of diseases spread that causes during manual slashing and digging weed management practices. Previously, several systemic herbicides have been evaluated by Jimma Agricultural Research Center and recommended Tigist and Tadasse (2022). However, since, coffee production becomes expanded yet now there is scarcity of systemic herbicides to reduce losses caused due to weed infestation. Often farmers practice Weeding at one or unwedded left this increases infestation of both broad-leaf and grass weeds (personal comm., Regional Ministry of Agriculture, 1997) resulting in low productivity. Selective herbicides are effective in controlling target weeds but inefficiency may arise in case the weeds develop resistance to certain selective herbicides and due to uncontrolled factors that may reduce the efficiency of the chemicals. Therefore, the use of non-selective broad spectrum chemicals becomes important to kill all weeds emerging before they may cause harm to crops. Glyphosate since many years has been used as the most important non-selective herbicide to control all types of weeds before planting.

Glyphosate [N-(phosphonomethyl) glycine] is a broad spectrum, non-selective, post-emergence herbicide that controls weeds by inhibiting their ability to synthesize amino acids. Amino-methyl-phosphonic acid (AMPA) is the major metabolite of glyphosate, found in plants, water and soil. Glyphosate is strongly adsorbed to most soils and thus, does not lead or run off appreciably and soil microorganisms break it down. The estimated half-life of glyphosate in soil is approximately 60 days. After 360 days, residue levels were from 6 to 18% of the initial applied dose. Precipitation, soil composition, presence and absence of a soil constricting layer and drainage type may influence the leaching of glyphosate from soil. Glyphosate is an amino-phosphonic analogue of the natural amino acid glycine.

Having above mentioned points the verification test was conducted following Pesticide Testing guidelines developed by Ethiopian Institute of Agricultural Research (EIAR) to evaluate the efficacy of newly introduced herbicides for verification that verification was done is Glyphosate 480G/L herbicide comparing with already registered herbicide Gly care 48% g/l SL as standard control for control perennial grasses, perennial broad leaves and annual grasses and broad leaves weeds in Coffee at Sidama Regional state, Hawassa agricultural research center on station and Wondo Genet district southern parts of Ethiopia. Such ineffective weed management is considered the main factor for the low average yield of Coffee resulting in an average annual yield loss of 60-80 % (Esheteu *et al*., 2007). Glyphosate IPA 480G/L SL is a nonselective herbicide used to control all broads, grass and Sedge weeds of coffee, currently verified at Hawassa Agricultural Research Center. The objective of study was to verify the efficacy of the new formulation Glyphosate 480G/L SL on the control of all weeds in Coffee perennial commercial crops.

## 2. Materials and Methods

### 2.1. Descriptions of the Study Area

The verification test was conducted at Hawassa Agricultural Research Center (HARC). HARC is found in Sidama regional state in Hawassa city, Ethiopia, 288 km to southern of Addis Ababa. It is located at 07° 03’52’’N latitude and 038° 28’ 52 'E longitude with an elevation of 1700 meter above sea level (masl) and the area receives a total of 1000 to1200 mm rainfall in bimodal raining pattern with short rains (belg rains) coming from April to May and long rains (meher rains) coming from July to October. The mean annul minimum and maximum temperature of areas were 16.5°C and 29.2°C, respectively. Similarly, the study was conducted at Wondo Genet district of northern Sidama zone in southern Ethiopia farm 36 km and 6°36′-6° 39′N latitude and 38°18′–38° 28′E longitude. The area

receives an annual rainfall in the range of 1480 to 2150 mm, with the main rainy season between June and September. Mean annual minimum and maximum temperatures are 18.8°C and 28.8°C, respectively with altitude of range 1770-1824 masl.

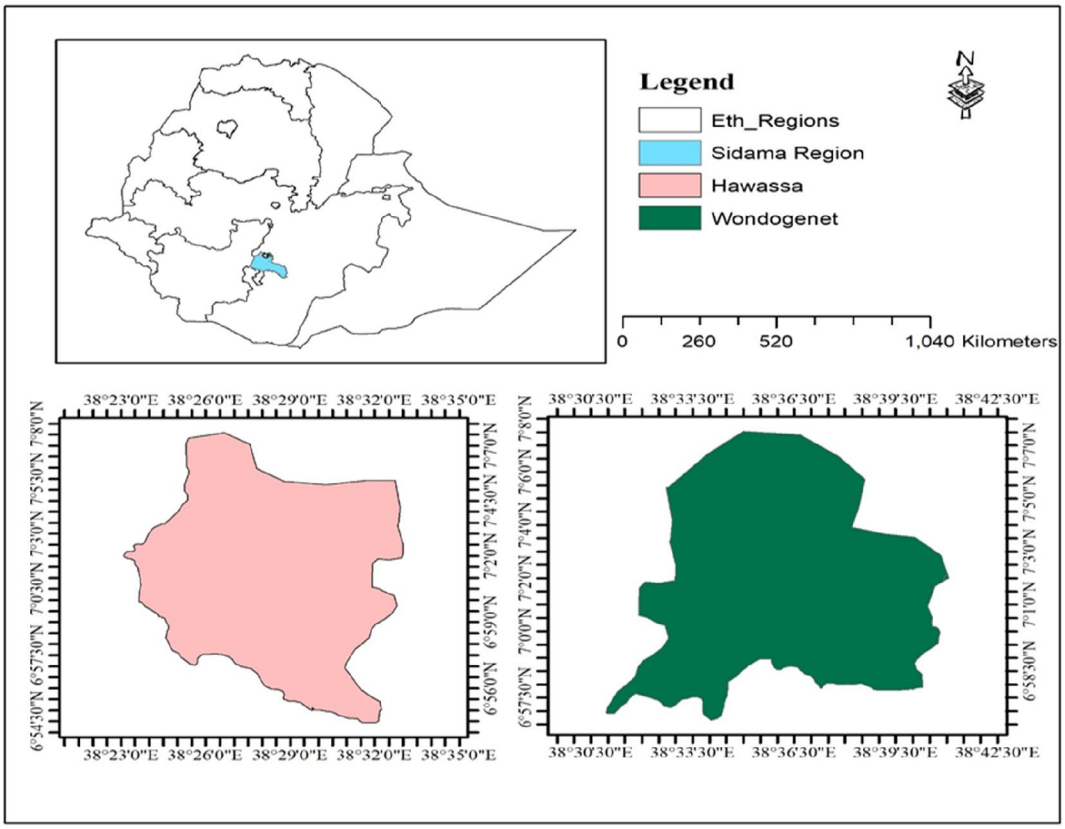


**Fig. 1.** Map of study area

**2.2. Verification Material and Procedure**

The herbicide test was conducted at Hawassa Agricultural Research Center under Southern Agricultural Research Institute by the agreement signed between the institute and the chemical Company called "HASSEN KEDIR TUKURA''. The trial was conducted at two locations via on-station of Hawassa Agricultural Research Center and Wondo Genet farmer orchard.

The test herbicide Glyphosate 480g/l SL along with the standard check (Glycare 48%g/l SL), and weedy check were evaluated. The plots were 10m x 10m size, at both on station and on farm. The testing trail was laid out in non-replicated plots, where locations were considered as replication. Glyphosate 480g/l SL was applied with a rate of 3lit/ha manually using a knapsack sprayer delivering with 250 liter of water/ha following harvesting time of cherry. Weeds were counted by randomly throwing the quadrant as pre-treatment weed count. After 7 and 14 days of herbicide application, weed counted as a post treatment by throwing quadrant ($0.25m^2$) randomly to the plots. Finally, pre and post spray weed count were subjected to efficacy calculation using formula of Fleming and Retnakaran (1985) as follows:

$$\text{Efficacy } \% = \frac{1 - (\text{Ta} * \text{Cb})}{(\text{Tb} * \text{Ca})} * 100$$

Where, Ta=Post-treatment population in treatment, Cb= Pre-treatment population in check, Tb= Pre-treatment population in treatment, Ca= Post-treatment population in check, similarly, the herbicide

weed control efficiency (WCE) can be calculated by using the following formula as suggested by (Mani, *et al*., 1973). Percentage of Weed inhibition (PWI) was calculated using the following formula.

$$\text{Percentage of weed inhiition (PWI)} = \left(\text{NWC} - \frac{\text{NWT}}{\text{NWC}}\right) * 100$$

Where, NWC &NWT are number of weeds ($0.25m^2$) in the weedy check and any particular treatment, respectively. Individual and general weed control evaluations (1-9 scale score), 1= no control and 9= (100% control) were determined through visual observation at 7th and 14th days' after treatment application by considering growth reduction, foliar chlorosis, wilting and stunting during the time of assessment. Weed Control Efficiency (WCE) was calculated based on the following formula (Surinder, 2016).

$$\text{WCE} = \frac{\text{Weed count in weedy plot} - \text{weed count in treated plot}}{\text{Weed count in weedy plot}} * 100$$

The plot (weedy check) was used as for comparison and all other management practices were applied as per their agronomic recommendations uniformly.

**2.3**. **Usage of Herbicide**

SERU 480 (Glyphosate IPA 480g/L SL) applied post emergency of Coffee that aged six (6) years as foliar spray treatment at 3liter $ha^{-1}$ rate soluble with water 250 liter $ha^{-1}$ and formulation of the chemical is soluble concentrate/liquid (SL) as stated in (Table 1) below. It is applied when weeds are medium stage and actively growing prior to flowering stage. The agro-chemical Manufactured: Jiangsu Aijin Agrochemical Co., Ltd and Supplied by: Nanjing Essence Fine- Chemical Co., Ltd,. The herbicide imported and intended for verification by company: HASSEN KEDIR TUKURA .

**Table 1:** Description of tested herbicide and standard check

| Trade Name | Common Name (active ingredient) | Application Rate (Liter $ha^{-1}$) | |
|---|---|---|---|
| | | Herbicide | Water Volume |
| **SERU 480 %SL** | Glyphosate 480G/L SL | 3 | 250 |
| **Gylycare 48% SL** | Glyphosate IPA | 3 | 250 |
| **Weedy check** | - | - | - |

**Note**: SERU 480 %SL and Gylycare 48% SL are broad spectrum non selective herbicides.

## 3. Results and Discussion

### 3.1. Weed Infestation in Terms of Taxonomy

In the verification test was conducted under coffee orchards pre-established in different weed species belonging to the annual broad leaf, grasses and sedge and perennial broad leaf, sedge, and grass categories were identified. Twenty-seven (27) weed species belonging to fifteen (15) families were recorded within the verification test fields across locations. Among the recorded species, 14.8%, grass and 85.2% were broad leaved weed species, respectively. This result is similar with the report of (Tigist and Tamiru, 2023) done in southern west Ethiopia of Jimma Zone. As study result showed number of broad leaved was more prevalent than grass species across sites (Table 2).

**Table 2:** Taxonomy of weed species observed in the verification test site across locations.

| S/no | Scientific Name | Family | Common Name | Morphology |
|---|---|---|---|---|
| **1.** | *Achyranthes aspera* L. | *Amaranthaceae* | Devils horsewhip | Broad leaf |
| **2.** | *Alternantherria caracasana* | *Amaranthaceae* | Khakiweed | Broad leaf |
| **3.** | *Amaranthus greecizens* L. | *Amaranthaceae* | Pig weed | Broad leaf |
| **4.** | *Antigonon leptopus Hook. & Arn.* | *Polygonaceae* | Coral vine | Broad leaf |
| **5.** | *Bidens Pilosa* | *Compositae* | Black Jack | Broad leaf |

| | | | | |
|---|---|---|---|---|
| **6.** | *Bracheria mutica* | *Poaceae* | Para grass | Grass |
| **7.** | *Chamaecrista pumila* | *Fabaceae* | Dwarf cassia | Broad leaf |
| **8.** | *Commelina benghalensis* L. | *Commelinaceae* | Tropical spider wort | Broad leaf |
| **9.** | *Convolvulus arvensis* L. | *Convolvulaceae* | Field bindweed | Broad leaf |
| **10.** | *Conyza albida* | *Asteraceae* | Tall fleabane | Broad leaf |
| **11.** | *Cyathula prostrat (*L.) *Blume.* | *Amaranthaceae* | Pasture weed | Broad leaf |
| **12.** | *Desmodium intorutum* | *Fabaceae* | Green leaf desmodium | Broad leaf |
| **13.** | *Digitaria abysinica* | *Poaceae* | Couch grass | Grass |
| **14.** | *Euphorbia hirta* L. | *Euphorbiaceae* | Asthma Weed | Broad leaf |
| **15.** | *Galinsoga parviflora* | *Compositae* | Gallant Solder | Broad leaf |
| **16.** | *Galiumm aparinae* | *Rubiaceae* | Madder family | Broad leaf |
| **17.** | *Ipomoea obscura (*L.) *Ker Gawl.* | *Convolvulaceae* | Obscure morning glory | Broad leaf |
| **18.** | *Lantana camara* | *Verbenaceae* | Common lantana | Broad leaf |
| **19.** | *Leucas martinicensis (jacg) Airt.g* | *Labiatae* | Bobbin weed | Broad leaf |
| **20.** | *Oplismenus hirtellus(*L.) *P.Beauv.* | *Poaceae* | Basket grass, | Grass |
| **21.** | *Oxalis cognuculata* L. | *Oxalidaceae* | Yeloow sorrel | Broad leaf |
| **22.** | *Paspalum conjugatum* | *Poaceae* | Buffalo grass | Grass |
| **23.** | *Phyllanthusniruri* L. | *Euphorbiaceae* | Store breaker | Broad leaf |
| **24.** | *Polygonun convolvulus* | *Polygonaceae* | Smartweed | Broad leaf |
| **25.** | *Portulaca oleraceae* | *Portulacaceae* | Moss rose | Broad leaf |
| **26.** | *Ruellia Prostrate poir* | *Acanthoceae* | Prostrate wild petunia | Broad leaf |
| **27.** | *Tribulus terrestris* | *Zygophyllaceae* | Puncture vine | Broad leaf |

### 3.2. Effect of Herbicides on Weed Density and Percentage of Weed Reduction

Weed density and percentage of weed reduction data after herbicides application presented in (Table 3). Current verification trial result indicated that weed density has been affected due to herbicides application. Glyphosate 480g/l SL effectively reduced the weed density as compared with weed check. The candidate herbicide Glyphosate 480g/l SL and standard check Gly care 48% g/l SL herbicides were non selective systematic weed that started to kill the weeds in the range of 7-9 days after application. Most of the weeds were killed 9$^{th}$ and 10$^{th}$ days after application and more than 98 % was killed on 14 days after application. About 14 weed species were identified from Hawassa agricultural researcher on site observed coffee farms. *Portulaca oleracea, Commelina benghalensis L., Desmodium intorutum , Galinsoga parviflora, Achyranthes aspera L., Galoinsoga parviflora, Lantana camara, Bidens Pilosa Portulaca oleraceae, Antigonon leptopus Hook. & Arn., Conyza albida, Cyathula prostrat (L.) Blume., Euphorbia hirta L* and *Polygonun convolvulus* were the majors weed species observed and identified while about twenty weed species were seen and those were: -
*Achyranthas aspera, Tribulus terrestris, Oplismenus hirtellus(*L.*) P.Beauv,Antigonon leptopus Hook. & Arn., Bracheria mutica, Chamaecrista pumila, Commelina benghalensis* L.*, Convolvulus arvensis* L. *,Conyza albida,Cyathula prostrat (*L.*) Blume., Digitaria abysinica. Galiumm aparinae, Ipomoea obscura (L.) Ker Gawl., Leucas martinicensis (jacg) Airt.g ,Oplismenus hirtellus(L.) P.Beauv.,Oxalis cognuculata* L.*,Paspalum conjugatum, Phyllanthusniruri* L.*, Polygonun convolvulus, and Ruellia Prostrate poir.*

The lower weed density mean value 6 followed by 8, 12 and 15 per 100m2 was recorded from the plot treated with Glyphosate 480g/l SL and Gly care 480g/l SL respectively at 14th day evaluation time after herbicide application across locations compared with weedy control while the highest weed population mean value (5701/100m2) was recorded in the weedy check plots (Table 3).

**Table 3:** Effect of herbicide on weed population and percentage of weed reduction

| **Location** | **Herbicide evaluation time per locations of 100m$^2$ area** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Glyphosate 480g/l SL** | | | **Glyph care 480g/l SL** | | | **Weedy check (untreated)** | | |
| | **BA** | **at7$^{th}$ DAA** | **at14$^{th}$ DAA** | **BA** | **at7$^{th}$ DAA** | **at14$^{th}$ DAA** | **BA** | **at7$^{th}$ DAA** | **at14$^{th}$ DAA** |
| **Hawassa on site** | 4553 | 1540 | 12 | 4780 | 1715 | 15 | 4620 | 5510 | 5510 |
| **Wondo Genet** | 4590 | 1340 | 8 | 5210 | 1625 | 06 | 4580 | 5610 | 5701 |
| **Mean** | **4572** | **1440** | **10.0** | **4995** | **1670** | **10.5** | **4600** | **5560** | **5606** |

Where, BA=Before Application and DAA=Days after application,

Different results on percentage of weed inhibition (PWI) or percentage of weed reduction (PWR) was also recorded in the present verification trials. As a result indicated weed reduction percentage mean value ranged from 44.4. % - 72.2%, 55.6% - 72.2%, at seven days after application 72.2 - 100% were obtained from plots treat with Glyphosate and Glycafe480g/l SL herbicides respectively as compared with plot untreated (Table 4 & Figure 2 and 3). A tested herbicide and standard check performed well on weed density reduction and weed reduction percentage compared with untreated plot.

**Table 4:** Mean effect of Glyphosate 480g/l SL and Gly care 480g/l SL herbicides on individual weed control over locations

| Weed Species | Treatment Evaluation time per Locations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Glyphosate 480g/l SL | | | | Gly Care 480g/l SL | | | |
| | at7th DAA | | at 14th DAA | | at 7th DAA | | at14th DAA | |
| | Score (1-9) | % WC | Score (1-9) | % WC | Score (1-9) | % WCE | Score (1-9) | % WC |
| ***Achyranthes aspera* L.** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Alternantherria caracasana*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Amaranthus greecizens* L.** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Antigonon leptopus Hook. & Arn.*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Bidens Pilosa*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Bracheria mutica*** | 6 | 66.7 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Chamaecrista pumila*** | 6 | 66.7 | 9 | 100 | 7 | 77.8 | 9 | 100 |
| ***Commelina benghalensis* L.** | 4 | 44.4 | 8.5 | 94.4 | 4.5 | 50 | 8.5 | 94.4 |
| ***Convolvulus arvensis* L.** | 5.5 | 61.1 | 9 | 100 | 5.5 | 61.1 | 9 | 100 |
| ***Conyza albida*** | 5 | 55.6 | 9 | 100 | 5.5 | 61.1 | 9 | 100 |
| ***Cyathula prostrat (*L.*) Blume.*** | 5.5 | 55.6 | 9 | 100 | 5.5 | 61.1 | 9 | 100 |
| ***Desmodium intorutum*** | 4 | 44.4 | 6.5 | 72.2 | 5 | 55.6 | 6.5 | 72.2 |
| ***Digitaria abysinica*** | 5.5 | 55.6 | 9 | 100 | 5.5 | 55.6 | 9 | 100 |
| ***Euphorbia hirta* L.** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Galinsoga parviflora*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Galiumm aparinae*** | 6 | 66.7 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Ipomoea obscura (*L.*) Ker Gawl.*** | 4 | 44.4 | 9 | 100 | 5 | 55.6 | 9 | 100 |
| ***Lantana camara*** | 4.5 | 50 | 9 | 100 | 5.5 | 61.1 | 9 | 100 |
| ***Leucas martinicensis (jacg) Airt.g*** | 5.5 | 55.6 | 9 | 100 | 5.5 | 61.1 | 9 | 100 |
| ***Oplismenus hirtellus(*L.*) P.Beauv.*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Oxalis cognuculata* L.** | 6 | 66.7 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Paspalum conjugatum*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Phyllanthusniruri* L.** | 6 | 66.7 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Polygonun convolvulus*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Portulaca oleraceae*** | 4 | 44.4 | 7.5 | 83.3 | 5 | 55.6 | 8 | 88.9 |
| ***Ruellia Prostrate poir*** | 6.5 | 72.2 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| ***Mean*** | 5.7 | 63.0 | 8.8 | 98.1 | 6.0 | 66.9 | 8.8 | 98.3 |

DAA= days after application


**Fig. 2:** A) The plot treated with Glycare 480g/l SL standad check; B) Glyhosate 480g/l SL test herbicide; and C) Weedy check untreated plot at Wondo Genet district on farmers field.

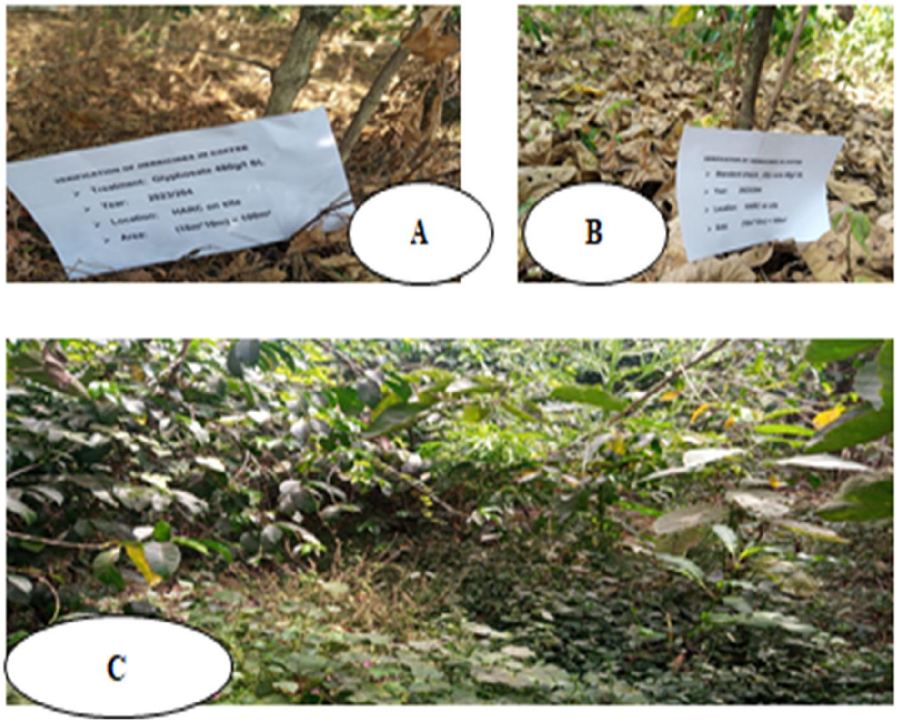


**Fig. 3:** A) Glyhosate 480g/l SL test herbicide B); The plot treated with Glycare 480g/l SL standard check; and C) Weedy check untreated plot at Hawassa agricultural research center on site .

### 3.4. Effect of Herbicide on General Weed Control

General weed control was evaluated via visual observation based on 1-9 scale and percent weed control after 7and 14days of herbicides application. Accordingly, all testes herbicide effectively controlled the annual and perennial broad leaves, grasses and sedge weeds which predominantly infested the experimental plots across locations. As present herbicide verification observation result showed that a herbicide showed good performance on general weed control compared with standard control herbicide. The weed control percentage range mean value (63% to 98.2%) obtained from the plots treated with Glyphosate 480% g/l SL herbicide at 7th and 14th day evaluation time after herbicide application across locations which were to some extent similar with the weed control percentage mean value (66.7% to 98.3%) obtained from the plots treated with Gly care 48% g/l SL standard check herbicide at seven and fourteen days after herbicide application, respectively (Table 5). The present verification trial result suggested that it has the same efficacy level with standard check. The current work is in line with the finding of Bidira and Shimelis (2023) done in Southern west Ethiopia.

**Table 5:** Mean effect of herbicides on general weed control.

| Location | Treatment Evaluation time per Locations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Glyphosate 480g/l SL | | | | Glyph care 480g/l SL | | | |
| | at 7th DAA | | at 14th DAA | | at 7th DAA | | at14th DAA | |
| | Score (1-9) | % WC | Score (1-9) | % WC | Score (1-9) | % WC | Score (1-9) | %WC |
| **Hawassa on site** | 5.4 | 60 | 8.65 | 96.1 | 5.5 | 61.1 | 8.7 | 96.7 |
| **Wondo Genet** | 6.0 | 66.7 | 9 | 100 | 6.5 | 72.2 | 9 | 100 |
| **Mean** | 5.7 | 63 | 8.8 | 98.1 | 6.0 | 66.7 | 8.9 | 98.35 |

### 3.5. Effect of Herbicide on Weed Control Efficiency

The highest weed control value 98.2% followed by 98.3%, obtained from Glyphosate 480g/l, SL and Gly care480g/l SL herbicides respectively (Table 6). This result indicates that the test herbicide have the same weed control efficacy with standard check which the farmers can use either one of them depending the availability of the herbicides.

**Table 6:** Herbicides weed control efficiency (WCE %).

| Location | Treatment Evaluation time per Locations of 1m² area at 14 days after application | | | | | |
|---|---|---|---|---|---|---|
| | Glyphosate 480g/l SL | | Glyph care 480g/l SL | | Weedy check (untreated) | |
| | Weed density /m² | WCE (%) | Weed density /m² | WCE (%) | Weed density /m² | WCE (%) |
| **Hawassa on site** | 0.12 | 98.1 | 0.15 | 98 | 5510 | - |
| **Wondo Genet** | 0.08 | 98.4 | 0.06 | 98.6 | 5701 | - |
| **Mean** | **0.1** | **98.2** | **0.11** | **98.3** | **5606** | - |

## 4. Conclusion and Recommendation

The present verification trials of the Glyphosate 480%g/l SL revealed promising results on against perennial sedge, perennial grasses, perennial broad leaf weeds and annual broad leaf weeds species in coffee. The herbicide effectively reduced the density compared with weedy control. The newly introduced candidate herbicide Glyphosate 480%g/l SL start weed killing after a week as compared with standard control herbicide Gly care 48%g/l SL start on seven days after application the same wise. This indicated that this herbicide can reduce the weed population equivalent to standard check. Repeated application after a month is not required to achieve full control throughout season compared with Glycare 48%g/l SL the same to standard control herbicide it can control the weeds in one season.

Therefore, if economically affordable and available to farmers, the new chemical Glyphosate 480G/L SL is recommended for use as broadleaved and grassy weeds and Sedges management option for Coffee, where the weeds are aggressive due to continuous use of selective herbicides and consequent buildup of resistance and inefficiency of the selective chemicals. Moreover, in the Coffee potential districts, commercial and near commercial farms are most frequent in which hand weeding is not suitable and difficult for critical stage of weeding. For such large scale production farms, where hand weeding is laborious, time-consuming, and costly, it is difficult or may not always be possible to facilitate timely weed control.

Thus, it is very wise to recommend the herbicide *Glyphosate 480g/l SL* for use against major post-emergency broadleaved, grass and Sedges weeds in Sidama coffee growing areas and similar agro-ecologies as an alternative herbicides.

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