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# Evaluation of Sholla 45% OD Herbicide against Grasses and Broad - Leaf Weeds on Barley

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## Abstract

The annual average national yield of the barley crop is only 1200 kg/ha. The low national average yield, which is far below the world average, could be partially attributed to poor weed management, which results in high competition from weeds. Yield gains from weed control, on the other hand, ranges from 14-60 percent depending on the location and type of weed. Field experiment was conducted to verify the effectiveness of the Sholla 45% OD Herbicide (Penoxusulum 30g/lit + Iodosulfuron- Methyl sodium 15g/lit) against grasses and broad - leaf weeds on Barley (Hordeum vulgare L.). It's carried out at three locations, Zala Shasha, Dalibo Wogane and Kokate, on farmers' field in a Randomized Complete Block Design (RCBD) with four replications during 2022 cropping season. The experiment result showed that, herbicide treated plots were showed significant difference compared to the control treatments in all variables. Evidence obtained from the verification trial showed that Sholla 45% OD at the rate of 0.5 lit/ha with 200 liter water acted significantly at 5% probability level in managing grass and broad leaf weeds in barely crop and consequently increased grain yield of barley as compared to the standard check (Hussar OD) and unsprayed checks in tested locations. In nut shell, it is concluded that Sholla 45% OD at the rate of 0.5 lit/ha per hectare with 200 liter water was highly effective in controlling grass and broad leaf weeds infestation on barley fields in all experimental locations as compared to the standard check (Hussar OD). However, it needs further investigation for the interval and frequency.

**Keywords:** Barley; Grasses; Broad leaf weeds; Verification; Herbicide

## Introduction

Ethiopia is the second largest barley [1] producer in Africa, next to Morocco, accounting for about 25 percent of the total barley production in the continent (FAO, 2014). It is grown mainly in the highlands of the country and represents approximately an 11% share of the total area where grain is cropped (CACC, 2003). It is predominantly grown at altitudes ranging from 2000 to 3000 m.a.s.l in various regions of the country. It is also preferred by subsistence farmers because of its ability to grow on marginal farms, unlike other cereals. The annual average national yield of the crop is only 1200 kg/ha (CSA, 2005). The low national average yield, which is far below the world average, could be partially attributed to poor weed management, which results in high competition from weeds. Yield gains from weed control, on the other hand, ranges from 14-60 percent depending on the location and type of weed [2]. Weed control play an active role in raising grain yield, since weeds cause great losses in yield reached 48.9 % (Metwally et al., 2000) in barley. Weeds can be controlled through different management practices in barley fields. Chemical control is the most common, efficient and economical method of control (Dalley et al., 2006). In many barley producing areas, barley fields are mostly treated with broadleaf herbicides. Under partial weed management, it is common to observe barley fields infested with grass weeds, causing yield losses of up to 60% in some barley growing areas of Ethiopia [3]. El- Bawab and Kholousy (2003) reported that controlling weeds by herbicidal treatments increased grain yield by about 40.3 and 13.6%, compared with unwedded and hand weeding treatments, respectively. Several herbicides are available to control barley weeds. Metosulam and sulfamoylurea for broad leaf weeds in cereals, Fenoxaprop-p-ethyl and clodinafop-propargyl herbicides for control of grasses weeds in wheat and barley (Nassar, 2008), so combinations of herbicides are there that can provide good control of broad and narrow leaved weeds and cause significant reduction in their density and increase yield attributes as compared to check [4]. Above research highlights indicates that there is shortage of herbicides for control of grass and broad leaf weeds in barely crop once at a time. To increase the availability of effective herbicides for control of grasses and broad- leaf weeds in barley growers, the efficacy of the newly introduced herbicides on grasses and broad- leaf weeds on barley fields should be regularly tested and verified before introducing to the farming community. The efficacy of herbicides is highly influenced by environmental factors, weed population load, application time [5]. Therefore, evaluation of the herbicides across the locations is greatly important to get an insight into the effects of the herbicides. Based on the above background, Areka Agricultural Research Center has been designated by the Ministry of Agriculture through Southern Agricultural Research Institute to test the efficacy of the new herbicides, Sholla 45% OD, against weeds on barley during the 2022 cropping season. Therefore, the objective of the verification trial was to evaluate the efficacy of the herbicide Sholla 45% OD (Penoxsulam30g/lit + Iodosulfuron Methyl sodium 15g/lit) relative to another promising standard herbicide, Hussar OD (Iodosulfuron Methyl sodium 100g/lit) for the control of grass and broad leaf weed in barley for registration purpose.

## Material and Methods

### Descriptions of the study site

The verification trial was conducted during 2022 main cropping season in an open environment to convince the objectives of the current verification around Wolaita Zone in three locations (Zala Shasha, Kokate and Dalibo Wogane) of Southern Ethiopia [6]. The

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experimental sites are geographically located at 06$^{O}$ 52'55" N and 037$^{O}$ 49' 15" E (at Zala Shasha), 06$^{O}$ 88' 79" N and 037$^{O}$ 80' 18" E (at Dalibo Wogane) and 06$^{O}$ 85' 28" N and 037$^{O}$ 76' 10" E (at Kokate). The sites are found at an elevation of 2105.94 (at Zala shasha), 2200 (at Dalibo Wogane) and 2156 (at Kokate) meters above sea level. Bimodal rainfall pattern is the major characteristics of the study area, short rainy season (April and May), and the main rainy season (early June to mid-November) [7]. Thus, the areas receive average annual rainfall is 1200-1300 mm and mean monthly temperatures varies from 11-26 $^{O}$C. The soils are sandy-loam with a PH of 5.2 [8].

### Treatments, design of experiment and trial management

This experiment was carried out in major barley growing areas of Zala Shasha, Dalibo Wogane and Kokate in 2022 under field condition. The total width and length of the layout were designed at 33 x 46 m with a unit plot size of 10 x 10 m, respectively [9]. Plots were spaced at each other by 1.5 m and blocks separated by a safeguard path of 2.0 m to prevent the drifts or cross-contamination. The experiment was layout in a randomized complete block design with four replications. A total of three treatments, including control, were comprised during the study. The improved variety HB-1307 was used for the experiment. All agronomic and trial management practices (like fertilizer, weeding) were implemented as per the recommendation. Herbicide such as Sholla 45% OD at the rate of 0.5 lit/ha with 200 liter of water (Candidate insecticide), Hussar OD at the rate of 1lit/ha with 250 L water (Standard check), and unsprayed check were used [10]. For the candidate herbicide, the use of the rate of herbicide per hectare and amount of water for mixing of herbicide was performed as suggested by the manufacturer. The control plots were sprayed with water only. Since the herbicide is the post emergence herbicide it's applied 21-25 days after weed emergence. The application was done with the help of Knapsack hand sprayer with 1-liter capacity bottles. Periodic inspection was made to notice target weed population.

### Data collection and analysis

Weed species identification was done by comparing individual species with predetermined weed species in the herbarium. The above ground dry biomass of weeds was done by cutting weeds from each quadrate placed into paper bags and then oven dried at a 65 $^{0}$C for 48 hours and finally the dry weights were measured. Weed control efficiency (WCE) was determined by the following formula, WCE = WDC – DWP/WDC X 100, where, WCE = Weed Control Efficiency, WDC=Weed Dry weight in Control Plot and DWP = Weed Dry weight in Particular treatment (Davasenapathy et al., 2008). Plant height, spike length, number of tillers per plant, number of seeds per spike were taken from five randomly selected plants and thousand grain weight and grain yield per plot was taken after threshing the sun dried plants harvested from each net plot (Amare et al., 2014). Data of each parameter was summarized and arranged before subjected to SAS software. The analysis of variance was done by using the GLM procedure of SAS (SAS 9.3 version).When the treatment effects were significant, means were compared using Fisher's LSD test at 5 % level of significance (Gomez and Gomez, 1984).

## Results and Discussion

### Composition of weed flora

The field had infestation of grass and broad leaf weeds that were categorized under four families. Out of total identified weed species, three species were annual broad-leaf weeds and three were annual grasses weeds (Table 1).

**Table 1:** Weed species, families and life form in the experimental plots.

| Weed Species | Families | Life Form (Category) |
|---|---|---|
| Galinsoga pulviflora Cav. | Asteraceae | Annual (broadleaf) |
| Guizotia Scabra (Viz ) chiov | Asteraceae | Annual (broadleaf) |
| Spergula arvensis | Caryophylaceae | Annual (broadleaf) |
| Phalaris Paradox L | Graminaea | Annual (grass) |
| Setaria Pumila L | Graminaea | Annual (grass) |
| Avena Fatua | Graminaea | Annual (grass) |

### Dry weed biomass

Dry weed biomass was significantly affected by application of different herbicides treatments (Table 2). The maximum weed dry weight of 2101.3 kg/ha, 1839 kg/ha and 1855.5 kg/ha at Kokate, Zala Shasha and Dalibo Wogane respectively were recorded from weedy check plots of tested locations. There were statistically significant differences observed due to application of Sholla 45% OD and Hussar OD at tested locations. The minimum dry weed biomass 105.2 3 kg/ha, 107.4 kg/ha and 115.2 3 kg/ha at Kokate, Dalibo Wogane and Zala Shasha respectively from application of Sholla 45% OD implies that reduced weed infestation in the plot and resulted in reduced dry weed biomass. These results are correlated with the study of Hossain et al. (2009) who documented that application of post emergence herbicides reduced the weed dry weight and consequently increased weed control efficiency. Megersa et al. (2017) also reported in barley that the lowest dry weight recorded was due to removal of most of the weed plants there which suppressed density of weeds and resulting into a lower competition between the crop and weeds for resources.

### Weed control efficiency

Weed control efficiency was significantly affected by application of different weed control treatments (Table 2). The highest weed control efficiency 93.69 %, 94.7 % and 95 % at Kokate, Dalibo Wogane and Zala Shasha respectively was recorded from plots treated with application of Sholla 45% OD but there was no weed control efficiency at weedy check plots at tested locations. Similarly, this result was in line with the works of Singh and Ali (2004) who also reported that the lowest weed control efficiency (0%) was observed under unwedded control because there is greater weed competition stress. The highest weed control efficiency from application of Sholla 45% OD was due to minimum weed dry biomass. Megersa et al. (2017) also reported in barley that the reduction in weed dry weight might be due to the inhibition effect of treatments on growth and development of weeds (Table 2). Means in the same column followed by the same letters are not significantly different at 5% level of significance. CV = Coefficients of variation (%); and LSD = Least significant difference at $p < 0.05$ probability level.

### Effect of herbicides on yield and yield components of barley

Plant height was not significantly affected by application of different weed control treatments at three tested locations (Table 3). This clearly indicates that plant height was more influenced by genetic than weed control treatments. The panicle length was not significantly affected by application of different weed control treatments at tested locations (Table 3). But, numerical difference was observed. Plots treated with Sholla 45% OD scored the highest panicle length (6.7, 6 and 5.6 cm) where the lowest (5.8, 5.3 and 5.3 cm) was observed in un-weeded plot at Zala Shasha, Dalibo Wogane and Kokate, respectively. The maximum highest panicle length might be accounted to favorable environment provided for health growth and development of crop

**Table 2:** Effects of the herbicides on dry weed biomass and weed control efficiency.

| Weed Control Treatments | Dry Weed Biomass (kg/ha) | | | Weed Control Efficiency (%) | | |
|---|---|---|---|---|---|---|
| Location | Zala Shasha | Dalibo Wogane | Kokate | Zala Shasha | Dalibo Wogane | Kokate |
| Sholla 45% OD | 115.7c | 107.4c | 105.2c | 93.69a | 94.7a | 95a |
| Hussar OD | 272.3b | 198.8b | 258.2b | 82.16b | 80.6b | 83b |
| Weedy check | 1835.5 a | 1839a | 2101.3a | 0.00c | 0.00c | 0.00c |
| LSD (5%) | 24.8 | 32 | 27 | 9.2 | 10.8 | 10.6 |
| CV (%) | 18.7 | 17.3 | 19.3 | 11 | 15 | 13.4 |

**Table 3:** Effects of herbicides on plant height, panicle length, number of tillers/plant, number of grain/spike and grain yield/ ha.

| Treatments | Zala Shasha | | | | | Dalibo Wogane | | | | | Kokate | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plht | Pal | No t/p | No g/s | yld (kg/ha) | plht | Pal | No t/p | No g/s | yld (kg/ha) | Plht | Pal | No t/p | No g/s | yld (kg/ha |
| **Sholla 45% OD** | 107.2a | 6.7a | 4.2a | 48.6a | 3089.6a | 99.2a | 6a | 4a | 44a | 2945a | 102a | 5.6a | 4a | 54a | 3112a |
| **Hussar OD** | 103.4a | 6.4a | 3.8a | 40.2b | 2768.9b | 101.4a | 5.8a | 3a | 38b | 2723b | 98.3a | 5.6a | 3.8a | 42b | 2623b |
| **Weedy cheek** | 105.3a | 5.8a | 2.2b | 31.3c | 2432.7c | 100.3a | 5.3a | 1b | 31c | 2357c | 101a | 5.3a | 2.4b | 33c | 2252c |
| **CV (%)** | 14.5 | 19.2 | 15.6 | 17.3 | 24 | 16.2 | 17 | 13 | 18 | 29.3 | 11.8 | 17.4 | 14.8 | 22 | 28 |
| **LSD** | 5.2 | 2.4 | 0.9 | 7.3 | 15 | 3 | 4.4 | 1.5 | 5.3 | 22.4 | 6.2 | 3.5 | 0.7 | 6.5 | 18.6 |

which in turn create conducive environment for flowering and panicle formation. A result of trials regarding number of tillers indicates that all treatments were shown superiority over un-weeded (weedy check) across locations (Table 3). Among the treatments, maximum number of tillers were obtained from plots treated with Sholla 45% OD (4.2, 4 and 4/plant) while the minimum (2.2, 1 and 2.4/plant) were observed in unwedded plots at Zala Shasha, Dalibo Wogane and Kokate, respectively. This maximum number of tillers was primarily due to the better crop growth as a result of less competition with weeds. This is in analogy with findings of Ijaz et al. (2008) who shown that better weed control increased the nutrients availability to the crop which ultimately increased the spike bearing tillers. Number of grain per spike and grain yield were one of the basic parameters in studying weed management practices to assess its impact on crop and weeds. Results showed that there was significance difference among treatments in case of number of grain per spike and grain yield (Table 3) All experimental treatments shown superiority over unwedded plots. The maximum number of grain per spike (48.6, 44 and 54.6) and grain yield (3089.6, 2945 and 3112 kg/ha) were obtained from the plots treated with Sholla 45% OD at Zala Shasha, Dalibo Wogane and Kokate, respectively. The minimum number of grain per spike (31.3, 31 and 33.5) and grain yield (2432.7, 2357 and 2252 kg/ha) were obtained from un-weeded plots at Zala Shasha, Dalibo Wogane and Kokate, respectively. Significantly higher number of grains per spike and grain yield might be the result of easily accessible growth factors (nutrient, moisture and light) for individual plant that retained more flowers and higher net assimilation rate in the absence of competition from weeds. Also the development of more and vigorous leaves under low weed infestation might have helped to improve the photosynthetic efficiency of the crop and supported higher number of grains. Similar result was reported by (Chaudhry et al., 2008). The minimum grain yield might be attributed to maximum infestation of weeds that can heavily compete for resource which adversely affected grain yield. This is in analogy with (Jarwar et al., 2005) which suggests Weeds compete with crop plants for various resources such as water and nutrients, resulting in low yields. Dalley et al., (2006) also reported that high weeds intensity and more competition time with crop plants cause more reduction in crop yield. Whereas plht = plant height (cm); Pal = panicle length(cm); No t/p= number of tiller/plant; No g/s: number of grain/spike and yld = yield per hectare (kg/ha) Means in the same column followed by the same letters are not significantly different at 5% level of significance.CV = Coefficients of variation (%); and LSD = Least significant difference at $p < 0.05$ probability level.

## Conclusions and Recommendation

Barley is one of major food grains that can be cultivated from small to large scale in addition to subsistence farmers in Ethiopia. Weed management practices such as post emergence herbicides are among the important methods for the management of weeds to improve barley production and productivity. Evidence obtained from the verification trial showed that Sholla 45% OD at the rate of 0.5 lit/ha with 200 liter water acted significantly at 5% probability level in managing grass and broad leaf weeds in barely crop and consequently increased grain yield of barley as compared to the standard check (Hussar OD) and unsprayed checks in tested locations. During the growing periods, no foliar toxic effect was observed from the effect of any tested herbicides. Generally, results showed that Sholla 45% OD at the rate of 0.5 lit/ha per hectare with 200 liter water was highly effective in controlling grass and broad leaf weeds infestation on barley fields. Hence, Sholla 45% OD was found highly effective for the control of grass and broad leaf weeds infestation on barley fields and therefore it is recommended for registration to the management of the grass and broad leaf weeds infestation in barley crop.

## Competing Interests

The authors declare that they have no competing interest.

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