

# Evaluation of different weed management practices for controlling purple nut sedge (*Cyperus rotundus* L.) on maize (*Zea mays* L.) yield in Malle District of South Omo Zone

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**ABSTRACT:** The experiment was conducted at Malle district of South Omo zone during 2017 and 2018 main maize cropping season with objective of evaluating the effect of integrated weed management techniques for controlling *Cyperus rotundus* in the study area. In the experiment, the maize variety BH140 was used. Field experiments were conducted with four treatments by a randomized complete block design with four replications. The result indicated that the highest *C. rotundus* population was recorded from treatments with farmer practices while due to herbicidal action the initial emerged *C. rotundus* weed population was low on Dual Gold 960 EC treated plots; however, in the later stage of crop growth the weed type converted to broad leaved species which have huge impact on the yield of the crop. The highest grain yield was obtained from plots under double hand weeding while the lowest grain yield was recorded from Dual Gold 960 EC treated plots. This result implies that the double hand weeding help to reduce the weed population and improves the crop performance while single herbicide treatment only control *C. rotundus* and broad leave weed species but cause huge decline in grain yield. From the above results, it was concluded that hand weeding at 21 and 35 days after sowing gives higher yield in comparison to other treatments, so, this practice was recommended for the effective management of *C. rotundus* in Malle district.

**Keywords:** *Cyperus rotundus*, days after sowing, Dual Gold 960 EC, maize.

## INTRODUCTION

Maize (*Zea mays* L.) is world's third most essential cereal crop followed wheat and rice (FAOSTAT, 2012). In Ethiopia, maize is the staple food and major sources calories in potential maize producing areas of the country. Maize possesses great genetic diversity and is grown across varied agro ecological areas. The crop has been selected as one of the countrywide commodity crops to meet the food self-sufficiency program of the country to provide for the alarmingly increasing population (Randjelovic et al., 2011). However, its production was constrained abiotic and biotic factors (Oerke, 2005; Kaur et al., 2016). Diseases, insects and weeds are the major factors. Among those, weeds cause severe problem for crop husbandry and develop a potential threat to the subsequent crops (Oerke and Dehne, 2004; Oerke, 2005;

Das, 2009). Besides, weeds harbour insects and plant disease organisms and in some cases, they serve as alternate host for insect pests and disease organisms (Kaur et al, 2016).

Purple nut sedge (*Cyperus rotundus* L.), commonly known as Nut grass, is a common weed in cereal crops (Brecke et al., 2005; Das, 2009). The plant is found in locations receiving full sunlight and provides enough water and can produce 100 or more tubers in about 100 days. The plant has slender leaves that are connected to a network of underground stems (rhizomes), roots, and tubers. *C. rotundus* is widespread in the tropics and subtropics, growing in almost every soil type, altitude, humidity, soil moisture and pH, but not in soils with a high salt content (Holm et al., 1977; Lingenfelter and Curran,

2004). Its range at increasing latitudes and altitudes is limited by cold temperatures (Sharma and Gupta, 2007).

Few herbicides kill *C. rotundus* but several have been used to suppress growth until after crop establishment, including carbamate compounds such as EPTC, butylate, pebulate and vernolate, and the uracils bromacil and terbacil. Amitrole, dichlobenil, MSMA, norflurazon and a range of other herbicides which suppress the growth of *Cyprus rotundus* and its competition with target crop (Bhowmik, 1997; Bhowmik et al., 2003). One of the common and frequently used herbicides against *C. rotundus* is metolachlor and its derivative s-metolachlor (Dual gold 960 EC). Metolachlor was applied for pre-emergence control of grasses and some small-seeded broadleaf weeds (USDA, 2004; Taylor-Lovell and Wax, 2001). It is also used in mixture with other herbicides to enhance the weed control efficacy (Armel et al., 2003). Metolachlor was developed as herbicide with a main strength in the control of grass weeds following pre-emergence application (Gerber et al., 1974; Hugo et al., 1990). A key factor in the effectiveness of S-metolachlor is that it is readily washed from crop residue to the soil surface by rainfall (Strek and Weber, 1981). Adsorption and bioactivity of metolachlor and S-metolachlor are correlated with a number of soil parameters including organic matter, soil microbial activity and clay content (Peter and Weber, 1985). Nevertheless, on light soils and particularly under adverse environmental conditions, phytotoxicity can occur (Reyer, 1998).

*C. rotundus* is a very serious problem for maize production and causes up to 40% production losses (Oerke and Dehn, 2004). Also, it is major problem in low land areas of South Omo zone of Southern Ethiopia. Therefore, effective and economically feasible management of *C. rotundus* is an urgent need of farmers. To alleviate the problem, this research experiment was conducted with the objective of evaluating the effect of integrated weed management techniques for controlling *C. rotundus* in Malle district of South Omo zone.

## MATERIALS AND METHODS

### Experimental site

The experiment was conducted at Beneta Farmer Association of Malle district in South Omo Zone in 2017 and 2018 main maize cropping season. The mean annual rainfall in the area ranges between 800 to 1200 mm and temperature ranges between 18 to 35°C and the soil of the field was sandy loam. Beneta is the major maize production belt of Malle district that was characterized by a double maize cropping system in one year. The major dominant weed species were presented in the Table 1.

### Experimental procedure

For the experiment, the maize variety called BH140 which

was developed by Bako Agricultural Research Center was used. Gross experimental size was 13.5 m x 19 m. The land was plowed three times with oxen driven plow. The experiment was arranged in randomized complete block design (RCBD) with four replication and the experimental plots size was 3 m x 4 m. The spacing between row was 75 cm and 25 cm between plants. The distance between plots was 1 m and 1.5 m blocks. The experiment had four treatments which were: T<sub>1</sub>-farmers' practices which was cultivation 21 days after sowing (DAS) and weed cutting at 40 DAS, T<sub>2</sub>-dual Gold 960 EC sprays 15 days before sowing, T<sub>3</sub>-hand weeding at 21 and 35 DAS and T<sub>4</sub>-dual Gold 960 EC + one hand weeding 35 DAS. 100 kg urea and 100 kg/ha inorganic NPS fertilizers were applied at recommended application time. Recommended agronomic practices except weeding was undertaken in all experimental plots and weeding was undertaken as stated in the treatment. Dual Gold 960 EC (produced by Syngenta ®) is produced by Syngenta and was sprayed 15 days before sowing by using knapsack sprayer at rate of 1 lit/hectare by mixing with 100 liters of water. Data like weed population yield and yield components were collected from each plot. The weed biomass was calculated by cutting and measuring dry weight of all above ground part of the weed in 2 m x 4 m area in each plot at 21, 35 DAS and at harvesting. The weed cover and weed density was calculated by visual estimating and counting weed species, respectively in 1 m x 1 m quadrat area. The weed dominance, frequency, abundance and importance value were calculated using standard formula as given below:

$$\text{Weed Dominance(D)} = \frac{\text{Total number of individuals}}{\text{Total number of quadrats studied}}$$

$$\text{Frequency(\%)} = \frac{\text{Number of quadrats in the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Abundance(A)} = \frac{\text{Total number of individuals}}{\text{Number of quadrats of occurrence}}$$

### Data analysis

All collected data were subjected to analysis of variance (ANOVA) using SAS GLM procedure. Mean separation between treatments will be performed using LSD ( $p < 0.05$ ) probability level.

## RESULTS AND DISCUSSION

### Weed frequency and dominance

In terms of weed frequency and dominance, almost all treatment plots were dominated by *Cyperus rotundus* at the start of the experiment. However, at later stages of the crop growth, *C. rotundus* was slowly replaced by broad leaf species (Table 1). At crop maturity, the highest weed

**Table 1.** The type of weed species identified in experimental plots and their respective frequency dominance, abundance and importance value during 2017 and 2018 cropping season.

Scientific name	Frequency	Dominance	Abundance	Importance Value
<i>Chromolaena odorata</i>	91.67	50.513	84.58	1.1653
<i>Amarantus hybridus</i>	58.33	1.2422	2.08	0.1262
<i>Cyprus rotundus</i>	83.33	41.0112	68.67	0.9616
<i>Leucas mertincensis</i>	33.33	0.645	1.08	0.0708
<i>Cassia absus</i>	16.67	0.1971	0.33	0.0329
<i>Ipomea Spp.</i>	25.00	0.1493	0.25	0.0465
<i>Euphorbia hirta</i>	8.33	0.4957	0.83	0.0244
<i>Guizoita Scabra</i>	8.33	0.4957	0.83	0.0244
<i>Acanthosporum hispidum</i>	8.33	0.1374	0.23	0.0172
<i>Cynodon dactylon</i>	8.33	0.0956	0.16	0.0164

**Table 2.** The mean values of weed cover weed density and weed biomass recorded from experimental treatment plots during 2017 and 2018 cropping season.

Treatments	Weed cover (%)	Weed density /m <sup>2</sup>	weed biomass (kg/ha)
T1: Farmers' practices	93.33a	382.67b	15500.0b
T2: Dual Gold 960 EC only	33.33b	119.33c	12138.9c
T3: Hand weeding at 21 and 35 DAS	100a	591.33a	18394.4a
T4: Dual Gold 960 EC + Hand weeding 35 DAS	31.66b	122.0c	15500.0d
CV (%)	9.91	28.98	9.93
LSD (0.05)	12.78	175.92	2357.7

frequency was *Chromolaena odorata* having 91.67 frequencies while *Euphorbia hirta*, *Guizoita Scabra*, *Acanthosporum hispidum*, and *Cynodon dactylon* were recorded at the lowest frequency. At harvesting, the frequency of *C. rotundus* decreased and was 83.33. In terms of dominance, the highest dominance was observed by *C. odorata* which was 50.5 followed by *C. rotundus* while the rest of the species have very low dominance value. This result indicates that *C. odorata* and *C. rotundus* are the dominant weed species This is in line with findings of Naik and Velayutham (2018). With regard to overall importance, the highest importance value was recorded from *C. odorata* followed by *C. rotundus* and this result dictates that weed management interventions should focus on these two species.

### Weed biomass, cover and density

Regarding weed biomass, the highest weed biomass was observed from hand weeding 21 and 35 days after sowing, whereas the lowest weed biomass was from plots treated with Dual gold 960 before planting and hand weeded at 35 days after sowing (Table 2). The result implies that after one time hand weeding, *C. rotundus* re-emergence from seed bank and increases the total weed biomass harvested from experimental plot. On Dual gold 960 treated plots, due to weed control by the chemical, the initially emerged weed population was low, however in the

later stage of the crop growth, the weed type converted to broad leaved species which have huge impact on the yield of the crop.

Regarding weed cover, the highest weed cover was observed from hand weeding treatment plots of 21 and 35 days after sowing, whereas the lowest weed cover was observed on plots treated with Dual Gold and hand weeded 35 days after sowing. This implies that herbicide treatment caused the decline of weed cover, however at the later crop growth periods the weed cover increased in herbicide treated plots due to succession by broad leaved weed species. Abdullahi et al. (2016) reported that low weed biomass was observed from well managed plots.

Concerning weed density, the highest weed density was observed from hand weeding treatment of 21 and 35 days after sowing, which was significantly higher than the other treatments while the lowest weed density was observed from plots treated with Dual gold 960 and hand weeding 35 days after sowing. This implies that herbicide treatment significantly reduced the density of *C. rotundus*; however, it does not have effect on later emerging weed species. Khan et al. (2003) and Shrestha et al. (2018) reported that different weed management techniques reduce weed density in maize fields.

### Effect on crop growth and yield parameters

The different weed management treatments had mixed

**Table 3.** The mean values of yield and yield components in 2017 and 2018 growing seasons.

Treatments	100HSW(g)	WB (Kg)		GY (Kg)		CB (Kg)		PH (Cm)	
	2018	2017	2018	2017	2018	2017	2018	2017	2018
T1: farmers' practices	22.0	4583.3a	15500b	1139.6	5263.7b	8542	18333	262.5	258.37
T2: Dual Gold 960 EC only	23.2	2166.7b	12139c	1604.2	3816.0c	8792	18194	249.5	243.6
T3: hand weeding at 21 and 35 DAS	24.5	3958.3a	18394a	2291.7	6579.7a	10417	19167	241.6	252.7
T4: Dual Gold 960 EC + HW 35 DAS	26.5	2770.8b	833d	1229.2	5878.1ab	8021	22083	262.5	262.03
CV (%)	9.7	18.6	9.93	???	9.9	22.18	15.4	10.05	7.17
LSD (0.05)	NS	1004	2357.7	NS	1065.9	NS	NS	NS	NS

HSW (g) = Hundred seed weight in gram, WB (kg) = weed biomass in kilogram, GY (kg) = Grain yield in kilogram, CB (Kg) = Crop biomass in kilogram, PH = Plant height in centimeter.

effect on maize growth and yield parameters (Table 3). Regarding plant height, in 2017 the highest plant height was observed from plots treated with Dual Gold 960 EC + hand weeding 35 DAS and the lowest plant height was obtained from plots with hand weeding at 21 and 35 DAS (Table 3). In 2018, there was no significant difference among treatment in terms of plant height, however, the highest plant height was observed from plots treated with Dual Gold 960 EC + hand weeding 35 DAS while the lowest plant height was observed from plots with hand weeding at 21 and 35 DAS. On average, plant height for both 2017 and 2018, the highest plant height was obtained from plots treated with Dual Gold 960 EC + hand weeding 35 DAS whereas the lowest average plant height was obtained from plots treated with Dual Gold 960 EC only. The above result was due to the fact that herbicide only controls the *C. rotundus* and later emerging broad leave species affected the crops performance. On ear length, there was no significant difference among treatments and the highest ear length was observed on plots hand weeded twice while the lowest ear length was observed from farmers' practices. There was no significant difference among treatments on 100 seed weight. The highest seed weight was

obtained from plots treated with Dual Gold 960 EC and hand weeded 35 DAS while the lowest seed weight was recorded from farmer's practices.

In terms of crop biomass in 2017, the highest crop biomass was obtained from two times hand weeded plots while the lowest crop biomass was recorded from plots treated with Dual Gold 960 EC and hand weeded 35 DAS. In 2018, the highest crop biomass was obtained from plots treated with Dual Gold 960 EC + hand weeding 35 DAS while the lowest was obtained from plots under Dual Gold 960 treatments only but there was no significant difference between treatments. On average, in both years, the highest biomass was obtained from plots treated with Dual Gold 960 EC + hand weeding 35 DAS and the lowest was from plots of farmers' practices. In general, the result implies that hand weeding after herbicide treatment improves over all crop performance.

In terms of grain yield in 2017, the highest grain yield was obtained from twice hand weeded plots whereas the lowest was obtained from plots under farmers' practices. In 2018, there was no significance difference between treatments. The highest grain yield was obtained from plots under double hand weeding while the lowest grain yield was recorded from plots under herbicide treatment

only. Sarma and Gautam (2010) reported that maximum yield obtained from double weeded plots. On average, for two years the highest was from hand weeding at 21 and 35 days after sowing while the lowest was from Dual Gold 960 EC herbicide spray. This result implies that the double hand weeding help to reduce the weed population and improves the crop performance while single herbicide treatment only control *C. rotundus* and broad leave weed species and cause huge decline in grain yield up to 42%. Oerke and Dehn (2004) reported that up to 40% yield losses from highly weeded plots. In a similar study, corn treated with mesotrione plus S-metolachlor plus atrazine at 1,120 g/ha consistently produced high yields (Whaley et al., 2009; Sanodiya et al., 2013). The same authors also reported that on the sandy soils of eastern Virginia, Pre emergence mixtures of mesotrione with S-metolachlor and atrazine can be effective for broadleaf weed control in corn (Khan et al., 2003; Whaley et al., 2009). Reports also indicated that S-metolachlor Pre-emergence and sequential applications of MSMA and sulfentrazone may be viable treatments for control of purple nut sedge shoots and tuber (Barry et al., 2005; Brecke et al., 2005).

## Conclusion

In conclusion, *Cyperus rotundus* is the most important weed in study area and major production constrain of maize. The study suggested urgent need for proper weed management practice along with development of appropriate cultural practices. From current study, on average for two years, the highest grain yield was recorded from plots treated with hand weeding at 21 and 35 days after sowing while the lowest was from plots treated with Dual Gold 960 EC herbicide treatment. From the above results, it is concluded that hand weeding at 21 and 35 days after sowing gives higher yield in comparison to other treatments, so it is better to use this practice for effective management of *C. rotundus* in Malle district.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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