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Research Article

Effect of Various Weeds Management Practices on Yield and Yield Components of Tef (*Eragrostis tef* (*Zucc.*) Trotter) in Buno Bedele Zone

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Abstract

The effect of weed is one of the important limiting factors for crop growth and productivity in agricultural crop production. Weeds compete with tef for nutrients, soil moisture, sunlight and space. The magnitude of losses would depend upon the type of weeds and duration of competition with the crops. Mechanical and cultural methods sometimes do not work due to fact that there is a morphological similarity of some major weeds of the crops. Combining cultural methods, pre- or post-emergence application of herbicides and hand weeding has been found to be effective and economical. Then; there should be a little information on the "Effect of various Weeds management practices on yield and yield components of Tef". Hence, this study was conducted in Buno Bedele zone (Gachi district) and Bedele (BeARC, Ilke sub-site) district; Southwestern Oromia to evaluate effectiveness of weed management practices on weeds, and growth, yield and yield components of tef and to determine optimum rates of herbicides, and their combination with hand weeding and hoeing for weed management in tef at Southwestern Oromia. The experiment was carried out in randomized completely block design (RCBD) with three replications. A total of ten weed control treatments were evaluated. The two years data (2023 and 2024) were noticed highly significant difference on the assessed parameters of weed, Yield and yield components of tef. The highest grain yield, Gross return and net return was obtained from Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS. Finally; using Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS is an economical and/or recommendable for tef production.

Keywords

Herbicide, Post-emergence, Tef, Yield, Weed Control, Weed

1. Introduction

Tef (*Eragrostis tef*) is a self-pollinated, annual grass under family of Poaceae that is used throughout the world as grain for human consumption and as forage for livestock [10]. Tef is a staple cereal grain which is well adapted, endemic and diversified to Ethiopia, and it has been widely produced for many centuries [15, 17, 24]. It is a very important crop in Ethiopia, both in terms of production and consumption [5], and supports more than 60-75% of Ethiopia's population as staple and co-staple food. Interest in tef has increased noticeably due to its very attractive nutritional profile and gluten-free nature of the grain [6]. Ethiopian farmers grow this crop for a number

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of merits, which is mainly attributed to the socioeconomic, cultural and agronomic benefits [11]. Despite of its importance, the average national yield of this crop is very low in Ethiopia possibly due to both biotic and abiotic factors. Weed is among a key biotic factors or pests that contribute to huge yield losses in tef crop. According to [11] the low average grain yield (0.7 ton ha^{-1}) of tef in Ethiopia is attributed to low soil fertility, and inappropriate tillage and weeds control practices. Lower tef grain yield is mainly attributed to inappropriate tillage and weed control practices [13, 21]. Other studies also added that weed is one of the key limiting factors for attaining higher tef yield [19]. In Ethiopia, tef faces challenges from several weeds throughout its growing period that lead to decreased yields [2, 3, 6]. On the other hand, the capacity of tef to compete with weeds, which is one of the main yield limiting biotic factors, is poor [11]. The tef yield losses due to weeds range between 23-65% in Ethiopia [23]. Furthermore, weed competition and control have major effects on yields and economic returns of the crop in the country [15]. Hence, appropriate weed management is necessities to reduce yield losses and attain the potential yield. According to [11] weed control treatments significantly increase the yield and yield components of tef crop over weedy plots. There are many direct and cultural control methods used by farmers to reduce weed competition, most of which are included in agronomic practices with tef [14]. The most common include frequent tillage before sowing the crop, hand weeding, and to some extent, the use of post-emergence herbicides. Hand weeding is the most widely used practice to control weeds in tef. Many farmers pick traditionally by their hands where it is tiresome activity and labor shortage as a constraint is being increased [6, 11]. In view of such shortcoming, herbicides (e.g., 2,4-D and MCPA) have been applied or recommended at rate of 1 litter ha^{-1} to control broad-leaved weeds [6, 23]. Only few herbicides, like Pyroxsulam could provide control for grass and broadleaf weeds; while others like 2, 4-D Amine, Dicamba, Aim and Florasu-fluroxy-pyro give control of broad leaf weeds at a varied level in tef [16]. This suggests that there is a need for selecting herbicides as well as their combination with other methods to control both narrow leaf grasses and broad leaf weeds with understanding of their effects across different soil types and climatic conditions. Despite of suitable environmental condition of Southwestern Oromia high and mid lands, and importance of tef for farmers, weed infestation has been a major production constraint in this area. Though hand weeding is the most widely practiced to control weeds, it is laborious, wearisome, and time consuming option. On the other hand, most of the commercially available herbicides could provide narrow spectrum weed control. Besides, the usage of herbicides of similar activity for a long time could leads to development of herbicide resistance. There was therefore a need to search for revised control methods, notably against grass and a broad leaf weed, such as evaluation of newly introduced herbicides and/or integrating herbicides with hand weeding in tef at Southwestern Oromia. This study was proposed to evaluate effectiveness of some post-emergence herbicides and their combination with integrated hand weeding to weed management.

2. Materials and Methods

2.1. Description of Study Area

The experiment was carried out in main cropping season of 2023 and 2024 in Buno Bedele Zone, Gachi and Bedele (Ilke sub-site) districts.

2.2. Experimental Materials and Design Used

Kora tef variety was used in the experimental study with two (2) post-emergence herbicides, 2, 4-D and Pallas 45 OD used for the study. Each herbicide combination with hand weeding, at 25 and 40 days after sowing (DAS) and weedy check as described in (Table 2). The 10 treatments were arranged in a randomized complete block design (RCBD) with three replications. It was sown (drilled) at 20cm row spacing on the plot size of 4m x 4m = $16m^2$, and also there was 1m and 1.5m paths between the plots and the blocks, respectively. All herbicides were applied at 30 days after sowing (DAS) as post-emergence onto the weed plants as per the treatment using manual knapsack sprayer. The spray volume of water was 200 liters ha^{-1}.

Table 1. *Common, trade and chemical names of the herbicides that used for study.*

Common name	Trade name	Chemical name
2, 4 –DEE	Hit 44 (38EC)	2, 4-D [(2, 4-dichlorophenoxy) ethyl easter]
Pallas 45 OD	Pyroxsulam (45-OD)	N-(5, 7-dimethoxy [1, 2, 4] triazolo [1, 5-a] pyrimidin-2-yl)-2- methoxy-4-(trifluoromethyl) pyridine-3-sulonamide

Table 2. Treatments Description/Weed management practices.

Treatment no.	Treatments /Weed management practice
T-1	Pallas 45 OD 0.5lt ha^{-1}
T-2	Pallas 45 OD 0.375lt ha^{-1}
T-3	Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS
T-4	Pallas 45 OD 0.375lt ha^{-1} + HW @ 40 DAS
T-5	2, 4-D 1.0lt ha^{-1}
T-6	2, 4-D 0.5lt ha^{-1}
T-7	2, 4-D 1.0lt ha^{-1} + HW @ 40 DAS
T-8	2, 4-D 0.5lt ha^{-1} + HW @ 40 DAS
T-9	HW 25 and 40 DAS
T-10	Weedy check

2.3. Collected Data

2.3.1. Weed Data

Weed flora and density: The weed species found within the sample quadrate were identified, counted and expressed in m^2. Accordingly, the weed density was recorded by throwing a quadrate (0.25 m×0.25 m) randomly at five places in each plot at harvesting (about 15 days before the expected harvest time).

Weed above ground dry biomass (g): The weeds falling within the quadrate were harvested near the soil surface immediately after recording data on weed count and was placed into paper bags separately treatment wise. The samples were sun-dried for 4-5 days and thereafter placed into an oven at 65 ℃ for 48 hours. The dry weight of each group of weed were taken by an electrical balance and expressed in gm^2. The dry weight of weed samples were recorded after air drying for 4-5 days and oven drying at 65 ° C for 48 hours. The dry weight of each group of weed was taken by an electrical balance and expressed in gm^2.

Relative Weed Density (RWD): It was calculated by the formula [18].

$$RWD = NPW/NPTW * 100$$

Where
RWD= Relative weed density,
NPW=Population per unit area of a particular weed species,
NPTW= Total weed species per unit area.

Weed control efficiency (WCE): It was the magnitude of weed reduction due to weed control treatments and calculated by

$$WCE = (WDC - WDT)/WDC \times 100 \quad (1)$$

where
WCE weed control efficiency,
WDC weed dry matter in weedy check,
WDT weed dry matter in a particular treatment.

2.3.2. Crop Data

The tef plant height (cm), panicle length (cm), biomass of the crop, and grain yield (kg) were recorded.

2.4. Economic Analysis

The economic analysis was done to determine the economic feasibility of the treatments following the procedure developed by [9]. Costs of tillage, weeding, and herbicide were taken as variable costs during the experiment, and the prevailing market price of the crop was estimated at the time of crop harvest as a return. Seed yield was also adjusted down by 10%.

2.5. Statistical Data Analysis

Analysis of Variance (ANOVA) of Weed density, dry weight, and weed control efficiency, weed index and Agronomic data were subjected to SAS software program version of 9.3. Mean separation was conducted for significant treatments mean using Least Significance Difference (LSD) at 5% probability level [12].

3. Result and Discussion

3.1. Effects of Integrated on Weed Management Flora Composition in Tef

In the study field, around 12 weed species belonging to 10

weed families were recorded. The experimental site was dominated by four weed families (*Poaceae, Compositae, Brassicaceae & Asteraceae*) and three life form/categories (Grass, Sedge and Broad leaved weed) were found in the experiment field. Out of total weeds present in the experimental field 66.7 percent were broad leaved weeds while the rest 25 and 8.3 percent were grass and segde leaved weeds respectively (Table 3).

Table 3. *Weed flora composition as affected by integrated weed management in tef.*

Botanical Name	Family	Category	Life Cycle
Galinsoga parviflor	Asteraceae	Broad leaf	Annual
Pennisetum clandestium	Poaceae	Grass	Perennial
Centella asiatica L.	Apiaceae	Broad leaf	Perennial
Polygonum Nepalese	Polygonaceae	Broad leaf	Annual
Commelina benghalensis L.	Commelinaceae	Broad leaf	Annual
Snowdenia polystachya	Poaceae	Grass	Annual
Plantago lanceolata L.	Plantaginaceae	Broad leaf	Annual
Cyperus esculentus L.	Cyperaceae	Sedge	Perennial
Trifolium pratense	Leguminosae	Broad leaf	Annual
Setaria pumila	Poaceae	Grass	Annual
Guzotia scabra (Vis.) Chiov.	Composite	Broad leaf	Annual
Spergula arvensis L.	Brassicaceae	Broad leaf	Annual

3.2. Effects of Integrated Weed Management on the Weed Density, Weed Dry Weight, and Weed Control Efficiency in Tef

Relative weed density: All treatments used in this experiment had significant ($P < 0.01$) effects on weed density, as compared with the weedy check treatment. The highest (35.3 and 40.35) weed density was recorded from the weedy check plot at Gachi and Bedele districts weed management practices respectively (Table 4). The lowest (8.35 and 7.6) weed density was recorded from the Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS at Gachi and Bedele districts weed management practices respectively (Table 4). This result is consistent with [15], who reported that weed incidence and infestation were higher in the unwedded plot. The integration of chemical and mechanical weed management is superior to the alone use of herbicides and one-time hand weeding.

Weed dry weight: Weed dry weight/biomass was significantly affected by integrated weed management practices. The result of the study was stated that Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS plot gave minimum weed dry weight (5.73 and 6.93) at Gachi and Bedele districts weed management practices respectively (Table 4). The highest (52.9 and 60.4) weed dry weight was recorded from weedy check plot at Gachi and Bedele districts weed management practices respectively (Table 4). The present study is in agreement with the finding of [8], who reported that the maximum dry weight was recorded in a weedy check plot.

Weed Control efficiency (%): The effect of the treatment was significant on weed control efficiency. The highest (74.01 and 80.8) weed control efficiency was observed in the Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS at Gachi and Bedele districts weed management practices respectively (Table 4), whereas the lowest (0.00 and 0.00) weed control efficiency was observed in the weedy check plot at Gachi and Bedele districts weed management practices respectively (Table 4). This result was similar to [1] report that herbicides supplemented by hand weeding gave higher weed control efficiency, which could be due to the complementary effect of hand weeding and herbicides.

Table 4. *Effect of different weed management practices on weed density, weed dry weight and weed control efficiency of Tef field in Gachi and Bedele districts.*

Treatments	Gachi district			Bedele district		
	RWD (%)	WDW	WCE (%)	RWD (%)	WDW	WCE (%)
Pallas 0.5lt ha^{-1}	18.46de	10.30de	63.22ab	21.33cd	11.70efg	70.47bc
Pallas 0.375lt ha^{-1}	25.79bc	14.10d	57.78bc	26.10c	16.70e	63.87c
Pallas 0.5lt ha^{-1} + HW @ 40 DAS	8.35f	5.73e	74.01a	7.56e	6.93g	80.80a
Pallas 0.375lt ha^{-1} + HW @ 40 DAS	17.86de	8.73de	65.32ab	16.11d	10.80fg	76.69ab
2, 4-D 1.0lt ha^{-1}	19.89cde	40.70b	47.77cd	23.69c	40.97c	47.40d
2, 4-D 0.5lt ha^{-1}	29.15b	46.93ab	38.39d	34.05ab	49.50b	41.61d
2, 4-D 1.0lt ha^{-1} + HW @ 40 DAS	14.82e	21.23c	60.15b	15.62d	13.03ef	69.48bc
2, 4-D 0.5lt ha^{-1} + HW @ 40 DAS	20.83cd	27.63c	55.08bc	24.11c	28.10d	65.20c
HW 25 and 40 DAS	29.35b	23.33c	20.89e	27.74bc	28.40d	31.82e
Weedy check	35.28a	52.90a	0.00f	40.35a	60.40a	0.00f
Grand mean	22.0	25.16	48.3	23.7	26.65	54.73
LSD	5.92	7.044	11.14	7.15	5.33	8.905
CV (0.05)	15.7	16.3	13.5	17.6	11.7	9.5

RWD= Relative Weed Density WDW= Weed Dry Weight WCE= Weed Control Efficient
LSD= List significance difference HW= Hand Weeding DAS= Days after sowing lt= Litre ha= Hectare

3.3. Effects of Weed Management Practices on Yield and Yield Components of Tef Crop

Plant Height (*cm*)

The analysis of variance showed that there was highly significant difference between the weed management practices on plant height ($p<0.01$). The application of Post-emergence herbicides and their combination with hand weeding had effects on tef height. The tallest (127.0 cm) and shortest plant height (90.2 cm) were recorded from weedy check and Pallas 45 OD at 0.5L/ha + hand weeding at 40 DAS treatment plots/weed management practices respectively in Bedele district (Table 5). Accordingly, the tallest (127.2 cm) and shortest plant height (90.5 cm) were recorded from weedy check and Pallas 45 OD at 0.5L/ha + hand weeding at 40 DAS treatment plots/weed management practices respectively in Gachi district (Table 6). The results of the present study was in agreement with the findings of [4] who reported that increased plant height with the weedy plot might be due to the effect of severe competition among plants which make them elongated in search of light.

Panicle Length of the crop (*cm*)

The application of Post-emergence herbicides and their combination with Hand weeding had an effect on tef panicle length. Panicle Length was showed significance differences. The tallest (50.33 cm) and shortest panicle length (35.23 cm) from Pallas 45 OD at 0.5L/ha + hand weeding at 40 DAS and Weedy check weed management practices respectively in Bedele district (Table 5). Accordingly, the tallest (44.7 cm) and shortest panicle length (31.3 cm) from Pallas 45 OD at 0.375L/ha + hand weeding at 40 DAS and Weedy check weed management practices respectively in Gachi district (Table 6). The increase in panicle length with repeated tillage and frequent weeding might be attributed to better availability of growth resources for the crop resulting from repeated tillage and weeding which is in agreement with the findings of [22] and the genetic nature of varieties.

Biomass of the crop (*Kg ha^{-1}*)

The above-ground biomass of the crop was significantly influenced by weed management methods. The largest above ground biomass of the crop was obtained in the Pallas 45 OD at 0.5lt ha^{-1} (5533.3 kg ha^{-1}), whereas the lowest biomass was observed in the weed-check plot (2100 kg ha^{-1}) at Bedele district (Table 5). Accordingly, the largest above ground biomass of the crop was obtained in the Pallas 45 OD at 0.5lt ha^{-1} + HW @ 40 DAS (8613.3 kg ha^{-1}), whereas the lowest biomass was observed in the weed-check plot (2200.0 kg ha^{-1}) at Gachi district (Table 6). These results were similar to the finding of [8], who reported that the highest biomass of the crop was obtained from a weed-free plot, and the lowest was from a weedy check plot. This may be because of the crop plants utilized the

resources more efficiently, which resulted in a higher final crop stand. The biomass of the crop is hugely significant on the grain yield of the crop.

Grain Yield (*Kg ha^{-1}*)

The analysis of variance showed that there was highly significant difference between the weed management practices on Grain yield ($p<0.01$). The application of Post-emergence herbicides and their combination with hand weeding had an effect on tef Grain yield. The highest (2533.3Kg ha^{-1}) and lowest grain yield (593.3Kg ha^{-1}) was recorded from Pallas 45 OD at 0.5L/ha and weedy check weed management practices respectively in Bedele district (Table 5). Accordingly, the highest (2280.0Kg ha^{-1}) and lowest grain yield (616.0Kg ha^{-1}) was recorded from Pallas 45 OD at 0.5L/ha and weedy check weed management practices respectively in Gachi district (Table 6). The improvement of tef grain yield might be due to efficient control of weed growth and weed density, and efficient utilization of resources by crops, which lead to proper growth and development of crops that favor an increase in yield and yield attributes. The minimum grain yield was due to weed infestation, accumulation of high dry matter in weeds, and occurrence of different weed species in weedy plots. The other reason is that the more the weeds, the more the nutrient depletion from the soil and the more their competition with crop plants that conspicuously concentrated the nutrient movement towards the grains which finally affected the grain development potential of a crop that resulted lower yield; and its opposite is true for a crop that resulted higher yield. The results was indicated that all weed management practices highly significantly increased the yield over weedy check (unweeded control) (Tables 5 & 6). This result is in line with [7] who reported that the highest grain yield of tef was obtained in weed-free treatment, while the lowest grain yield was obtained in the weedy check. The result also showed that the combination of weed management practices with Hand weeding and sole weed management practices had high advantage over weedy check. The results are in line with the report of, [20] who reported that tef grain production was greater with herbicide application treatment compared to the weedy check treatment.

Table 5. *Effect of weed management practices on yield and yield components of Tef* (*Eragrostis* (*Zucc.*) *Trotter*) *in Buno Bedele Zone, Bedele district in 2024 cropping season.*

Treatments	PH (cm)	PL (cm)	DB (kg ha^{-1})	GY (kg ha^{-1})
Pallas 0.5lt ha^{-1}	116.7bdc	42.22cb	4116.7bc	1122.7ed
Pallas 0.375lt ha^{-1}	118.7bc	41.11cb	4183.3bc	984.0ed
Pallas 0.5lt ha^{-1} + HW @ 40 DAS	90.2e	50.33a	5533.3a	2533.3a
Pallas 0.375lt ha^{-1} + HW @ 40 DAS	121.9ba	50.11a	4636.7ba	1982.7b
2, 4-D 1.0lt ha^{-1}	110.6d	39.89c	4066.7bcd	1270.0d
2, 4-D 0.5lt ha^{-1}	111.0dc	39.56c	3200.0ecd	752.7ef
2, 4-D 1.0lt ha^{-1} + HW @ 40 DAS	119.0bac	44.23b	3625.3bcd	1794.7b
2, 4-D 0.5lt ha^{-1} + HW @ 40 DAS	117.5bdc	44.23b	2926.7ed	1662.0cb
HW 25 and 40 DAS	97.9e	35.33d	4466.7ba	1280.0cd
Weedy check	127.0a	35.23d	2100.0e	593.3f
Grand mean	113.1	42.2	3885.5	1397.5
LSD (0.05)	8.1	3.92	1149.8	386.3
CV (%)	4.2	5.4	17.3	16.1

Table 6. *Effect of weed management practices on yield and yield components of Tef* (*Eragrostis* (*Zucc.*) *Trotter*) *in Buno Bedele Zone, Gachi district in 2024 cropping season.*

Treatments	PH	PL	DB (kg ha^{-1})	GY (kg ha^{-1})
Pallas 0.5lt ha^{-1}	120.1dce	39.00cd	6444.7c	910.0e
Pallas 0.375lt ha^{-1}	119.9dce	38.7cd	7042.0bc	711.3fe
Pallas 0.5lt ha^{-1} + HW @ 40 DAS	90.5g	43.7a	8613.3a	2280.0a

Treatments	PH	PL	DB (kg ha^{-1})	GY (kg ha^{-1})
Pallas 0.375lt ha^{-1} + HW @ 40 DAS	125.9ba	44.7a	7961.3ba	1886.7b
2, 4-D 1.0lt ha^{-1}	117.7de	38.00ed	5256.7d	880.0fe
2, 4-D 0.5lt ha^{-1}	116.0e	36.23e	5433.3d	813.3fe
2, 4-D 1.0lt ha^{-1} + HW @ 40 DAS	122.8bc	41.4b	7326.0bc	1460.0dc
2, 4-D 0.5lt ha^{-1} + HW @ 40 DAS	120.8dc	40.6cb	7700.0ba	1218.7d
HW 25 and 40 DAS	100.3f	34.03f	6626.0c	1520.0c
Weedy check	127.2a	31.3g	2200.0e	616.0f
Grand mean	116.1	38.8	6460.3	1226.6
LSD (0.05)	4.4	2.03	932.7	145.5
CV (%)	2.22	3.05	8.4	12.8

Economic analysis / production cost analysis

Different weed management needs different cost of production. The highest MRR (12137.5) was obtained from Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS, while the lowest MRR (616) from weedy check weed management practices (Table 7). This analysis is in agreement with the study of [25], who reported that chemical usage gives the most actual, economical, and practical method of weed control when supplemented with hand weeding.

Table 7. *Post-emergence Herbicides on economic analysis of tef.*

Treatments	Ave yield (kg ha^{-1})	Adjusted yield (kg ha^{-1})	TVC	Gross return	Net Benefit	MRR (%)
Pallas 45 OD 0.5lt ha^{-1}	1189.3	1070.37	24500	117740.7	93240.7	0
Pallas 45 OD 0.375lt ha^{-1}	984	885.6	24200	115500	91300	646.9
Pallas 45 OD 0.5lt ha^{-1} + HW @ 40 DAS	2154.7	1939.23	25000	213400	188400	12137.5
Pallas 45 OD 0.375lt ha^{-1} + HW @ 40 DAS	1746	1571.4	24700	205700	181000	2466.7
2, 4-D 1.0lt ha^{-1}	1470	1323	23600	101200	77600	9400.0
2, 4-D 0.5lt ha^{-1}	752.8	677.52	23300	96800	73500	1366.7
2, 4-D 1.0lt ha^{-1} + HW @ 40 DAS	1933.3	1739.97	24100	169400	145300	8975.0
2, 4-D 0.5lt ha^{-1} + HW @ 40 DAS	1608	1447.2	23800	156200	132400	4300.0
HW 25 and 40 DAS	1280	1152	23000	137500	114500	2237.5
Weedy check	593.3	533.97	15000	80300	60300	615.0

*Note; One HW=One Times Hand Weeding; Two HW =Two Times Hand Weeding, DAS=Days after Sowing, @=at, AY= adjusted yield, GR=gross return, TPC=total production cost, NR=net return, BCR=benefit cost ratio

4. Conclusion and Recommendations

The application of post-emergence herbicides and their combination with hand weeding had effect on the collected parameters of tef and weed. All yield and yield components of tef were highly significantly influenced by the weed management practices. Both total weed density and total weed biomass were highly significantly influenced by the weed management practices. Applying Pallas 45 OD at 0.5Lha^{-1} + HW at 40 DAS was the best Tef weed management Practices. The highest MRR were recorded from Pallas 45 OD at 0.5Lha^{-1} +

hand weeding at 40DAS. Finally; using post-emergence herbicide Pallas 45 OD at 0.5 $ltha^{-1}$ + HW at 40 DAS is more profitable weed management practice and recommended for managing any weed species in tef field and improve yield production.

Abbreviations

DAS	Days After Sowing
HW	Hand Weeding
MRR	Marginal Rate of Return
ANOVA	Analysis of Variance
LSD	List Significance Difference
BeARC	Bedele Agricultural Research Center
OARI	Oromia Agricultural Research Institute

Author Contributions

Takele Kusa: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Software, Supervision, Writing – original draft, Writing – review & editing

Alemayehu Abdeta: Conceptualization, Methodology, Software, Writing – review & editing

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] Amare T, Raghavaiah C, Zeki T (2016). Productivity, Yield Attributes and Weed Control in Wheat (Triticum aestivum L.) as Influenced by Integrated Weed Management in Central High Lands of Ethiopia, East Africa. Advances in Crop Science and Technology 4(206): 23298863.

[2] Assefa, K.; Tadele, Z.; Chanyalew, S. (Eds.) 2013. Achievements and Prospects of Tef Improvement: Proceedings of the Second International Workshop, November 7–9, 2011, Debre Zeit, Ethiopia; Universität Bern: Bern, Swiss.

[3] Balesh, T.; Aune, J. B.; Johnsen, F. H.; Vanlauwe, B. 2008. The prospects of reduced tillage in tef (Eragrostis tef Zucca) in Gare Arera, WestShawa Zone of Oromiya, Ethiopia. Soil Tillage Res. 99, 58–65.

[4] Bekele B, Dawit D, Zemach S (2018). Effect of Weed Management on Yield Components and Yield of Bread Wheat (Triticum aestivum L.) At Wolaita Sodo in Southern Ethiopia. International Journal of Research in Agriculture and Forestry 5(10): 34-43.

[5] Berhane G, Paulos Z, Tafere K, Tamru S (2011) Food grain consumption and calorie intake patterns in Ethiopia.

[6] Birhanu Gizaw, ZerihunTsegay, Genene Tefera, Endegena Aynalem, et al. Traditional Knowledge on Teff (Eragrostistef) Farming Practice and Role of Crop Rotation to Enrich Plant Growth Promoting Microbes for Soil Fertility in East Showa: Ethiopia. Agri Res & Tech: Open Access J. 2018; 16(5): 556001.

[7] Brhane, "Response of yield and yield components of tef[Eragrostis tef (Zucc.) Trotter] to tillage, nutrient, and weed management practices in Dura Area, Northern Ethiopia,"International Scholarly Research Notices, vol. 2014, 2014.

[8] Merga, B. and Alemu, N. (2019) Integrated weed management in chickpea (Cicer arietinum L.). Cogent Food & Agriculture 5(1), 1–18.

[9] CIMMYT (International Maize and Wheat Improvement Center). Farm Agronomic Data to Farmer Recommendations: An Economics Training Manual. Completely Revised Edition. DF: CIMMYT, Mexico D. F. 1988. 124p.

[10] Collyns Dan (2013) Quinoa brings riches to the Andes.

[11] Gebreyesus BrhaneTesfahunegn. 2014. Response of Yield and Yield Components of Tef [Eragrostis tef (Zucc.) Trotter] to Tillage, Nutrient, and Weed Management Practices in Dura Area, Northern Ethiopia. International Scholarly Research Notices, Hindawi Publishing Corporation, Volume (XX), pp 1-9 pages.

[12] Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd Ed. John Willey and Sons, Inc. New York. 1984. 641p.

[13] Habtegebrial. K., B. R. Singh, and M. Haile. 2007. "Impact of tillage and nitrogen fertilization on yield, nitrogen use efficiency of tef (Eragrostis tef (Zucc.) Trotter) and soil properties," Soil andTillage Research, vol. 94, no. 1, pp. 55–63.

[14] Haftamu, G.; Mitiku, H.; Yamoah, C. F. 2009. Tillage Frequency, Soil Compaction and NFertilizer Rate Effects on Yield of Teff (Eragrostis Tef (Zucc) Trotter) in Central Zone of Tigray, Northern Ethiopia. MomonaEthiop. J. Sci. 1, 82–94.

[15] Haftamu Gebretsadik Gebrehiwot, Jens Bernt Aune, Jan Netland, Ole Martin Eklo, Torfinn Torp and Lars Olav Brandsæter. 2020. Weed-Competitive Ability of Teff (Eragrostis tef (Zucc.) Trotter) Varieties. Agronomy, 10, 108.

[16] Joel Felix. 2010. Evaluation of Herbicides for Possible use on Tef. Onion, Ave Ontario, OR 97914.

[17] Kebede. F and C. Yamoah. 2009. Soil fertility status and Numass fertilizer recommendation of Typic Hapluusterts in the Northern Highlands of Ethiopia," World Applied Sciences Journal, vol. 6, pp. 1473–1480.

[18] Marwat, K. S., Usman, K., Khan, N., Khan, U. M., Ejaz Ahmad Khan, A. E., Khan, A. M., Rehman, U. A., 2013. Weeds of Wheat Crop and Their Control Strategies in Dera Ismail Khan District, Khyber Pakhtun Khwa, Pakistan. American Journal of Plant Sciences, 4: 66-76.

[19] Mersie. W and C. Parker. 1983. "Response of teff (Eragrostis tef (Zucc.) Trotter) to 2, 4-D and MCPA at various growth stages," WeedResearch, vol. 23, no. 1, pp. 53–59.

[20] Norberg, S. and Felix, J. "Response of Teffff, Barnyardgrass, and broadleaf weeds to post emergence herbicides," Weed Technology, vol. 28, no. 2, pp. 371–376, 2014.

[21] Oicha. T., W. Patro and M. Ray, "Integration of chemical and cultural methods for weed management in wheat," Advance Research Journal of Crop Improvement, vol. 7, no. 2, pp. 207–210, 2016.

[22] Reicosky DC, Allmaras RR (2003). Advances in Tillage Research in North American Cropping Systems. Journal of Crop Production 8(1-2): 75-125.

[23] Rezene F, Zerihun T. 2001. Weed research in tef. In: Hailu T, Getachew B, Mark S (Eds.), Narrowing the Rift. Debre Zeit, Ethiopia, pp. 191-200.

[24] Seyfu Ketema. 1993. Tef (Eragrostis tef) breeding, genetic resources, agronomy, utilization and role in Ethiopian agriculture. Addis Ababa: Institute of Agricultural Research.

[25] Sureshkumar, R. and Durairaj. 2016. Weed characters and indices of transplanted rice as influenced management by different practices. weed International Journal of Agriculture Sciences. 8(51): 2221-2223.