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Effect of Weed Management on Yield Components and Yield of Bread Wheat (Triticum aestivum L.) at Wolaita Sodo in Southern Ethiopia

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Abstract

Weeds infestation is one of the major threats to crop yield. Thus, a field experiment was carried out during 2017cropping season at Wolaita Sodo Agricultural and Techniques Vocational Education Training (ATVET) farm to evaluate the effect of weed management on yield components and yield of bread wheat and feasibility of weed managem.ent. The treatments were (2, 4-D EE 1lha-1, 2, 4-D EE¼ ha-1+1/4 lha-1pallas, 2, 4-D ½EE lha-1+1/4lha-1pallas, pallas1/2 lha-1, 2, 4-DEE (1lha-1) +1/2lha-1pallas, once hand weeding after four weeks of crop emergence, once hand weeding after six weeks of crop emergence, weedy check , weed free ,twice hand weeding at four week +six weeks after crop emergence) and laid out in a randomized complete block design (RCBD) with three replications. Crop parameters such as days to maturity, plant height, and numbers of effective tillers per m2, numbers of spikelet per spike, grain yield and above ground biomass were recorded and statically analyzed. The result showed except days to heading, phenological, growth and yield components reacted response to weed management methods. The analysis of variance revealed that weed management showed greatest biomass and grain yield at the treatment of weed free. Besides these, the maximum economic return was recorded from the 2, 4-D EE¼ ha-1+1/4 lha-1pallas. From this result it could be concluded that 2, 4-D EE¼ ha-1+1/4 lha-1pallas has better herbicide efficacy.

Keywords: *Economic feasibility, Weed, Weed management, Yield*

Introduction

Wheat (*Triticum aestivum L.)* is one of the most important food crops of the world and a member of the family Poaceae that includes major cereal crops of the world such as maize, wheat and rice. It is a staple food in the diets of several Ethiopian, providing about 15 percent of the caloric intake for the country's over 90 million population (FAO 2015a), placing it second after maize and slightly ahead of teff, sorghum, and enset, which contribute 10-12 percent each (Minot et al., 2015). Wheat is produced by close to 5 million smallholder farmers, which makes about 35 percent of all small farmers in the country. It accounts close to 17 percent of acreage of arable land and a fifth of all cereal food crops produced in the country (CSA, 2013/14a). After South Africa, Ethiopia is the second largest wheat producer in sub-Saharan Africa (FAO 2015b).

Wheat is mainly grown in the highlands of Ethiopia, which lie between 6 and 16° N and 35 and 42° E, at altitudes ranging from 1500 to 2800 meters above sea level and with mean minimum temperatures of 6o C to 11o C (MOA, 2012).

In Ethiopia, wheat covered an area of 1,696,082.59 ha with a total production of 45,378,523.39 quintals with yield average of 2600kgha-1 during 2016/2017 main cropping season (Meher) CSA, 2016/2017). In South Nations Nationalities People Region (SNNPR) wheat covered an area of 133,419.80 ha with a total production of 334,633.928 tons and in Wolaita zones, 1,630.25 ha which produce 3,092.392 tons (CSA, 2015/16).Out of the total grain crop area, 81.27% (10,219,443.46) hectares) was under cereals.

Despite its importance in Ethiopia, the mean national yield is 2600.75kg/ha-1which is 12% below the mean yield of Africa and 24% below the global mean yield of wheat (CSA, 2016/17).Yield reducing factors in wheat are soil fertility decline, weeds, disease, and insects. Weeds are one of the major constraints of wheat production and weed control is the key factor in increasing yield (Lopez-Granados, 2011; Shahzad et al., 2012). There are many reasons for low yield of wheat crop but weed infestation is the basic and major component of low yield in crop production system. With the advent of new short stature varieties, weeds competition has become even more severe (Shah et al., 2013).

Weed infestation has been reported as a major constraint to wheat production in Ethiopia in both the peasant and the state farm sectors. Weeds are generally defined as plants growing where are unwanted and they differ in the damage that they cause to crops and this is governed by their growth habit, vigour, seed production, regenerative capacities and time of germination. The total global potential loss due to pests varied from about 50% in wheat. The total annual loss in agriculture produce, weeds account for 45% (Mohamed et al., 2014).

Weeds compete with crop plants for essential growth factors like light, moisture, nutrients and space. Weeds increase harvesting costs, reduce quality of product (Marwat, 2008). Apart from increasing the production cost, weeds also intensify the disease and insect pest problem by serving as alternative hosts, and uncontrolled weed growth throughout the crop growth caused a yield reduction of 57.6 to 73.2% (Tesfaye et al., 2014).

Weed management increases the cost of production and thus it is necessary to device such methods which could reduce not only the cost of production but also save time and labor (Shah et al., 2013).Weeds can be suppressed in wheat through variety of techniques as single method of weed control is not sustainable (Barros et al., 2008). Physical methods of weed managements are laborious, tiresome and expensive due to increasing cost of labor, draft animals and implements and weeds cannot effectively be managed merely due to cro p mimicry (Marwat et al., 2008).

Depending on the type of cereal crop, the weed spectrum, cultural practices and climatic factors, 2,4-D might be applied as salts, esters, amines or free acid formulations at rates ranging from 250 g to 2 kg/ha (Sanjay and Atul, 2010). Elanchezhian and Panwar (1997) opined that 2, 4-D foliar spray increased the amylase activity, root number and shoot dry weight, which in turn increased the yield attributes of wheat. On the other hand, Pyroxsulam was more effective on controlling broadleaved weeds which reduced the weed population as compared to other herbicides and also it can control serious grassy weeds on wheat (Mohammad et al., 2007). However, the use of a single herbicide may cause shift in the weed flora in favor of the species that are not controlled, thus may increase the problem in future. Herbicides are frequently used to increase crop yield through effective weed control, but excessive and non judicious use of herbicides has posed many environmental and health problems (Jabran et al., 2008). An effective herbicide is one that can manage complex weed community. As the introduction of herbicides with new mode of action has slowed down, there is a need for using combination of existing herbicides in a way to lower the load on the environment and to improve weed control efficiency without any adverse effect on the crop. However due to ignorance and lack of knowledge the farmers blindly apply herbicides without considering its economics, resistance, health and environment (Barros et al., 2008).

Despite the facts that the use of chemicals deteriorates environment, herbicides are still the most common method of weed management (Montazeri, 2005).The herbicide combination of pyroxsulam + 2, 4-D has to ability to control dominant grass as well as broadleaved weeds (Adam et al., 2014).

Wheat productivity is remarkably reduced by weed infestation in the study area. Farmers in the area are aware of 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.

Such ineffective weed management is considered as the main factor for low yield of wheat resulting in yield loss of up to 58.6% when there is uninterrupted weed growth (Dawit et al., 2014).

Nevertheless, there are many weed management options that can reduce weed infestation remarkably and enhance wheat production and productivity. Hence, this study was initiated with objectives of: To evaluate the effect of different weed management methods on yield components and yield of bread wheat and to evaluate the feasibility of weed management in wheat production.

MATERIALS AND METHODS

Description of Experimental Site

A field experiment was conducted during 2017 cropping season at Sodo Agricultural Technical Vocational and Educational Training College (ATVET) demonstration site at Wolaita Sodo in Southern region. Geographically coordinates of the site is 6°34'N latitude and 37°43'E longitude having an altitude of 1950 meters above sea level. The area has a bimodal rainfall distribution pattern with annual rainfall of 1488 mm. The average minimum and maximum air temperatures during the growing period were 13.4OC and 27.25OC respectively. The soil type is Nito-soils with sandy clay loam texture ((Merkineh, 2016).

Treatments and Experimental Design

Treatments were consisted in 2, 4-D EE 1lha-1, 2, 4-D EE¼ ha-1+1/4 lha-1pallas, 2, 4-D ½EE lha-1+1/4lha-1 pallas, pallas1/2lha-1, 2, 4-DEE (1lha-1) +1/2lha-1 pallas, once hand weeding after four weeks of crop emergence, once hand weeding after six weeks of crop emergence, weedy check , weed free ,twice hand weeding at four week +six weeks of crop emergence. Herbicides were applied 30 days after crop emergence. The experiments were laid out in Randomized Complete Block Design (RCBD) in three replications.

Materials Used For the Experiment

Types of herbicides used in the study were presented in table 1. The wheat variety 'Kakaba' was used as a test crop which was released by Kulumsa Agricultural Research Center in 2010 and is popular which is currently in production and takes 90- 120 days to maturity with potential yield ranging from 3300- 5200 kgha-1 (MoARD, 2010).

Table1. *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	Pyroxsulam(45-OD)	N-(5,7-dimethoxy[1,2,4]triazolo[1,5-a]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl) pyridine-3-sulonamide

Agronomic Practices

Experimental field was ploughed, pulverized and leveled in order to get smooth seed bed. The plot size was 3 m long and 2m wide with total growth area of 6m-2 with the net area of 4.8m-2. The crop was sown (150 kg ha-1) seeding rate by drilling seeds in furrow 20 cm. From the recommended rate of 85kg ha-1 one - third of N fertilizer and uniform dose of P (46 kg P2O5 ha-1) were applied within the rows at sowing and the remaining two – third N in the form of urea was top dressed in two equal splits at tillering and panicle initiation stages. The herbicides were applied as per the treatment in the assigned plots at 30 days after emergence of wheat with 250 l ha-1 water as a carrier using hand sprayer. Hand weeding was done in the assigned plots at an appropriate time. The weeds in weed free plots were removed by hand pulling frequently to keep the plots free from any weeds. Plot wise harvesting was done at harvest maturity of the crop.

DATA COLLECTION AND MEASUREMENTS

Phenological parameters

Days to heading (No): It was recorded when 50% of the plants in plots exhibit heading. Days to physiological maturity: it was recorded when 90% of plants in plots lose their green leaf panicle.

Growth Parameters

Plant height (cm): It was measured from above the ground to apex for 10 (main shoots) randomly selected plants from each plot at physiological maturity. Spike length (cm): It was measured at physiological maturity on 10 randomly selected plants per plot.

Yield Components and Yield

Number of total tillers (No): It was counted at late tillering stage. Effective tillers (No):: It was counted at physiological maturity. Number of spikelet's per spike (No): Each 10 spike was threshed separately after harvesting and grains of each spike were counted and averaged. Thousand grain weight(g): Number of thousand grain counted using electronic seed counter from a bulk of shelled grain and weighed using sensitive balance from a plot at harvest at 12.5 % moisture by using grain moisture tester. Above ground Biomass yield (kgha-1): It was recorded from the net plot area by weighing the total above ground biomass at harvesting. Grain yield (kgha-1): It was measured at harvesting after adjusting at 12.5% moisture content. Harvest index (%): It was calculated as the ratio of grain yield to above ground dry biomass per plot and multiplied by 100 at harvest from the respective treatments.

$$HI = \frac{\text{Grain yield}}{\text{Above ground biomass}} \text{ x } 100\%$$

Economic Analysis

The economic analysis was done to determine the economic feasibility of the treatments. It was calculated by taking into account the variable input cost involved and the gross returns obtained from different treatments. The gross benefit was calculated as 10% adjusted grain yield (kg ha-1) multiplied by field price that farmers receive for the sale of the crop. The net returns were calculated by subtracting the cost of treatment from the gross returns as RNR = GR-VC, where, RNR = Relative net returns, GR = Gross returns, and VC = Variable cost as described by CIMMYT (1988) was used on the yield results and benefit to cost ratio and marginal rate of return was calculated.

Data Analysis

The data were subjected to the analysis of variance (ANOVA) appropriate to the design using SAS version 9.2 (SAS, 2008). Mean separation was done using Fisher's protected least significant difference (LSD) test at 5% level of significance.

Results And Discussion

Plant Height

The Plant height was significantly influenced by weed management methods. The plant height affected by weed management methods ranged from 96.37cm to 92.27cm.The longest plant height was recorded at weedy plots with the mean of 96.37 cm while shortest plant height was recorded at the 2, 4-D EE¼ ha-1+1/4 lha-1pallas treated plots followed by weed free (Table 2).

The mean difference between 2, 4-D EE¼ ha-1+1/4 lha-1pallas treated plots and weedy check was 4.10cm was due to high weed population caused difference in plant height to changing plants the lower light penetrating into canopy bed and more inter-specific competition for absorption of light. The non-significant differences were obtained at 2, 4-D EE¼ ha-1+1/4 lha-1pallas and weed free treatment. The non-significance difference among 2, 4-D EE¼ ha-1+1/4 lha-1pallas and weed free treatment might be due to availability of abundant of growth promoting factors in both treatments that allowed the plants to attain their maximum height. The 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 and lack of availability of plentiful of growth encouraging Factors in weedy plot that allowed the plants to increase in height, the competition between weeds and crop for sun light and space in un-weeded plots resulted in tall height of plants. Similarly, Salahuddin et al., (2016) reported that the competition among weeds and wheat plant enforced to grew plant.

Spike Length

The analysis of variance showed that weed management methods had resulted significant difference on spike length. The spike length affected by weed management methods ranged from 9.67cm to 6.8cm. The maximum spike length was recorded at weed free treated plots with spike length of 9.67cm and minimum spike length was recorded at the weedy check with spike length of 6.8cm (Table 2). When compared to weedy check all the treated plots had longest spike length.

This longest spike length could be due to the lower dry weight of weeds at treated plots that probably led to better resources (water, light, nutrients) and enhanced spike length.

Among the herbicide treated plots of herbicide combination rate increased the spike length decreased. These might be due to increased weed population at herbicide rate combination increased. 2, 4-D EE¼ ha-1+1/4 lha-1pallas treated plots came in the second rank among the treatments might be lower dry matter accumulation in weeds produced more assimilates synthesized, trans located and accumulated in various plant organs which positively reflected in the spike length of wheat. In the higher weed population and accumulation of higher dry matter in weeds, the spike length decreased at weedy plots and at lower dry matter accumulation in the weeds, the spike length increased due to availability of resources.

The increment of spike length might be due to sufficient growth resources facilitated cell elongation for spike length per plant for weed free plots. Similarly Salahuddin et al., (2016), Khan et al., (2003), Hassan et al., (2003) reported that the maximum spike length was recorded at complete weed free, whereas minimum spike length was recorded in weedy check.

Table2. *Plant height and spike length as affected by weed management methods in 2017 cropping season*

Treatments	Plant height (cm)	Spike length(cm)
2, 4-D EE 1lha^{-1}	93.90^{bcd}	7.87^{d}
pallas1/2lha^{-1}	94.20^{bc}	8.53^{bc}
2, 4-D EE¼ ha^{-1}+1/4 lha^{-1}pallas79.00^{cdef}	92.27^{d}	8.87^{b}
2, 4-D ½EE lha^{-1}+1/4lha^{-1}pallas78.67^{bcde}	94.30^{bc}	8.53^{bc}
2, 4-DEE (1lha^{-1}) +1/2lha^{-1}pallas79.67^{def}	93.63^{bcd}	8.017^{d}
Once hand weeding after four week of crop	93.67^{bcd}	8.33^{cd}
Twice hand weeding four +six week after of crop	92.83^{bcd}	8.63^{bc}
Once hand weeding after six week of crop	94.53^{ab}	7.30^{e}
Complete weed free	92.50^{cd}	9.67^{a}
Weedy check	96.37^{a}	6.80^{e}
LSD (0.05)	1.93	0.50
CV(%)	1.20	3.50

Means followed by the same letter within a column are not significantly different at 5% probability level, LSD = Least Significant difference and CV= Coefficient of variance

YIELD COMPONENTS AND YIELD

Number of Tillers

The analysis of variance showed that weed management methods had resulted significant difference on number of tillers. The number of tillers affected by weed management methods ranged from 274 to 115.3. The maximum number of tillers was recorded at weed free treated plots with number of tiller of 274 and minimum number of tiller was recorded at the weedy check with number of tiller 115.3(Table3).Maximum number of tiller was recorded at weed free plots followed by 2, 4-D EE¼ ha-1+1/4 lha-1pallas, twice hand weeding four week +six week after crop emergence with the mean of 274.0, 268.7 and 251.3 m-2 respectively while minimum number of tiller was counted at the weedy plots with the mean of 115.3 m-2(Table 3). The production of more total tillers at weed free plot might be attributed to better access of space, nutrient, water and light that enabled plants to produce more tillers m-2and reduction in tiller number m-2was probably the increased weed population and continuous competition reduced access to different resources. Among the herbicide treated plots the lower weed population and dry weight at 2, 4-D EE¼ ha-1+1/4 Lha-1pallas due to reduced crop weed competition contributed to more number of tillers m-2. Similarly, Takele (2001) reported that reduction in number of tillers in barley with increased weed population.

Effective Tillers

The analysis of variance indicated that weed management methods had resulted significant difference on effective number of tillers. The number of tillers affected by weed management methods ranged from 261.3 to 102.7. The maximum number of effective tillers was recorded at weed free treated plots with number of tiller of 261.3 and minimum number of tiller was recorded at the weedy check with number of tiller 102.7.

Maximum number of effective tiller was recorded at weed free plots followed by 2, 4-D EE¼ ha-1+1/4 lha-1pallas, twice hand weeding four week +six week after crop emergence with the mean of 261.3, 254.7 and 238 (m-2) respectively while minimum number of tiller was counted at the weedy plots with the mean of 102.7(m-2) (Table 3). Herbicides combination of lower rate gave increased number of tillers m–2 than recommended rate of separate application. 2, 4-D EE¼ ha-1+1/4 lha-1pallas treated plots came in the second rank among the treatments and the enhancement of wheat effective tiller (m-2) might be attributed to higher herbicide efficacy in weed elimination and consequently reduced weed competitive ability against wheat plants.

The production of more effective tillers at weed free plot might be attributed to better access of space, nutrient, water and light that enable plants to produce more tillers per m-2 and reduction in effective tiller at weedy plot was probably the increased weed population and different weed species reduced access to different resources. The reduced number of effective tillers (m-2) in weedy plot might be due to inter plant competition for growth resources that reduced the tillering capacity of plant. The effect of weed was pronounced in number of effective tiller which might be due to more space and nutrients available for the individual plant under weed free plots. Similarly Shah et al., (2013) reported that maximum weed control enhanced the production of effective tillers m–2 which subsequently contributed towards the increase in wheat yield.

Table1.*Total tillers and Effective tillers as affected by weed management methods in 2017 cropping season*

Treatments	Total tillers(No)	Effective tillers(No)
2, 4-D EE 1lha^{-1}	188.0^{cd}	173.3^{cd}
pallas1/2lha^{-1}	191.3^{cd}	176.0^{cd}
2, 4-D EE¼ ha^{-1}+1/4 lha^{-1}pallas	268.7^{a}	254.7^{a}
2, 4-D ½EE lha^{-1}+1/4lha^{-1}pallas	220.0^{bc}	206.7^{bc}
2, 4-DEE (1lha^{-1}) +1/2lha^{-1}pallas	188.7^{cd}	171.3^{cd}
Once hand weeding after four week of crop	209.3^{c}	194.7^{c}
Twice hand weeding four +six week after of crop	251.3^{ab}	238.0^{ab}
Once hand weeding after six week of crop	160.0^{d}	146.0^{d}
Complete weed free	274.0^{a}	261.3^{a}
Weedy check	115.3^{e}	102.7^{e}
LSD (0.05)	36.9	36.9
CV (%)	10.4	11.1

Means followed by the same letter within a column are not significantly different at 5% probability level, LSD = Least Significant difference and CV= Coefficient of variance

Number of Spikelet's Per Spike

The analysis of variance result showed that significant variation was observed on number of spikelets per spike. In general, number of spikelets per spike as affected by weed management methods ranged from 33.67 to 50. The highest (50.00) was recorded for weed free treatment followed by 2, 4-D EE¼ ha-1+1/4 lha-1pallas with mean number of spikelet's per spike 47.17. The result showed that maximum number of spikelet's per spike were counted from weed free treated plots with the mean of 50 and the minimum number of spikelet's spike-1were counted at the weedy check plots with the mean of 33.67 (Table 4). This result was in agreement with the Ijaz et al., (2008) who observed that better weed control increased the nutrients availability to the crop which ultimately increased the spike bearing tillers. The number of spikelets per spike is an important characteristic in determining the wheat yield. The results showed that the spikelets per spike increased significantly versus weedy control. Among herbicide treated plots the higher number of spikelets per spike obtained at 2, 4-D EE¼ ha-1+1/4 lha-1pallas treated plots and decreased at increased rate of herbicide combination. The enhancement of spikelets per spike of wheat was due to the higher weed control efficiency. The higher number of spikelets per spike at weed free plot

might be due to efficient utilization of water, nutrients and light and lower weed population and dry weight of weeds at weed free plots. The severe competition under weedy plots diminished the availability of photosynthetic during the same period by shading which ultimately reduced the number of spikelet per spike. Similarly, Hassan et al., (2003) reported that the increase in number of spikelet per spike was due to better weed management and abolition of weed crop competition for nutrients, moisture and light and better use of available resources by the crop.

Thousand Grain Weight

The analysis of variance result indicated that significantly ($p<0.05$) variation was observed on thousand grain weight. Thousand grain weight as affected by weed management methods ranged from 31.67 to 52.00. Maximum thousand grain weight was recorded at weed free treated plots with the mean of 52g followed by 2, 4-D EE¼ ha-1+1/4 lha-1pallas with mean of 49.33g. Whereas, minimum thousand grain weight was recorded at the weedy plots with the mean of 31.67g (Table4). As the rate of herbicide combination increased the thousand grains weight decreased but, the combination had better thousand grain weight than single application of recommended rate. Among herbicide treated plots 2, 4-D EE¼ ha-1+1/4 lha-1pallascame in the first rank in the thousand grain weight might be due to the higher number of spiklet spike-1, taller spike length, lower accumulation of dry matter in weeds, higher weed control efficacy and higher herbicide efficacy index. The minimum thousand grain weight could be due to Severe competition among plants in the weedy plots that caused reduction of assimilates synthesis which in turn brings poor seed filling of wheat and higher weed population was noted in weedy check which was accompanied by strong inter competition that might have caused reduction in thousand grain weight. Similarly, Tomar et al., (2003), Kawa et al., (2016) reported that the weed free crop stand produced robust grains and ultimately resulted in more thousand grain weight.

Total above Ground Biomass Yield

Total above ground biomass yield as affected by weed management methods ranged from11993kg ha-1 to 5425 kg ha-1(Table 4). The highest biomass yield (11993kgha-1) was recorded for weed free treatment followed by 2, 4-D EE¼ ha-1+1/4 lha-1pallas with mean biomass yield of 11550 kgha-1. Minimum biomass was recorded at weedy plots with the mean of 5425 kgha-1 (Table 4). This lowest biomass yield at weedy plot could be due to lower weed control efficiency. Among herbicide treated plots herbicide combination at lower rate had better biomass yield than herbicide combination at recommended rate and single application of recommended rate. These might be due to herbicide combination at lower rate have higher herbicide efficacy index. The better biomass yield was obtained by combination of herbicide treated plots than weedy check. Similarly, Hassan et al., (2003) reported that the mixture of herbicides produced a higher biomass yield than weedy check plots. The increased biomass yield might be due to decreased weed population and dry weight caused better utilization of growth resources and translocation of assimilates from source to seed since plant with better accesses to environmental resources had better photosynthate formation and in turn it is expressed on biomass. The reduced biomass yield might be due to increased competition of resource; this increased competition between increased weed population and low weed control efficacy leads thin and weak stem reduced tiller number, spikelet spike-1, thousand grain weight (g) and reduced total biomass yield. Similarly, Malhiet al.,(2006) reported that the biomass accumulated by plants is the final product of photosynthetic activity and is the food reserve for most plants.

Grain Yield

Grain yield as affected by weed management methods ranged from 4788 kgha-1 to 1299 kgha-1 (Table 4). The highest grain yield (4788 kgha-1) was recorded for weed free treatment followed by 2, 4-D EE¼ ha-1+1/4 lha-1pallaswith mean grain yield of 4306 kgha-1. However ,from the hand weeded treatments rather than weed free,2, 4-D EE¼ ha-1+1/4 lha-1pallas treated plots had better yields due to the combined effects of presence of weeds and uprooting damage of the roots during hand weeding reduced the ability of absorbing the moisture and nutrients from the soil by roots. The higher grain yield might be due to lower dry weight of weeds and efficient utilization of resources. The minimum grain yield was due to basically weed infestation, accumulation of high dry matter in weeds and occurrence of different weed species in weedy plots. From the result the better grain yield was obtained by treated plots than weedy check and within herbicide treated plots as rate of herbicide combination increased as yield decreased. These might be due to reduced weed infestation provided conducive environment for proper growth and development of crop plant and yield attributes to the desirable extent. From the finding, weed management during the crop growth resulted grain yield an average of 3489kgha-1 yield difference with in weedy check and weed free plots. Similarly, Massinga et al., (2003), Canner et al., (2002) reported that yield reduction can vary greatly as a result of weed species. The raise in wheat grain yield with in weed free treatment could be due to absence of weeds, weed growth and biomass accumulation in weeds that favored increased in yield attributes such as number of effective tillers m-2 , spikelet spike-1, spike length and thousand grain weight. Similarly, Dawit et al., (2014) reported that the highest grain yields of 4700.9 and 4455.0 kg ha-1 were obtained in weed free treatment at Bobicho and Faate, respectively while the lowest grain yield was obtained in weedy check at both sites in southern Ethiopia.

Table4. *Spikelets per spike, TGW (g), Total above ground biomass (kg ha-1) and grain yield (kg ha-1) as affected by weed management methods in 2017 cropping season.*

Treatments	SPS	TGW	Grain yield	TAGBM	HI (%)
2, 4-D EE 1lha^{-1}	37.33^{def}	38.00^{cd}	3253^{e}	10366^{ef}	34.49^{c}
pallas1/2lha^{-1}	37.00^{def}	38.67^{c}	3399de	10525^{cdef}	35.34^{c}

2, 4-D EE¼ ha^{-1}+1/4 lha^{-1}pallas	47.17^{abc}	49.33 ^{a}	4306^{b}	11550^{ab}	40.99^{ab}
2, 4-D ½EE lha^{-1}+1/4lha^{-1}pallas	44.9^{abc}	46.00^{ab}	3931^{c}	11165^{bcde}	38.70^{b}
2, 4-DEE (1lha^{-1}) +1/2lha^{-1}pallas	42.83^{bcd}	41.33^{bc}	3486^{d}	11017^{bcd}	35.12^{c}
Once hand weeding after fourweek ofcrop	41.23^{cde}	41.33^{bc}	3285^{e}	10460^{def}	34.70^{c}
Twice hand weeding four +six WACE	47.40^{ab}	47.00^{ab}	3979^{c}	11249^{abc}	39.31^{b}
Once hand weeding after six WACE	36.50^{ef}	38.67^{c}	2931^{f}	9816^{f}	34.18^{c}
Complete weed free	50.00^{a}	52.00^{a}	4788^{a}	11993^{a}	42.39^{a}
Weedy check	33.67^{f}	31.67^{d}	1299^{g}	5425^{g}	25.27^{d}
LSD (0.05)	5.967	6.380	766.3	181.0	2.952
CV%	8.3	8.8	4.3	3	4.8

Means followed by the same letter within a column are not significantly different at 5% probability level, LSD = Least Significant difference and CV= Coefficient of variance

Table5. *Effect of weed management on economic analysis*

Treatments	Average Yield(kgha^{-1})	Adjusted yield(kgha^{-1})	GB (Birr ha^{-1})	TVC (Birrha^{1})	NB (Birrha^{1})	(C: B) MRR
2, 4-D EE 1lha^{-1}	3253	2927.7	40987.8	2226.5	38761	0.057 14.64
pallas1/2lha^{-1}	3399	3059.1	42827.4	2369.5	40457	0.046 14.41
2, 4-D EE¼ ha-1+1/4 lha^{-1}pallas	4306	3875.4	54255.6	2637.6	51617	0.046 18.08
2, 4-D ½EE lha^{-1}+1/4lha^{-1}pallas	3931	3537.9	49523.6	2600	46923	0.055 16.02
2, 4-DEE (1lha^{-1}) +1/2lha^{-1}pallas	3486	3137.4	43923.6	3030	40893	0.074 10.59
Once hand weeding after four week of crop emergence	3285	2956.5	41391.0	3377.5	38013	0.0888.18
Twice hand weeding four+six week after of crop emergence	3979	3581.1	50135.4	5259.8	44875	0.1176.32
Once hand weeding after six week of crop emergence	2931	2647.9	37070.6	3138	33932	0.092 7.32
weed free	4788	4309.2	60328.8	15732	44596	0.3521.9
Weedy check	1299	1169.1	16367.4	652.5	15714	0.041 0

Conclusion

Ineffective weed management is considered as the main factor for low yield of wheat resulting in yield loss of up to 72.87% when there is uninterrupted weed growth. The analysis of variance revealed that weed management showed significance difference on total above ground biomass yield with the greatest biomass yield of 11993kg ha-1 recorded at the treatment of weed free and the lowest of 5425kg ha-1 was recorded from the treatment of weedy plots. Grain yield was significantly differed due to weed management method where the highestgrain yield of 4788kg ha-1 was recorded from the weed free treatment and the lowest of 1299kg ha-1 was recorded from the treatment of weedy plots.

The highest HI of 42.39% obtained at weed free treatments and the lowest HI of 25.27% at weedy plots. Among the weed management method the highest total production cost of 15732 ha-1 birr at weed free treatment and the lowest of 652 .5 birr ha-1 at weedy plots.

The current investigation clearly showed that among the weed management method of highest economic return of 51617.95birr ha-1 obtained at 2, 4-D EE¼ ha-1+1/4 lha-1pallas treatment and next higher economic return of 46923.6 birr ha-1 obtained from 2, 4-D ½EE lha-1+1/4lha-1 pallas. Weed management method had significant value to increase yield attribute of wheat in relative to the control. Among the treatments 2, 4-D EE¼ ha-1+1/4 lha-1pallas could be the best option for weed management for wheat production in study area. None of herbicides combination at lower rate showed phyto-toxicity symptoms on crop. From this result it could be concluded that 2, 4-D EE¼ ha-1+1/4 lha-1pallas has better herbicide efficacy. However, as the experiment was done in one season for one location, repeating similar study over season and across location need to be done to come up with conclusive recommendation.

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