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Assessment of Systemic Post Emergence Herbicides Against Broadleaf Weeds in Wheat

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Abstract: Wheat is the major food crops of the global importance. However, its production and yield was inadequate due to several living and nonliving aspects. The objective of this trial was to explore the influence of herbicides utilization on weed control and productiveness of wheat. Treatments consisted of three post emergence broadleaf herbicides; Broadleaf K 42 ME 1 L/ha, Agro 2,4-D 720 g/L @ 1 lt ha^{-1}, Pallas 45 OD @ 0.5 lt ha^{-1} beside with weed free and control which were arranged in RCBD having three replications. The experimental fields were troubled with eight weed species in which six species were annual broadleaf weeds and two species were annual grasses. The tallest plants were recorded from weedy check plots while the shortest plants were recorded at Agro 2, 4-D amine salt 720g/l at both locations. Results also showed all traits were significantly influenced by treatment of various herbicides. There is no weed dry weight were earned from the treatment of weed free and also the higher weed control efficiency were recorded from application of weed free and Broadleaf K 42 ME while no weed control at weedy check. Maximum stand count and thousand grain weight recorded from application Pallas 45 OD while lowest values were obtained at weedy check. The maximum numbers of tillers per plant, spike length, seeds per spike and grain yield were gained from application of Broadleaf K 42 ME. Furthermore, maximum 1000 grain weight was recorded from weed free while their lowest values were observed from the weedy check. Hence, it could be summarized that application of Broadleaf K 42 ME 1L/ha reduced weed dry weight and gave maximum yield and yield components; which can be recommended for the test environments.

Keywords: Achieved, Attained, Broadleaf, Minimum, Weed

1. Introduction

Wheat is a significant food grain produce and is attaining acceptance all all over the globe and particularly in Ethiopia. In spite of growth in population and nutrient values, greater produce of wheat may perform a dynamic part in alleviating the nutrient prices [1]. Though wheat has a unlimited dietary and economic values, its output was inadequate due to innumerable crop development issues. Among the living components, weeds are the major restraints in wheat yield as they decrease yield due to antagonism, allelopathy and habitations for pathogens as well as helping as alternative congregation for numerous insects, fungi and rise harvest price [2].

Hand picking is among the extensively practiced of weed control methods at Ethiopia however; it is laborious, less effective and costly. Though chemical method is being discouraged worldwide, its immediate effect and economic return cannot be ignored totally by the farmers of countries like Ethiopia especially in small cereals where hand weeding is difficult and laborious [3].

The weed management techniques used long time ago are strenuous, tedious and luxurious because of aggregate price of employment, draft animals and farm equipment. Today, the utilization of of herbicide weed control condition has become well known around the globe and in Ethiopia primarily due to shortage or luxurious employment throughout main planting season and comparatively the greater weeding price [4]. Nevertheless, the optimal use of suitable herbicide, appropriate period of treatment and accurate dosage is an imperative deliberation for profitable incomes [5].

In Ethiopia, weeds are more challenging in the time of main season when rainfall is higher. Weeds dominated rapidly in pitches and can affect in entire crop loss if left untreated. Ecological weed management really needs combination of traditional practices that includes the herbicides treatment. Nevertheless, due to diverse propagation time of the weeds, herbicides with better efficiency must be prepared for the growers to reduce the consequential yield loss caused by the weeds. Additionally, recurrent usage of the similar mixture of herbicides can affect in a shift in weed flora and progress of resistance. Alternation of herbicides with a dissimilar mode of action avoids the difficulty of weed resistance and progresses weed management. Hence, the aim of this investigation was to assess the influence of broad leaf herbicides application on weed management and productivity of wheat.

2. Materials and Methods

2.1. Experimental Area Description

Field experimentation was done at the period of 2020 main season under rain fed system at Holeta and Robgebeya. Holeta is situated 33km west of Addis Ababa at an altitude of 2400 meter above sea level and inside the geographical location of 9° 00′N and 38° 30′E. The area get yearly rain fall of 1144 mm with average minimal and maximal temperatures of 6°C and 22°C consecutively (EIAR, 2018). The soil factor of the research field is clay loam with pH of 6.65, organic carbon (2.26%), available Phosphorus (14.17 mg kg^{-1}), total nitrogen (0.12%) and CEC (17 Cmol kg^{-1}) (EIAR, 2018). The edaphic and climatic conditions observed during trial time were conducive for the excessive growth many weed species that challenged the crop plants. The climatic conditions determined during the trial period mean rain fall of 1114.5 mm relative humidity 78.8% with mean lowest and highest temperatures of 8°C and 25.2°C respectively. Robgebeya is also located 20 km from Holeta Agricultural Research Center which receives similar agro ecology with that of Holeta.

2.2. Treatments Component

Treatments were included four kinds herbicides Broad leaf k 42 ME 1L/ha, Agro 2,4-D amine 720g/L 1L/ha, Pallas 45 OD 0.5 L/ha, weed free and control. The trial was arranged in a Randomized Complete Block Design with three replications.

2.3. Experimental Techniques and Crop Management

The trial sites were tilled twice with tractor to make seed bed conducive for sowing. Gross plot sizes of 5 m x 3 m (15 m^2) were used as the trial unit contained 15 rows of each 5 m long wheat variety, *Dendea* was used as a experimental crop. Seeds were drill sown in rows at 20 cm spaced between rows on July 5, 2020. The investigation area were nourished with the suggested rate of 55 kg ha^{-1} of N and 182 kg ha^{-1} of P_2O_5 that were added in the kind of Urea (46% N) and DAP (18% N, 46% P_2O_5), correspondingly. Nitrogen fertilizer was added at two quantities (split application) i. e 2/3 of it was added at time of planting by combining with all dose of Nitrogen and the remaining 1/3 was added at tillering stage. Herbicides were applied as post emergence stage (30 DAE) with the help of knapsack sprayer nozzle size of 350 um while the volume of water was 200 L/ha^{-1} pressurized at 40 psi. All other management practices were consistently added to all plots as per the suggested practices.

2.4. Data Collection

The aboveground dry weeds gathered from each quadrant positioned into paper bags independently then oven dried at temperature of 65°C for 48 hours and successively the dry weights were weighed. Weed control efficiency (WCE) was calculated by the formula:

$$\mathrm{WCE}(\%) = \frac{\mathrm{WDC}-\mathrm{DWP}}{\mathrm{WDC}} \mathrm{X}100$$

where, WCE=Weed Control Efficiency, WDC=Weed Dry weight in Control Plot and DWP = Weed Dry weight in Particular treatment [6].

Plant height was measured with a meter from 4 arbitrarily selected plants in each net plot area from the plant base to the tip of the spike devoid of awns at physiological ripeness and the mean was used for the examination. Spike length was taken with a ruler from 4 randomly selected and pre-tagged plants in each net plot area from the base of the spike to the tip of the spike excluding of awns at physiological ripeness and the average was used for the examination.

Stand count was done by counting total number of plants in quadrat and calculated on m^2 area basis. Number of fertile tillers were counted from five rows with the length of 1 m randomly taken in each net plot area and was converted into m^2 at harvest. Number of seeds per spike was determined from randomly taken 4 spikes per plot. Thousand grain weights were counted from the bulk of threshed produce from the net plot area and their weight recorded. Grain yield was measured after threshing the sun dried plants harvested from each net plot and the yield was adjusted at 12.5% grain moisture content.

2.5. Statistical Analysis

The average of each characters were done by the normality test subjected to Shapiro test (Pr < W) previously examination of variance by the GLM technique of SAS (SAS 9.3 version). When the treatment effects were significant, means were matched using Fisher's LSD test at 5% level of significance [7].

3. Results and Discussion

3.1. Weed Flora

The research fields were infested with diverse weed species which were categorized to five main families. From recognized weed species, six species were annual broad leaf weeds but only two species were annual grasses which exhibited that the fields were subjected by annual broadleaf weeds (Table 1).

Table 1. *Weed species and families at Holeta and Robgebeya.*

Weed species	Families
Polygonum nepalense L.	Polygonaceae
Galinsoga pulviflora Cav.	Compositae
Guizotia scabra (Viz)chiov	Compositae
Spergula arvensis L.	Caryophylaceae
Cotula australis (Sieber ex spreng.) Hook.f.APNI	Asteraceae
Anagalis arvensis L.	Caryophylaceae
Phalaris paradoxa L.	Poaceae
Setaria pumila L.	Poaceae

3.2. Dry Weed Biomass

Dry weed biomass was significantly influenced by treatment of broadleaf herbicides (Table 2). Minimum weed dry was achieved at weed free while the maximum weight (2251.67 kg/ha) and (2235 kg/ha) were recorded respectively at Holeta and Robgebeya locations from weedy check plots. Application of Broad leaf K 42 ME was also showed lowest weed dry weight. The minimum weed dry weight at weed free signified that compete removal of weeds throughout crop growth stages and ability of herbicides acting on various weed species consequently resulted in lower dry weed biomass. This finding was analogous with [8] who stated that the lowest weed dry weight in herbicide treatment might be the action of herbicides that decreased weed density by killing both broadleaf and narrow leaf weeds and inhibit the growth of those that stay on field. This finding was similarly with who summarized that maximum weed density in control can be contributed to unchecked growth, while treatment of herbicide caused death of weed consequently in decreased weed density at harvest [9, 10].

3.3. Weed Control Efficiency

Weed control efficiency was significantly affected by treatments of various broadleaf herbicides (Table 2). The highest weed control efficiency (100%) was achieved from application of weed free next Broad leaf K 42 ME (99.93%) at Holeta but no weed control efficiency at control at both experimental fields. Maximum weed control efficiency at plots treated with Broadleaf K 42 ME due to ability of broad spectrum herbicides acting on various weed species resulted in mortality of weeds that could produce low dry weight of weeds. This observation analogous with [11] who suggested that herbicides with broad spectrum give better weed control efficiency than control plots. Maximum control efficiency revealed that the weed were managed when they are immature or earlier they increased much dry substance by competitive with the crop plants [12].

Table 2. *Weed dry weight and weed control efficiency as affected by herbicides application in wheat at Holeta and Robgebeya.*

Treatments	weed dry weight (kg/ha)		Weed control Efficiency (%)	
	Holeta	Robgebeya	Holeta	Robgebeya
Broad leaf K 42 ME	151.67d	106.67c	99.93a	95.22b
Agro 2,4 -D amine salt 720g/l	166.67cd	152.00bc	99.92ab	93.19c
Pallas 45OD	185.00bc	155.00b	99.90b	93.06c
Weed free	0.00 e	0.00d	100.00a	100.00a
Weedy check	2251.67a	2235.00a	0.00c	0.00d
LSD (5%)	18.75	47.10	0.02	1.59
CV (%)	1.69	4.72	0.01	1.11

3.4. Plant Height

Plant height was significantly affected by broad leaf herbicides (Table 3). The tallest plant height was registered at untreated plots whereas the shortest plant height was recorded from application of Agro 2, 4-D amine salt 720g/l. Further, statistically no significant difference was achieved due to treatment of Broadleaf K 42 ME, Pallas 45 OD and weed free. The tallest plants at control plots probably crop weed contention in search of light. On other hand, plant height was more influenced by genetic than herbicides treatment. Plant height is a generic attribute more subjected by the genetic constitution than by the environment. Nevertheless, interrelated factors to certain degree expressively altered plant height [8].

3.5. Stand Count

Crop stand count was significantly affected by broadleaf herbicides (Table 3). The maximum stand count at both locations (528.67 m^2) was observed from application of Pallas 45 OD but the minimum number 154.67 m^2 and 140.67 m^2 were recorded from weedy check plots at Holeta and Robgebeya respectively. Application of Broad leaf K 42 ME and Pallas 456 OD showed no significant difference at both locations. Correspondingly, there is non-significant differences were observed between of Agro 2, 4-D amine and weed free at Holeta. The maximum stand count due to application of Pallas 45 OD and Broad leaf K 42 ME implied that better weed control that enable the plants to produce more number of tillers but the minimum number of stand count at weedy check probably due to severe competitions of weeds that resulted limited access to photo assimilates. Under low competition between weeds and crop for resources that increased fertile tillers which bring enhanced in stand count [13].

Table 3. *Plant height and stand count as affected by herbicides in wheat at Holeta and Robgebeya.*

Treatments	Pant height (cm)		Stand count (m^2)	
	Holeta	Robgebeya	Holeta	Robgebeya
Broad leaf K 42 ME	102.33ab	102.33bc	434.33a	434.33a
Agro 2,4 -D 720g/l	86.33b	97.33c	317.33b	317.33b
Pallas 45 OD	108.33ab	105.33b	528.67a	528.67a
Weed free	108.92ab	107.58ab	528.00b	534.00a
Weedy check	123.50a	113.33a	154.67c	140.67c
LSD (5%)	30.00	7.50	107.18	108.53
CV (%)	15.05	3.79	14.50	14.74

3.6. Fertile Tillers Per Plant

Fertile tiller was significantly affected by broadleaf herbicides (Table 4). The maximum number of tillers (8.16) was recorded from application of Broadleaf K 42 ME while the minimum number (4.00) was attained from weedy check plots. There is non-significant differences were achieved between Pallas 45 OD and weed free. The maximum fertile tillers from application of Broadleaf K 42 ME indicated that better weed control that helps the plants to use more growth resources but the minimum number of tillers at control might be scarcity of growth resources. The number of tillers was essential quality of variety which was largely affected by nutrients, water and environmental stress [14].

Table 4. *Tillers and spike length as affected by herbicides at Holeta and Robgebeya.*

Treatments	Tillers/plant		Spike length (cm)	
	Holeta	Robgebeya	Holeta	Robgebeya
Broad leaf K 42 ME	8.33a	8.33a	10.67a	10.67a
Agro 2,4 -D 720g/l	6.00c	6.00b	8.08b	8.08b
Pallas 45 OD	8.00ab	8.00a	8.16b	8.17b
Weed free	7.83b	7.83a	8.00b	8.00b
Weedy check	4.00d	4.33c	4.16c	5.00c
LSD (5%)	0.47	0.73	2.12	2.02
CV (%)	3.65	5.61	1.96	13.48

3.7. Spike Length

Spike length was significantly influenced by herbicides treatment (Table 4). Longest spike length (10.67 cm) was attained from plots treated with of Broadleaf K 42 ME at both locations whereas the shortest spike length (4.00 cm) at Holeta and (4.33 cm) at Robgebeya were achieved from weedy control plots. There is non-significant differences were observed due to applications of all other weed control treatments. The longest spike length from application of Broadleaf K 42 ME indicated that improved weed control that helps the plants to use more growth resources that assist plant to make longer spike but the minimum spike length at weedy check probably due to severe competitions of weeds. The 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 [15].

3.8. Seeds Per Spike

Seeds per spike were significantly influenced by herbicides treatment (Table 5). The maximum seeds per spike (37.66) at Holeta and (39.00) at Robgebeya were received from application of Broad leaf K 42 ME. Likewise, there is statistically non-significant differences were achieved due to application of all weed control treatments except for control plots at all locations. The maximum number of seeds per spike obtained from application Broad leaf K 42 ME at all tested locations implied that better weed management that helps the plants to use more growth resources while the minimum seeds per spike at weedy check might be too intense competitions of weeds. The higher number of grains / spike in 30 cm a part single-row sowing with chemical weed control was probably due to enhanced plant height which led to longer spikes and a larger number of grains [14].

3.9. Thousand Grain Weight

Thousand grain weights were significantly influenced by treatment of various broadleaf herbicides (Table 5). The maximum thousand grain weight (46.80 g) was achieved from treatment of weed free in all tested sites whereas the minimum number (24.28 g) at Holeta and (32.00 g) at Robgebeya were attained from control plots. There is no statistically significant differences were achieved between treatments of Broadleaf K 42 ME, Pallas 45 OD and weed free. Likewise, there is no statistically significant variation was observed due to application of Agro 2, 4-D amine 720g/l and weed free at Robgebeya. The maximum thousand grain weight from application of weed free implied that good weed management which assists the plants to drive nutrients but the minimum thousand grain weight at weedy check probably due to severe competitions of weeds. The lower thousand grain weight in weedy check and availability of nutrients and better plant growth might be the reason for heavier grains in high fertilizer levels [16].

Table 5. *Seeds per spike, thousand grain weights and grain yield as affected by herbicides at Holeta and Robgebeya.*

Treatments	**Seeds / spike**		**1000 grain weights (g)**		**Grain yield (kg/ha)**	
	Holeta	**Robgebeya**	**Holeta**	**Robgebeya**	**Holeta**	**Robgebeya**
Broad leaf K 42 ME	37.66 a	39.00a	44.53a	46.00a	4600.00a	4603.30a
Agro 2,4 -D 720g/l	32.33b	32.33b	36.93b	37.33b	2180.40c	2180.40c
Pallas 45 OD	32.33 b	32.33b	46.20a	46.20a	3359.70b	3359.70b
Weed free	34.5ab	34.50b	46.80a	48.80a	3816.70ab	3362.00b
Weedy check	20.66c	20.66c	24.28c	32.00b	140.00c	194.00d
LSD (5%)	3.53	2.93	5.60	5.33	957.56	957.28
CV (%)	5.96	4.91	7.48	6.79	18.03	17.90

3.10. Grain Yield

Grain yield was significantly influenced by treatment of broadleaf herbicides (Table 5). The maximum grain yield 4600.00 kg/ha and 4603.30 kg/ha was achieved from treatment of Broadleaf K 42 ME at Holeta and Robgebeya respectively. However, the minimum number 140.00 kg/ha at Holeta and 194 kg/ha at Robgebeya were recorded from control plots. There is no statistically significant differences were achieved between treatment Pallas 45 OD and weed free plots at all experimental sites. Nevertheless, application of Agro 2, 4-D 720 g/l at both locations produced similar results. The maximum Grain yield from application of Broadleaf K 42 ME might be superior weed management that allows the plants to use additional nutrients in order to create improved grain yield but the minimum grain yield at weedy check probably due to severe competitions of weeds. Low grain yield could be related to high infestation of weeds and lower amount of absorption of output by this treatment consequently produced in lower accessibility of resources and yield [17].

4. Conclusion

Wheat is one of the main food grains of the world. However, production and grain yield was decreased various weeds. Broad spectrum herbicides nowadays have been becoming advantageous over narrow spectrum herbicides for better weed management in the same way attaining higher yield. Thus, this experiment was planned to explore the effects of broadleaf herbicides utilization for weed control and productivity of wheat.

All of the traits studied under this experiment were influenced by herbicides treatments. Result revealed that application weed free caused better performance on weed dry weight and weed control efficiency while there is no weed control at control plots conversely the maximum numbers of dry weed weight were obtained from weedy checks. The maximum number of stand count and 1000 grain weight were obtained from application of weed free whereas the tallest plant height was determined at control plots. Furthermore, application of Broadleaf K ME yielded better of tillers, spike lengths, seeds/spike and grain yield but maximum thousand grain weight was obtained from application of weed free while minimum numbers were recorded at weedy check. In general, use of broad spectrum herbicides more effective as compared to narrow spectrum herbicides for effective weed management and obtaining maximum yield. Therefore, Broadleaf K 42 ME 1L/ha is recommended for the management of numerous broadleaf weeds in wheat field.

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