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Integration of Seed Rate with Herbicide Application Time for the Management of Weed Dynamics and Increment of Bread Wheat (*Triticum aestivum* L.) Yield at South Eastern Part of Ethiopia

Ashenafi Mitiku* and Dawit Dalga

Madawalabu University; School of agriculture; Department of Plant Science
P. Box 247, Bale Robe, Ethiopia

*Corresponding author e-mail: asnfmtk.mitiku@gmail.com

A B S T R A C T

Filed experiment was conducted in south eastern part of Ethiopia at Madawalabu University and Shallo with the objective of to investigate the application of topic in a different time with different seed rate of bread wheat on weed density and yield of bread wheat. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and five treatments. The experiment was conducted by a Dendea variety of bread wheat with the following treatments application of topical 15day with 120kgha^{-1},30day with 130kgha^{-1}, 45day with 140kgha^{-1}, 60 days with 150kgha^{-1} and 100kgha^{-1} seed rate of bread wheat as a control. Statistical analysis showed that the integration of different time of topic application with different seeding rate of bread wheat had a significant ($P<0.001$) effect on weed density and yield of wheat. Maximum number of tillers (9.67 and 7/plants), grain per spike (64 and 57), spike length (10cm and 7cm) and plant height (91.5cm and 65.2cm), 1000g grain weight (56.67g and 49g) and grain yield (4104.5kg/ha and 3462.7kg/ha), the highest weed controlling efficacy 57.3% and 27% were recorded in application of topic at 30 days with 130kgha^{-1} of bread wheat at Shallo and Madawalabu University respectively. As compared to 60day with 150kgha^{-1} and control integration of topic 15day with 120 kgha^{-1} and 45day with 140kgha^{-1} seed rate was effective to increase yield of bread wheat. Therefore, application of topic at 30 days with 130kgha^{-1} of seed rate was recommended for the control of weeds and to increase yield of bread wheat.

Keywords: Weed density, Yield, Time of herbicide application.

INTRODUCTION

In Ethiopian economy, agriculture plays great role in the total production of about 11.8 million hectares of land are covered by grain crops and 203.5 million quintals are harvested each year. Cereals are the major food crops in terms of both area coverage and volume of production as staple crops[1]. Currently, the crop production worldwide is facing a number of challenges. These include environmental constraints, pest infestation, loss of genetic diversity, and global climate change. However, the loss by pests (diseases, insect pest and weed) infestation is higher. The crop losses due to disease, weeds and insect pests in five economically important crops, i.e. wheat, rice, maize, potatoes and cotton[2]. Biotic agents collectively caused approximately 28–40% harvest loss in these economically important crops[2]. The highest crop losses were shown in potatoes (40%) followed by rice (38%), maize (30%), wheat (28%) and cotton (28%). Among the pests, the highest contribution towards crop losses was by diseases, followed by insect pests and the least was due to weed competition[3].

Bale District is one of the most productive areas of bread wheat in Ethiopia[4]. In this location wheat is produced as extensive farming system. This extensive farming technique generates very high income for Farmers and private sectors. But both farmers and private sectors were cultivating wheat as monocropping practice. This practice facilitates building up of pest such as cereal rust (like stem, stripe and leaf rusts), weeds like *Avena* spp., Brome grass (*Bromus pectinatus)*, *lolium temulentum* and Aphid insect pest are the major pest and most destructive pest at Farmers and private sector field. Among the pest infestation of grassy weeds and Rust disease is the major pest and challenging the production of wheat at Bale district.

Weeds are the most omnipresent class of pests that interfere with crop plants through competition and allelopathy, resulting in direct loss of quantity and quality of the product[5]. In Ethiopia grain yield reductions were 26 to 63% across four bread wheat cultivars at 90 weed seedlings m^{-2} [6]. Weeds problem is getting from bad to worse in wheat sown under irrigated areas, cropping intensity is rapidly increasing as a result the weed control with traditional method as Dab (suicidal germination) and hand weeding has become impossible. Weeds can be controlled by manual hoeing, which is laborious, time consuming, energy intensive and only possible on a small scale. Mechanical means are economical but it controls only inter row weeds, not intra row weeds. In such situations, herbicides offer most ideal, practical, effective and economical means of reducing early weed competition and crop production losses. So, chemical method for controlling weeds is most effective, efficient, up-to-date and time saving[7].

Chemical and hand weeding have often been used as a weed control in wheat. Integration of herbicides and hand weeding decreased dry weight of weeds significantly compared to dry weight in non treated plots[8]. Chemical weed control in wheat was best in producing a higher grain yield than hand weeding. Application of grassy and broad leaf herbicides increased grain yield and yield components[9]. Herbicides are generally effective; wild oat is widely spreading and continues to reduce yields. Herbicide choice and timing are critical for wild oat control in many fields. Quality losses, due to contamination of cereal samples of wild oats, can be substantial, resulting in rejection for seed and milling[10]. The topic is one of the products of choice on all varieties of durum and bread wheat for wild oat control and may be applied up to

flag leaf stage. There is considerable scope for reducing rates of wild oat herbicides when applied at the early stages[11]. In the Bale Zone, farmers and private sectors were managing the weed in different weed management tactics among cultural, shifting cultivation and chemical weed managements were the major types of weed management. Among the management, chemical application was one alternative weed management at this district, but miss use of herbicide application time with seeding rate was challenging for the management of weeds for both farmers and private sectors. Therefore, this experiment was conducted with the objectives of: - To determine the effective time of Topic herbicide application with different seed rate of wheat for the management of weeds and to increase bread wheat yield.

MATERIALS AND METHODS

The studies were conducted on the south eastern part of Ethiopia in Madawalabu university experimental site and Shallo farmers training center during the main cropping season of 2012. The experiments were conducted using Randomized Complete Block Design (RCBD) with three replications. Reduce the inter plot effect each plot and blocks were spaced 0.5 and 1 m apart, respectively. Dendea variety of Bread wheat was used with intra row spacing of 20 cm. The experiment was conducted with the following treatment. Application of topic at 15days with 120kgha^{-1}, 30day with 130 kgha^{-1}, 45day with 140 kgha^{-1}, 60day with 150 kgha^{-1} and 100 kgha^{-1} of bread wheat as a control. During the experiment topic was applied after wheat emergence at the rate of 1kg/ha. All the package of practices as recommended rate was followed to raise the crop. To spray the herbicides successfully all the precautionary measures were adopted so as to avoid any danger of misuse of the herbicides.

Data collection

Data were collected within a week interval of the inner four rows on the following parameters, weed density m^{-2} 25 days after herbicide application, Fresh weed bio-mass before harvesting (kg ha^{-1}), Number of tillers per plant, Spike length (cm), Plant height at maturity (cm), 1000 grain weight (g) and grain yield kg ha^{-1}. The weed control efficiency (WCE) was calculated by using formula Suggested[12].

$$WCE = \frac{NWC - NWT}{NWC} * 100\%$$

Where:
NWC = Number of Weeds m^{-2} from Control plots (weedy check).
NW T = Number Weeds m-^{2} in plots Treated with herbicides.
WCE = Weed Control Efficiency.

Statistical analysis

The collected dates were subjected to the analysis of variance with SAS computer software version 9.3.1[13]. The mean was compared with the least significance difference (LSD) at the 5 % probability level.

RESULT AND DISCUSSION

During the experiment were conducted the following weed types were determined *Amarnthus* spp., *Plantago lanceolata, Galinsoga parviflora*, *Guizotia scabra*, *Datura stramonium, Argemone Mexican*, *Cyperus* spp., *Avena* spp., *Brumus pectinatus, lolium temulentum*, *Phalaris paradoxa*, are the types of weed at the site. Among the listed weed the grassy weed species are the major weeds specially *Avena* spp. and *Brumus pectinatus* are the dominant weeds in both location.

Weed density in m^{-2}

Weed density was significantly affected by the integration of topics with different seeding rate of bread wheat

($p<0.001$). The smallest weed density was recorded at application of topic at 30day with 130kgha^{-1} of wheat with the mean of 28m^{2} and 32.33m^{-2} at Madawalabu University and Shallo respectively. Maximum weed density was recorded in the control. In both locations application of Topic in 45 days with 140kg ha^{-1} and 60days of application with 150kg ha^{-1} of wheat seed rate was no significant effect for the management of weed (Table 1&2). The highest weed controlling efficacy was obtained by application of Topic at 30 days with 130 kg ha^{-1} of wheat seed rate with maximum weed controlling efficacy 57.3% and 27% at Madawalabu University and Shallo district respectively. The result was in line with[10] who reported the highest wild oat (*Avena fatua* L.) control efficacy (94.04%) was obtained in the application of the topic 32 days of 1 lit ha^{-1} herbicide application at the same time they are reported application of topical at14 days after wheat emergence was slightly lower than when the crop was in the tillering stage. Seeding rate improves weed control in an integrated weed management system[14].

Number of tillers

Integration of Topic in a different time with different seeding rate of bread wheat was a significant ($p<0.01$) effect on tiller number of wheat. The maximum effective tiller number was counted at application of topic at 30 days with 130kg ha^{-1} bread of wheat, which is 10.3 and 10 tiller number at Shallo and Madawalabu University respectively. In both location application of the topic in 15 days with 120kg ha^{-1} and 45 days with 140kg ha^{-1} bread wheat were no signs to be increased effective number of tillers. This is due to regermination of weed form there seed bank and development of resistance for herbicide. While the minimum tiller number was recorded at application of topic at 60 days with 150kg ha^{-1} seed rate of bread wheat and control (Table 1&2). This is due to competition between weeds and wheat. The result was in agreement with the work of[15,16] reported that weed competition in wheat reduces yield through decreases in spike numbers. Application of Lintur 70 WG @ 375 g/ha at two leave stage produced the highest spike/m^{2}[17].

Fresh weed biomass (kg ha-1) before harvesting

Application of Topic in a different time with different seeding rate was significant ($p<0.05$) effective on fresh weed biomass. Maximum fresh weed biomass (5013 and 4515 kg ha-1) was recorded in the weedy check followed by 60 day application with the 150kg ha-1 seed rate of bread wheat while minimum fresh weed biomass (1938 and 1898 kg ha-1) was recorded 30 day application with 130kg ha-1 treated plots at Madawalabu university and shallo respectively (Table 1&2). The result was in agreement with the work of[18] they are reported integration of seed rates with herbicides was a significant effect on fresh weed biomass of weed. The same results were reported by[19] they reported that application of herbicides decreased the fresh weed biomass as compared to weedy check. The dry matter weight of weeds by application of Lintur @ 375 g/ha as compared to dry matter wt. of before spray (45 DAS) and control[17].

Plant height

Integration of topics at different time with different seed rate had a significant ($p<0.001$) effect on plant height. The highest plant height was recorded at application of Topic at 30 days with 130kgha^{-1} and 15 days with 120kgha^{-1} which is 91.5m and 74.7m at Shallo and Madawalabu University respectively. The non significant result was recorded at application of topic at 15 days with 120kgha^{-1} and 45 days with 140kgha^{-1}. At the same time application of topic at 30 days with 130kgha^{-1} and application of topical

at15 day with 120kgha^{-1} of seed rate of wheat. The smallest plant height was recorded at the control and application of topic 60 days with 150kg ha^{-1} (Table 1&2). This is the result of competition. The result was in agreement with the work[10] who reported that significant differences was observed in grain yield, plant height, spike per unit and biomass with respect to herbicide application time.

Spike length

Statistical analysis shows that integration of topics at different time with different seeding rate of bread wheat was a sign ($p<0.001$) effect for spike length of bread wheat. The highest spike length was recorded at application of Topic at 30days with 130kgha-1 seeding rate of bread wheat, which is 8cm & 10cm at Madawalabu University and Shallo respectively, followed by application of topic at 15 days with 120kgha-1 seeding rate of bread wheat. Application of topic at 45 day and 60 day was not significant for the increment of spike length of wheat. In both locations smallest spike lengths was recorded in the control and at 60 day application with the rate of 150kgha-1 of bread wheat (Table 1&2).

Grains per spike

Application of herbicide in a different time with different seeding rate had a significant ($p<0.01$) value of grains per spike of bread wheat. Maximum numbers of grains per spike were counted at application of topic 30 days with 130kg ha-1 seeding rate of wheat, which is the mean of 54.67 & 64.45 at Madawalabu University and Shallo respectively, followed by application of the topic in 15 days with 120kg ha-1 seed rate of wheat. Minimum number of grains per spike was counted at the control which is 25.3 & 38.3 at Madawalabu University and Shallo respectively. Application of topic at 45day, 60 day and control plots was no significant on number of grains per spike of bread wheat (Table 1 & 2). Similar finding was reported by[20] reported that, in barley, competition in the higher seeding densities reduce yield through a decrease in the number of grains per spike.

1000g grain weight

The statistical analysis result shows that grain weight had significantly ($p<0.01$) affected by integration of application of topic with different seeding rate of Bread wheat. Maximum 1000g grain weight was recorded at application of topic at 30day with 130kg ha-1 seed rate of bread wheat, which is 49g & 72.33g at Madawalabu University and shallo respectively. While minimum1000g grain weight was recorded on the control and application of topic at 60 days with 150kgha-1 of bread wheat at Madawalabu University and shallo respectively. Application of the topic in 15 days and 45day were no significant on 1000g grain weigh of bread wheat (Table 1&2). The result was in line to the work of[10] who reported that application of herbicide in the early seedling stage (14 days after emergence) was highly influenced durum wheat yield and important yield related traits. Grain yield reduced up to 26 to 63% across four bread wheat cultivars at 90 weed seedlings m-2 in Ethiopia[6].

Grain yield kg ha^{-1}

The statistical analysis shows that the integration of different topic application time with different seeding rate was a significant ($p<0.05$) effect on grain yield of bread wheat. In both location maximum grain yield was harvested at application of topic at 30 days with 130kg ha-1 seed rate of bread wheat, which is 3462.7kgha -1 and 4104.3 kgha-1 at Madawalabu university and shallo respectively, followed by 15 days of topical application with 120kgha-1seed rate of bread wheat and 45 days with 140kgha-1. Minimum grain yield was harvested at the control (100kgha-1) and application of Topic at 60

days with 150kgha-1 (Table 1 and 2). The result was in line with the work of[10] reported Maximum durum wheat yield (3870.73 kg/ha) was obtained when Topic was applied at the recommended rate followed by 50 and 25% of the recommended rate reducing durum wheat yield only by about 1.6 and 2% respectively. The result was in line to[18] Different herbicidal treatments had a significant effect on grain yield of wheat. The greatest reduction of yield was occurred when no herbicide was applied[10].

SUMMARY

General application of Topic in a different time with different seeding rate of wheat was a significant effect on bread wheat yield. As compared to the other treatment application of topic at 30 days with 130kg ha^{-1} is effective in the management of weeds and the increment of bread wheat yield followed by application of Topic at 15 days with 120kg ha^{-1}. Application of Topic at 45day with 120kgha^{-1} and 60 days with 150kg ha^{-1} seeding rate of bread wheat was not effective for the management of the weeds and for the increase of bread wheat yield. Therefore, application of topic at 30 days with 130kg ha^{-1} seeding rate of bread wheat was recommended for the increment of bread wheat and the management of weed.

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Table 1. Effect of topic application time with different rate of wheat on number of tiller, weed density, fresh weed biomass, spike length, grain per spike, 1000g grain weight and grain weight at Madawalabu university experimental site

Treatment	Number of tiller	Weed Density m^{-2}	Fresh weed Biomass (Kg/ha)	Plant Height (cm)	Spike Length (cm)	Grain/ spike	1000g Grain weight	Grain weight Kg/ha
15x120kg	6.67^{b}	58.3^{c}	2948^{c}	71^{ab}	6.87^{b}	53^{b}	41.67^{b}	2454.3^{ab}
30x130kg	10^{a}	28^{d}	1938^{d}	74.7^{a}	8^{a}	64.65^{a}	49^{a}	3462.7^{a}
45x140kg	$6b^{c}$	57.3^{b}	2838^{c}	61.3^{cb}	6^{bc}	42^{c}	38.67^{bc}	2617^{b}
60x150kg	4.3^{c}	59.3^{b}	4728^{b}	49.3^{c}	4.85^{dc}	34.3^{d}	34.67^{c}	2167^{b}
100kg only	2^{d}	65.67^{a}	5013^{a}	35.67^{d}	4.67^{d}	32.67^{d}	25.3^{c}	2000.3^{b}
LSD	1.79	5.27	509.5	12.97	1.35	6.86	6.94	612.25

Means with the same letter are not significantly different

Table 2. Effect of Topic application time with different seed rate of bread wheat on number of tiller, weed density, fresh weed biomass, spike length, grain per spike, 1000g grain weight and grain yield at Shallo

Treatment	Number of tiller	Weed density m^{-2}	Fresh weed biomass (Kg/ha)	Plant height (cm)	spike length (cm)	Grain/ spike	1000g Grain weight	Grain weight Kg/ha
15x120kg	7.67^{b}	38^{b}	2820^{c}	80.67^{ab}	8^{b}	51^{b}	53^{b}	2388^{c}
30x130kg	10.3^{a}	32.33^{c}	1898^{d}	91.5^{a}	10^{a}	54.67^{a}	72.3^{a}	4104.5^{a}
45x140kg	6^{cb}	37.33^{b}	3500^{b}	71.67^{b}	7.16^{c}	41.3^{c}	45.67^{bc}	3312.7^{b}
60x150kg	5^{cd}	42.67^{a}	3890^{b}	52^{c}	7^{c}	38.67^{C}	39^{cd}	2437.7^{c}
100kg only	4^{d}	44.33^{a}	4515^{a}	58.3^{c}	4.03^{d}	35.3^{c}	37.67^{d}	2154.33^{d}
LSD	2.28	4.88	490.5	12.6	1.38	9.07	12.98	684.6

Means with the same letter are not significantly different