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EFFECT OF CULTIVATION FREQUENCY ON GROWTH, YIELD AND YIELD COMPONENTS OF BREAD WHEAT (*Triticum Aestivum (L.)* AT SELMAMER, SOUTHERN ETHIOPIA

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A field experiment was carried out at Selmamer during the 2014 cropping season to determine the effects of cultivation frequency on growth, yield and yield components of bread wheat (*Triticum aestivum L.*). The treatments used in the study were seven cultivation frequencies (30 DAE, 45 DAE, 60 DAE, 30 and 45 DAE, 30 and 60 DAE, 45 and 60 DAE, 30, 45 and 60 DAE) and one control or no cultivation. The experimental design was a randomized complete block design (RCBD) with four replications. Phenological and growth parameters such as yield and yield components, total biomass and harvest index were studied. The result depicted that frequency of cultivation had brought no significant effect on the studied phenological parameters. The result also showed that all the studied growth parameters were significantly affected by frequency of cultivation except spike length. There was a proportional increased number of productive tillers per plant obtained from the cultivated treatment over the control (non cultivated) one. All the studied yield and yield components except harvest index were significantly affected by frequency of cultivation. Grain yield advantages of 62.72% and 57.84% were obtained from the treatments 30 and 45 DAE and 30 and 60 DAE (from cultivation frequency of 30 and 45 and 30 and 60 days after emergence), respectively over the non cultivated or the control one. The highest grain yields of (3.93 t ha^{-1}) and (3.475 t ha^{-1}) were recorded for the treatments 30 and 45 DAE and 30 and 60 DAE, respectively. Therefore, it can be concluded that using the cultivation frequency of 30 and 45 days after emergence or 30 and 60 days after emergence is advisable and could be appropriate for bread wheat production in the test area even though further testing is required to put the recommendation on a strong basis.

Key Words: Bread Wheat, Frequency of Cultivation, Growth Parameters, Phenological Parameters, Yield Components, Yield

INTRODUCTION

Wheat is one of the most important cereal crops of the world and is a staple food for about one third of the world's population (Hussain and Shah, 2002). It is primarily used as a staple food providing more protein than any other cereal crop (Iqtidar, et al., 2006). In sub-Saharan Africa, Ethiopia ranks second to South Africa in terms of total wheat area and production. In Ethiopia, wheat ranks fourth in total cultivated area and production (Bekele et al., 2000). According to the report of Epherem et al. (2000), Ethiopia is the largest wheat producer in Sub-Saharan Africa with the cultivated land of 1.1 million hectares. Area coverage of wheat increased from 600,000 to 760,000 ha between 1979/80 and 1994/95 (CSA 1989; CSA 1995). Despite the significant area of wheat production in the country, the mean national yield 1.3 t ha^{-1} is 24% below the mean yield for Africa and 48% below the global mean yield (Bekele et al., 2000). Also, Haile and Chilot (1992) reported that the national average yield of wheat less than 1.5 t ha^{-1}. The low average national yield of wheat may be partially attributed to the low level of using the optimum improved production technologies for wheat in the target area. Wheat is grown in the highlands at altitudes ranging from 1500 to 3000 masl, geographically situated between 6 to 16^{o}N latitude and 35 to 42^{o}E longitude; however, the most suitable agro ecological zones for wheat production fall between 1900 and 2700 masl (Hailu, 1991). Out of the total wheat area coverage smallholders cultivate about 82% of the wheat area and accounts for 76% of wheat production (Adugna et al., 1991). In Ethiopia, from an estimated total area under wheat production in the country, bread wheat (*Triticum aestivum L.*) covers about 60% (Hailu et al., 1991). Bread wheat is also one of the most important crops in high lands of Southern Ethiopia in general and in

Senegal and Selmamer areas of South Ari District of South Omo Zone in particular. In these areas, it is the dominant cereal crop and its production is with increasing area coverage year after year, but there are a number of production constraints with this crop. Soil tillage is among the important factors affecting soil properties and crop yield. Khurshid et al. (2006) reported that among the crop production factors, tillage contributes up to 20%, and also Lal and Stewart (2013) reported that tillage affects the sustainable use of soil resources through its influence on soil properties. Often farmers practice two to three plowings before wheat sowing (Yohannes, 1982). But such a low cultivation frequency practice increases infestation of both broad-leaf and grass weeds resulting in low productivity. There had no trend of using optimum cultivation frequency in the existing production system and it is one of the bottle necks in the study area. The lack of optimum cultivation frequency practices is associated with edaphic and biotic factors that have been appreciated as one of the primary sources of lower yield of bread wheat in the target areas. Therefore, this study is aimed at and initiated with the objective of determining the best and optimum cultivation frequency for bread wheat in the target area.

MATERIALS AND METHODS

Description of the Study Area

The experiment was conducted at Selmamer located at 036^{o} 38'08'' E longitude and 05^{o} 47'99'' N latitude and at an altitude of 1920 meters above sea level (masl). The experiment was conducted during the second cropping season (August to November, 2014) under rain fed conditions.

Treatments and Experimental Design

The experiment was executed by using seven cultivation frequencies and one control (non cultivated). The field experiment was laid out in a randomized complete block design (RCBD) with four replications. Bread wheat was shown on August 27, 2014 in ten rows per plot with spacing of 20 cm between rows and 10 cm between plants within a row and a single plot size of 3 m length by 2 m width making a gross plot area of 6 m^2.

DATA COLLECTION

Phenological Parameters

Phenological parameters such as days to emergence, days to heading and days to maturity were recorded. Days to emergence was recorded when 50% the plants per plot emerged while days to heading was recorded by counting the number of days after emergence when 50% of the plants per plot had the first open flower. Days to maturity were recorded when 90% of heads per plot got matured.

Growth Parameters

At mid flowering stages ten plants from each of the plots were selected randomly and uprooted carefully to determine crop growth parameters such as plant height and number of tillers.

Grain Yield, Yield Components, Total Biomass and Harvest Index

Eight central rows (3 m x 1.6 m = 4.8 m^2) were harvested for determination of grain yield. Grain yield was adjusted to 12.5% moisture content. Ten plants were randomly selected from the eight central rows to determine yield and yield components, which consisted of number of tillers per plant and thousand seeds weight. Seed weight was determined by taking a random sample of 1000 seeds and adjusted them to 12.5% moisture content. Total biomass yield was measured from the eight middle rows when the plant reached harvest maturity. Harvest index was calculated as the ratio of seed yield to total above ground biomass yield.

STATISTICAL ANALYSIS

Analysis of variance was performed using the GLM procedure of SAS Statistical Software Version 9.1(SAS, 2007). Effects were considered significant in all statistical calculations if the P-values were ≤ 0.05. Means were separated using Fisher's Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

The analysis of variance result for mean squares showed that both days to heading and days to maturity were not affected significantly due to frequency of cultivation (Table 1). On the other hand; the result of analysis of variance for mean squares depicted that number of productive tillers per plant was significantly (P < 0.01) affected due to frequency of cultivation. Plant height of bread wheat was significantly affected by frequency of cultivation (Table 1). This result is in full agreement with the previous findings of (Tenaw, 2010). The analysis of variance result for mean squares also showed that spike length of bread wheat was not affected significantly due to cultivation frequency (Table 1). On the other hand, Tenaw (2010) reported that spike length of wheat was significantly affected by tillage frequency. The maximum number of productive tillers per plant of (6.0500) and the minimum (2.2500) were recorded from the cultivation frequency of 30 and 45 days after emergence and control (no cultivation), respectively (Table 2). The highest plant height of (80.825 cm) and the least (67.825 cm) were noted from the cultivation frequency of 30 and 45 days after emergence and control (no cultivation), respectively (Table 2). To this end; it was noted that, cultivating the land in certain cultivation frequency in general and with the frequency of 30 and 45 days after emergence in particular had brought consistently a marked increments on all the studied growth parameters when compared to control or no cultivation.

Table 1: Mean Square Values for Crop Phenology and Growth Parameters of Bread Wheat at Selmamer, in 2014.

Source	DF	Days to heading	Days to maturity	Productive Tillers (plant^{-1})	Plant height (cm)	Spike Length (cm)
Replication (R)	3	4.28125**	43.0312***	5.9004**	7.2178ns	. 0.43ns
Treatments (Trt.)	7	0.99554ns	8.10268ns	5.32411**	55.2881*	0.39ns
Error	21	0.85268	4.24554	1.12041	19.4578	0.36

***, ** and *** indicate significance at P< 0.05, P< 0.01 and P< 0.001, respectively and 'ns' indicate non significant**

Table 2: Crop Phenology and Growth Parameters of Bread wheat as Affected by Frequency of Cultivation at Selmamer, in 2014

Treatments	Days heading	toDays to maturity	Productive Tillers (plant^{-1})	Plant height (cm)	Spike Length (cm)
Treatments					
T1 (no cultivation)	57.00a	112.750a	2.2500c	67.825b	5.6000a
T2 (30 DAE)	57.00a	112.750a	5.2500ab	76.075a	6.5000a
T3 (45 DAE)	57.00a	112.750a	4.0000b	75.750a	6.4250a
T4 (60 DAE)	57.00a	114.500a	4.0500b	74.075ab	6.2750a
T5 (30 and 45 DAE)	58.00a	116.000a	6.0500a	80.825a	6.1500a
T6 (30 and 60 DAE)	58.00a	116.000a	5.0500ab	74.150ab	6.4500a
T7 (45 and 60 DAE)	58.00a	114.500a	3.7500bc	77.225a	6.3500a
T8(30, 45 and 60 DAE)	57.25a	113.000a	4.7500ab	77.050a	5.9000a
LSD 0.05	**NS**	**NS**	**1.1006**	**6.4866**	**NS**
CV (%)	**1.60**	**1.8**	**24.09**	**5.85**	**9.72**

Note: Means with the same letters within the columns are not significantly different at P < 0.05.
DAE= Days After Emergence

According to the result of analysis of variance for mean squares, grain yield of bread wheat was significantly affected by frequency of cultivation (Table 3). This result is in agreement with the previous findings of (Macharia et al., 1997; Tenaw, 2010; McConkey et al., 2012). The maximum grain yields of (3.93 t ha^{-1}) and (3.475 t ha^{-1}) were recorded for the treatments 30 and 45 DAE and 30 and 60 DAE, respectively (Table 4). In this study, grain yield advantages of 62.72% and 57.84% were obtained from the treatments 30 and 45 DAE and 30 and 60 DAE (from cultivation frequency of 30 and 45 and 30 and 60 days after emergence), respectively over the non cultivated or the control one. From the above findings, it could be suggested that use of cultivation frequency of 30 and 45 DAE and 30 and 60 DAE had brought a proportional grain yield increment than the control one. The analysis of variance result also depicted that thousand seeds weight of bread wheat was significantly (P < 0.05) affected by frequency of cultivation (Table 3). This result is in agreement with the previous result of (Tenaw, 2010). The maximum 1000 seeds weights of (45.750 gm) and (45.6300 gm) were obtained from 30 and 45 DAE and 30 and 60 DAE (from cultivation frequency of 30 and 45 and 30 and 60 days after emergence), respectively. The total biomass weight of bread wheat was significantly affected by cultivation frequency (Table 3). Similar result was reported by (Tenaw, 2010; McConkey et al., 2012). On the other hand, frequency of cultivation had brought no significant effect on harvest index of bread wheat (Table 3). The maximum biomass yields of (9.9975 t ha^{-1}) and (10.417 t ha^{-1}) were noted from cultivation frequency of 30 and 45 DAE and 30 and 60 DAE, respectively and the minimum biomass yield of (5.469 t ha^{-1}) was recorded from the control (Table 4). There was also biomass yield advantages of 45.29% and 47.49% were obtained from the cultivation frequency of 30 and 45 DAE and 30 and 60 DAE, respectively over the local check. The biomass yield advantage obtained in this study might be attributed by the enhanced tiller number from cultivating the land in the frequencies of 30 and 45 DAE and 30 and 60 DAE than the control.

Table 3: Mean Square Values for Yield and Yield Components and Total Biomass in Bread wheat at Selmamer, in 2014

Source	**DF**	**Grain Yield (t ha^{-1})**	**1000 Seeds Wt (gm)**	**Total Biomass (t ha^{-1})**	**Harvest Index**
Replication (R)	3	0.2057ns	31.9408ns	2.5657ns	0.0349ns
Treatments (Trt.)	7	2.0358***	38.7492*	8.8694*	0.0163ns
Error	21	0.2283	14.7139	2.8757	0.0425

***, ** and *** indicate significance at P< 0.05, P< 0.01 and P< 0.001, respectively and 'ns' indicate non significant**

Table 4: Yield and Yield Components of Bread wheat as Affected by frequency of cultivation at Selmamer, in 2014.

Treatments	Grain Yield (t ha^{-1})	1000 seeds Weight (gm)	Total Biomass Weight (t ha^{-1})	Harvest Index
Treatments				
T1 (no cultivation)	1.4650c	35.900b	5.469b	0.26024a
T2 (30 DAE)	2.9350b	42.500a	9.896a	0.2950a
T3 (45 DAE)	3.0250b	45.475a	8.854a	0.3450a
T4 (60 DAE)	3.2300ab	42.550a	9.375a	0.3473a
T5 (30 and 45 DAE)	3.9300a	45.750a	9.9975a	0.4246a
T6 (30 and 60 DAE)	3.4750ab	45.6300a	10.417a	0.33336a
T7 (45 and 60 DAE)	3.1950b	45.025a	8.854a	0.3613a
T8 (30, 45 and 60 DAE)	3.2200b	41.100ab	8.854a	0.3648a
LSD 0.05	**0.7028**	**5.6407**	**2.4937**	**NS**
CV (%)	**15.62**	**9.02**	**19.08**	**25.46**

Note: Means with the same letters within the columns are not significantly different at P <0.05.
DAE= Days After Emergence

SUMMARY AND CONCLUSION

Using the optimum cultivation frequency could make an important contribution to increase agricultural production and productivity in areas like Selmamer where there is low practice of using frequency of cultivation technologies such as optimum cultivation frequency. To this end, use of optimum cultivation frequency could be one of the alternatives to improve productivity by small farmers. However, the use of optimum cultivation frequency is not yet studied in the area. Thus, this research work is initiated to investigate the impact of including optimum cultivation frequency on the existing production system is of paramount important.Study on cultivation frequency was conducted at Selmamer under rain fed conditions in 2014. The objective of the study was to determine the best and optimum cultivation frequency that will improve bread wheat production and productivity in the target area. The experiment was carried out using the randomized complete block design (RCBD) with four replications at Selmamer in 2014. During the field implementation, seven cultivation frequency and one control were used. According to the results of analysis of variance, cultivation frequency did not affect significantly the studied phenological parameters but cultivation frequency had brought a significant effect on all the studied growth parameters except spike length. All the yield and yield components studied in this experiment such as grain yield, 1000 seeds weight and total biomass weight except harvest index were significantly affected by frequency of cultivation. The maximum grain yields of (3.93 t ha^{-1}) and (3.475 t ha^{-1}) were recorded for the treatments 30 and 45 DAE and 30 and 60 DAE, respectively. Therefore, it can be concluded that using the frequency of cultivation at 30 and 45 DAE or 30 and 60 DAE is advisable and could be appropriate for wheat production in the test area even though further testing is required to put the recommendation on a strong basis.

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