Novelty Journals

ISSN 2394-966X

International Journal of Novel Research in Life Sciences
Vol. 11, Issue 2, pp: (21-25), Month: March - April 2024, Available at: www.noveltyjournals.com

Effects of sowing date on wheat productivity under irrigated condition, Middle Awash, Ethiopia

*[1]Tamiru Dejen, [2]Fikeremariam Tegegn, [3]Mekuria Bekele

[1] Melkasa Agricultural Research Canter, Ethiopian Institute of Agricultural Research,

[2,3] Werer Agricultural Research Canter, Ethiopian Institute of Agricultural Research

DOI: https://doi.org/10.5281/zenodo.10829671

Published Date: 18-March-2024

Abstract: **The sowing date is one of the more important factors that determines the yield of irrigated wheat. This experiment was conducted to find out the proper sowing time for low-land irrigated wheat varieties under the irrigation conditions of Middle Awash, Ethiopia. The experiment was laid out in an RCBD design with three replications and seven sowing dates (1st October, 15th October, 30th October, 15th November, 30th November, 15th December, and 30th December), and the Gambo wheat variety was used as the test crop for the experiment as treatments. Productive tiller/plant height Grain/spike, biomass yield t/ha, grain yield kg/ha, 1000 seed weight, straw yield, and harvest index were significantly affected by the treatment. However, total tiller/plant and spike length were not significantly affected by the treatment. The highest biomass yield (16.1 t ha^{-1}) was obtained when the crop was sown on 15th October it was at par with 3858.1 kg ha-1 and 3674.6 kg ha^{-1} obtained from 1st October and 15th November respectively. The lowest biomass yield (5.1 t ha^{-1}) was recorded in the case of late sowing, i.e., December 15th, which was on par with December 30th. The highest grain yield (3881.2 kg ha^{-1}) was obtained when the crop was sown on 1st October it was on par with 3858.1 kgha^{-1} and 3674.6 kg ha^{-1} obtained from 15th October and 15th November respectively. The lowest grain yield (559.3 kg ha^{-1}) was recorded in case of late sowing, i.e. 15th December, which was on par with 30th December.**

Keywords: **Biomass yield; Grain yield; Sowing date; Straw yield; Tiller; Wheat.**

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) Is the world's most widely cultivated cereal crop. It finds a major place in both time meals of common population in major wheat growing states. It is an important cereal crop as being consumed for staple food in the world [1].

Wheat is an important staple food crop in Ethiopia, especially in urban areas. 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 [2] placing it second after maize and slightly ahead of tef, sorghum, and inset, which contribute 10-12 percent each [3]. Wheat is also the fourth largest cereal crop produced by close to 5 million smallholder farmers, which makes about 35 percent of all small farmers in the country.

Wheat production has grown significantly over the past two decades following several government programs and initiatives implemented to drive agricultural growth and food security in the country1. Production increased from around 1.1 million tons in 1995/96 to 3.9 million tons in 2013/14, which is an average annual growth of 7.5 percent. Although wheat production has grown steadily, consumption of wheat has also expanded significantly. Wheat consumption

increased from 2.1 million tons to 4.2 million tons, representing an annual increase of about 4.2 percent between 1995/96 and 2013/14.

The sowing date is one of the more important factors that determine yield of irrigated wheat. Research conducted for wheat on sowing dates (Green et al. 1985) has shown a trend towards increased yield as sowing is advanced. On the basis of field micro plot experiment the reduction in grain yield by two-week delay in sowing is 15%, while sowing delayed by four weeks results in a reduction in yield by about 30% [4]. Higher yields after earlier sowing time were also obtained in experiments conducted by [5].

The question of the impact of sowing time on wheat yield has been taken up many times in exact experimental conditions, which resulted in optimal sowing time recommendations varying for different climatic region [6]. Not much research assessing the influence of sowing time has been based on data coming directly from production ([6, 7]). Despite the awareness of the benefits of timely sowing and the hazard resulting from delay, sowing often takes place long after the optimal time. This experiment was conducted to find out proper sowing time for low land irrigated wheat varieties under Irrigation condition of Middle Awash, Ethiopia.

2. MATERIALS AND METHODS

Description of the Study Area

An experiment was conducted at Werer Agricultural Research Center (WARC) in 2014 and 2015 cropping season under irrigation. The site is located in the Afar National Regional State, in Rift Valley of Amibara Woreda at Melka Werer town, which is 280 km in the north east of Addis Ababa. It is located at 9° 60’ 45” N latitude and 40° 9’ 32” E longitude and at an altitude of 740 m.a.s.l. The area is characterized by low and erratic rainfall with total annual rainfall of 568.6 mm which is less than the total annual average evapo-transpiration of 2846.7 mm [8]. The mean annual temperature is 27.14 °C with a minimum of 19.5 °C and maximum of 34.8 °C, respectively [8]. Light textured alluvial and black soils with a ph of 8.4 are the dominant soil types of the center. Thus, crop production is mainly dependent on irrigation.

Treatments and Experimental Design

The experiment was laid out in RCBD design with three replications seven sowing dates (1st October, 15th October, 30th October, 15th November, 30th November, 15th December, and 30th December) and Gambo wheat variety was used as test crop for the experiment as treatments. Wheat seed was planted in plot size having 5 m length and 3.6 m width. During data collection and harvesting time, a dimension of 4 m length and 2.4 m width was treated as harvestable plot size. The central eight rows were considered during data collection and harvesting, ignoring two rows left and two rows right as border rows. The crop under different sowing dates was harvested at different dates depending on maturity. The crop was sown by drilling on well prepared seed bed separated with 30 cm from each row Spacing between plots and replications was 2 m and 3.6 m respectively. The experiment was conducted for two years at Werer on one location. Other management practices were performed as per their research recommendations.

Data Collection

Phenology and growth parameters

Plant height (cm): The plant height was taken by measuring the tallest culm from the ground level to the tip of spike from randomly pre-tagged five plants from the net plot at physiological maturity.

Spike length (cm): The spike length was taken by measuring the length of one spike from each of the ten plants per net plot size and the average of ten panicles was recorded as spike length.

Yield components and yield

Number of total tillers: The number of total tillers was counted from randomly pre-tagged five plants from net plot area and their average was recorded as the total number of tillers.

Number of effective tillers: While counting the total number of tillers as above, the tiller’s bearing spike was also counted to record number of effective tillers.

Number of kernels per spike: One spike from each 10 plants as above was taken and their grains were counted and their average was taken as number of grains per spike.

Thousand kernels weight (g): One thousand kernels were counted from the harvested bulk of each net plot and their weight was recorded as the 1000 kernels weight and the weight was adjusted to moisture content of 14%.

Aboveground dry biomass yield (kg ha^{-1}): The aboveground dry biomass yield of the net plot area was recorded after harvesting and sun drying of the produce till a constant weight and expressed in kg ha^{-1}.

Grain yield (kg ha^{-1}): The weight of grains from the aboveground dry biomass after threshing was recorded and adjusted to 12.5% grain moisture content and expressed as grain yield in kg ha^{-1}.

Straw yield (kg ha^{-1}): Straw yield of each plot was calculated by subtracting the grain yield from the total aboveground dry biomass yield and expressed in kg ha^{-1}.

Harvest index: was determined as the grain yield divided by the aboveground dry biomass yield multiplied by 100.

Data Analysis

Data were analyzed statistically using the analysis of variance (ANOVA) technique using SAS (SAS, 2004). When significant differences existed between treatments, comparisons of means were made using the least significant difference (LSD) test at 5% probability levels.

3. RESULT AND DISCUSSION

The data on plant height revealed that sowing dates affected significantly. Maximum plant height (79.9 cm) was obtained when crop was sown on 15th October and it was statistically at par with 1st October, 30th October, 15th November, 30th November sown treatment against the minimum plant height in case of 15th December and 30th December (Table 1). Decrease in plant height in late sowing was due to shorter growing period. Early sown crop may have enjoyed the better environmental conditions especially the temperature and solar radiation which resulted to tallest plants. These results are in line with those reported by [9].

The sowing dates significantly affected the tillering. The crop sown on 1st December produced significantly a greater number of fertile tillers per plant (7.1) while significantly minimum number of fertile tillers per plant (4.0) was obtained when crop was sown on 15th December (table 1).

Number of grains per spike is an important yield contributing parameter and has a direct effect on the final grain yield of wheat. Data regarding number of grains per spike revealed that sowing dates significantly affect this parameter. The maximum grains per spike (45.8 and 44.8) were obtained from 30th October and 15th October respectively, while the minimum grains per spike (16.9 and 17.9) were obtained from 30th December and 15th December respectively (table 1). Less number of grains per spike in late sowing was due to less production of photosynthates due to shorter growing period. These results are in line with those of [9].

The data regarding 1000-grain weight indicated that 1000-grain weight was significantly affected by sowing times. The crop sown earlier produced significantly heavier grains than that of the crop sown later. The grain weight decreased significantly with each day delay in sowing. The heaviest 1000- grain weight (39.6 g) when it was sown on 15th October, which was at par 1st October and 30th October. However, minimum1000-grain weight (21.9 g) was produced when it was sown on 30th December which was statistically at par with 26.2 g when it was sown on 15th December. The early sowing resulted in better development of the grains due to longer growing period. These findings are strongly supported by those of [9, 10] who had also reported decreased 1000-grain weight with delay in sowing.

Biomass yield was significantly affected by sowing date. Significantly maximum biomass yield (16.1 t ha^{-1}) was obtained when crop was sown on 15th October it was at par with 3858.1 kgha^{-1} and 3674.6 kg ha^{-1} obtained from 1st October and 15th November respectively. The minimum biomass yield (5.1 t ha^{-1}) was recorded in case of late sowing i.e. 15th December, which was at par with 30th December.

Grain yield of wheat crop is the result of combined effect of various yield contributing components. It is evident from the data that sowing date affected significantly the grain yield. Significantly maximum grain yield (3881.2 kg ha^{-1}) was

obtained when crop was sown on 1st October it was at par with 3858.1 kgha^{-1} and 3674.6 kg ha^{-1} obtained from 15th October and 15th November respectively. The minimum grain yield (559.3 kg ha^{-1}) was recorded in case of late sowing i.e. 15th December, which was at par with 30th December. Lower grain yield in late sowing was mainly due to lower a smaller number of tillers per plant, a smaller number of grains per spike and lower 1000-grain weight. These results are in accordance with those of [10, 11]. They also reported that late sowing results in less grain yield per hectare.

The straw yield is reflected by growth parameters like number of total and effective tillers and plant height. The data indicated that planting time significantly affected the straw yield. Significantly higher straw yield (16894 kg ha^{-1}) was produced when crop was sown on 15th October which was statistically at par with 1st October, 15th November and 30th November sowing against the minimum straw yield (6217 kg ha^{-1}) in case of 15th December sowing. Higher straw yield in early sowing was mainly due to a greater number of tillers per plant and more plant height. These results are in line with those of [12]. They reported that early sowing resulted in higher straw yield due to a greater number of tillers.

Harvest index represents the ratio of the dry matter of harvested part of the crop (grain yield) to the total dry matter production [13]. Analyzed data revealed that early sowing had significantly higher harvest index (25.1%) than late sowed (5.9%).

TABLE: I

SOURCE OF VARIANCE	TOTAL TILLER/PLANT	PRODUCTIVE TILLER/PLANT	PLANT HEIGHT	SPIKE LENGTH	GRAIN/SPIKE	BIOMASS YIELD T/HA	GRAIN YIELD KG/HA	1000 SEED WT	STRAW YIELD	HARVEST INDEX
YEAR 1	5.1 ^{b}	5.1^{b}	69.4^{b}	8.4^{b}	35.6	5.5 ^{b}	1437.2 ^{b}	32.9	4024^{b}	22.6^{a}
YEAR 2	6.8 ^{a}	6.0^{a}	76.3^{a}	10.2^{a}	35.0	17.5 ^{a}	3491.4^{a}	33.9	20874^{a}	13.8^{b}
LSD	0.7	0.6	4.3	1.4	ns	2.1	533.0	ns	2526.2	3.6
1ST OCTOBER	7.2	7.1^{a}	78.1^{a}	9.2	41.8^{ab}	14.0^{abc}	3881.2^{a}	37.9^{a}	13740^{ab}	25.1^{a}
15THOCTOBER	5.7	5.7^{bc}	79.9^{a}	9.1	44.8^{a}	16.1^{a}	3858.1^{a}	39.6 ^{a}	16894^{a}	21.8^{a}
30TH OCTOBER	6.1	5.9^{b}	77.8^{a}	8.9	45.8^{a}	10.6^{cd}	2521.5^{b}	38.3^{a}	11136^{b}	22.5^{a}
15TH NOVEMBER	5.9	5.8^{b}	78.9^{a}	11.1	42.3^{ab}	14.5^{ab}	3674.6^{a}	36.3^{a}	15440^{ab}	24.9^{a}
30TH NOVEMBER	5.7	5.5^{bc}	76.2^{a}	9.2	37.6^{b}	11.2^{bcd}	2096.0^{b}	33.8^{ab}	12701^{ab}	18.6^{a}
15TH DECEMBER	5.0	4.0^{d}	56.5^{b}	8.3	17.9^{c}	5.1^{e}	559.3^{c}	26.2^{bc}	6217^{c}	8.6^{b}
30TH DECEMBER	5.8	4.5^{d}	62.3^{b}	9.3	16.9^{c}	8.9^{de}	659.5^{c}	21.9^{c}	11013^{b}	5.9^{b}
LSD	Ns	1.2	8.1	Ns	6.6	3.9	997.2	8.7	4726	6.8
MEAN	5.9	5.5	72.8	9.3	35.3	11.5	14913.2	33.4	12448.9	18.2
CV%	18.4	18.4	9.4	23.6	15.8	29.1	31.1	22.2	32.2	31.8

4. CONCLUSION

Sowing dates of October 1st October, 15th October, and 15th November to be the best sowing dates to obtain the maximum grain yield of the Ga'ambo variety under irrigated conditions.

REFERENCES

[1] Khan, H., et al., Effect of sowing methods and seed rates on grain yield and yield components of wheat variety Pak-81. Pakistan Journal of Biological Sciences (Pakistan), 2000.

[2] Pingali, P., Agricultural policy and nutrition outcomes–getting beyond the preoccupation with staple grains. Food Security, 2015. 7(3): p. 583-591.

[3] Minot, N., et al., The wheat supply chain in Ethiopia: Patterns, trends, and policy options. Addis Ababa, Ethiopia, 2015.

[4] Podolska, G. and M. Wyzińska, Reakcja nowych odmian pszenicy ozimej na gęstość i termin siewu. Polish J. Agron, 2011. 6: p. 44-51.

[5] Milford, G., et al., Effects of previous crop, sowing date, and winter and spring applications of nitrogen on the growth, nitrogen uptake and yield of winter wheat. The Journal of Agricultural Science, 1993. 121(1): p. 1-12.

[6] Oleksiak, T., Effect of sowing date on winter wheat yields in Poland. Journal of Central European Agriculture, 2014. 15(4): p. 0-0.

[7] Oleksiak, T. and D. Mankowski, The effect of sowing date on winter wheat basing on survey research results. BIULETYN-INSTYTUTU HODOWLI I AKLIMATYZACJI ROSLIN, 2007. 244: p. 21.

[8] Chekol, W. and A. Mnalku, Selected physical and chemical characteristics of soils of the middle awash irrigated farm lands, Ethiopia. Ethiopian Journal of Agricultural Sciences, 2012. 22(1): p. 127-142.

[9] Shahzad, K., et al., Yield and yield components of various wheat cultivars as affected by different sowing dates. Asian J. Plant Sci, 2002. 1(5): p. 522-525.

[10] Spink, J., et al., Effect of sowing date on the optimum plant density of winter wheat. Annals of Applied Biology, 2000. 137(2): p. 179-188.

[11] Aslam, M., et al., Response of wheat varieties to sowing dates. Journal of Agronomy, 2003.

[12] Donaldson, E., W.F. Schillinger, and S.M. Dofing, Straw production and grain yield relationships in winter wheat. Crop Science, 2001. 41(1): p. 100-106.

[13] Marschner, H., E. Kirkby, and I. Cakmak, Effect of mineral nutritional status on shoot—root partitioning of photoassimilates and cycling of mineral nutrients. Journal of experimental botany, 1996: p. 1255-1263.