

Growth and Yield Components of Wheat (Triticum aestivum L.) as Affected by Variable Planting Methods

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Abstract

Background and objective: Planting method plays an important role in the placement of seed at proper depth and distance thereby affecting the germination and plant population dynamics. As a result, it ultimately affects crop growth and yield performance through the influence it has on the competition among plants for limited amount of nutrients in the soil. A study was conducted in 2016 cropping season at experimental site of College of Agriculture, Hawassa University to investigate the effect of planting method on growth performance and grain yield of wheat. **Materials and Methods:**The treatment studied includes two planting methods (i) conventional-broadcasting and ii) drill planting by using 15cm and 20cm row spacing. The treatments arranged in a randomized complete block design with three replications. The treatment means were compared through least significant different test at 5%probability level. **Results**:Analysis of the results revealed that planting method have a significant effect on plant height, number of tiller, fresh weight, dry weight, and grain yield. However, marked difference was not detected on number of spikelet per spike due to planting methods. A row spacing of 20 cm showed higher effective tiller number (8.33), number of spikelet per spike (16.66), dry weight (2.46) and grain yield (3.24) compared with the remaining treatments. **Conclusion**:Based on the results of the current experiment, it can be concluded that using 20 cm spaced row planting is advantageous for wheat crop production for the study area, provided that all the agronomic practices are kept optimal.

Keywords: Agronomic performance, Grain yield, Growth, Row spacing

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important food grain crop grown in the world for commercial production and human consumption. The crop is grown at an altitude ranging from 1500 to 3000 meters above sea level, between 6 – 16 ^{0}N latitude and 35 – 42 ^{0}E longitude. The most suitable agro-ecological zones, however, falls between 1900 and 2700 m.a.s.l[1]. The crop constitutes about 10% of the annual cereal production and plays a crucial role in supplying carbohydrates, protein and minerals[2-3].

In Ethiopia, wheat is one of the most important cultivated cereals, largely growing in highlands of the country including Arsi, Bale, Shewa, Ilubabor, Western Hareghe, Sidamo,Tigray, North Gonder and Gojjamzones[1]. It ranks fourth after tef, maize and sorghum in area coverage and third in total production [4-8]. The average per capital consumption of wheat in Ethiopia estimated to be 39 kg/year during 1994 – 1997. To fulfill this requirement 331, 000 tons of wheat was imported during 1995 – 97[9].

The national average yield of wheat (1.83 t ha $^{-1}$) is by far low compared with the world average of 2.85 metric t ha^{-1}[6,8]. Moreover, the national average yield is 3 – 4 t ha^{-1} far below the research station yields of over 6 t ha^{-1} in the country[5]. Several factors are contributing for this low yield of the crop in the country. Methods of sowing, which determine germination, crop stand establishment and population dynamics[10] , ultimately affect the growth and yield related performance of the crop [11,12] . Therefore, this study was conducted to identify the optimum planting methods for better growth and grain yield performance of wheat crop under the agro-climatic conditions of Hawassa, southern Ethiopia during 2016 cropping season. The result of this current research suggests the suitable row spacing for optimized wheat yield for the studied environment.

MATERIALS AND METHODES

Description of the study site and experimental design

The experiment was conducted in Hawassa University, College of Agriculture experimental field during 2016 main cropping season. The experimental site is located at 273 km south west of the capital city Addis Ababa in Southern *Nations*, *Nationalities and Peoples*' *Region* (*SNNPR*) state. The site is geographically situated at 7^o 4’N latitude and 38^o 3’E longitude with an altitude of 1650 meter above sea level. The site is characterized by sandy loam soil with 7.9 pH value, which is volcanic origin and described as flovisol. The average maximum and minimum temperature of the area is 27 and 12 ˚C, respectively with an average annual rain fall of 900 to 1110 mm. The main rainy season extends from April to September and it is interrupted by some dry spells in June and sometimes in May to July.

The treatment studied includes two planting methods (i) conventional-broadcasting and ii) drill planting by using 15cm and 20cm row spacing. The treatments arranged in a randomized complete block design with three replications having a total plot size of 5 m x 9.5 m (47.5 m^2) with a spacing of 1, 0.5 and 0.2 m between blocks, plots and rows, respectively.

Management practice and experimental procedure

The experiment was started from land preparation by clearing, digging, harrowing, and leveling the land in order to prepare a good seed bed and laying out the plot based on experimental lay out. The drilling row was prepared for planting at 15 and 20 cm apart. The seeds were sown in a row and broadcasting method and DAP was applied 100 kg/ha as per the recommendation for the same crop. Nitrogen fertilizer was applied 1/3 at sowing and 2/3 at mid-tillering and the rest are applied as side dressing when the plants are reached at knee height and a recommended seed rate of 125 kg ha^{-1} was used for this experiment. The crop was irrigated each day early morning and evening, especially during the first four weeks i.e. during the establishment stage of the crop. Regular hand weeding was practiced to make the experiment free of weed infestation.

The observations on the parameters such as plant height (cm), number of tillers/m^2, number of spikelets/spike, fresh weight, dry weight and grain yield (kg ha^{-1}) was recorded during the course of the experimentation from six randomly selected plants taking in to consideration the treatments.

Statistical analysis

The data thus collected was analyzed using SAS computer software version 9.2 (SAS, 2008). The treatment means were compared through least significant difference test at 5% probability level (Steel et al., 1997).

RESULTS AND DISCUSSION

Plant height

Plant height of wheat significantly affected due to the methods of planting (Table 1). The tallest plant height was recorded from T3 (20 cm row spacing) followed by T2 (15 cm row spacing). Whereas the shortest plant height was obtained from T1 (conventional/broadcasting) planting methods. Plant height is basically affected by the genetic makeup of the plant and the growing conditions[13], and planting method affects the plant height though its effect on resource competition and reduction in vigor of the plant[4] . In practice, wider spacing which result with lower plant density result with shorter plant height, this is because high plant density remains with minimum space for horizontal expansion of the plant and increase the competition for light interception between plants thereby drives upward growth of the plant. This result is in agreement with [14,15], who reported that increase in the seeding rate, which directly translated to lower spacing, resulted in a slight decline in the heights of the plants. [15]also reported a maximum plant height production when widely spaced rows of 30 cm was used when compared with that of broadcasting, 22.5 and 15 cm row spacing. The same study further revealed that decreased plant height with decreasing spacing. In contrast to this finding, [16]reported that an increment on the height of plants due to increased seeding rate. [17]also reported an increasing pattern in plant height with increasing seed rate/ha.

Table 1. Mean plant height and number of effective tillers as affected by variable planting methods

Treatments	Plant height (cm)	Number of effective tillers	Number of Spikelet's per spike
T1 = Broadcasting	50.26c	6.90b	11.00b
T2 = 15cm row spacing	57.26b	6.93b	13.33ab
T3 = 20cm row spacing	59.63a	8.33a	16.66a
LSD at 0.05 %	2.8	0.914	4.34

Means sharing the same superscript letter in within the column do not differ significantly at P = 0.05 according to the LSD test.

Number of effective tillers

The final yield of most cereals is affected by the number of effective tillers the plant produces, since tillers attribute to ensure optimal plant population per production land through compensating the difference in number of plants across plots[18]. In the current experiment, the analysis of variance for number of effective tillers showed statistically significant ($P<0.05$) difference among treatment (Table 1). The maximum number of effective tillers (8.33) was produced from plants with T2 (20 cm spaced row). However, the minimum number of effective tillers (6.93 and 6.90) was recorded from T2 and T1, respectively. The lower number of effective tillers was produced from T2 (15 cm spaced row planting) might be because of the more competition created for space in the case of narrower spacing which thereby results with lesser effective tiller formation per plant. In line with these results, [16]also reported significantly higher effective tiller production in the case of lower seed rates, which means wider spacing. On the other hands, the lower effective tiller production from conventional planting methods (broadcasting) might be explained that, this planting method result with higher number of seed/narrower spacing resulting with dense plant population. Therefore, higher population density increases the competition for spaces thereby allow formation of limited number of effective tiller.

Number of spikelet's per spike

Statistical analysis of data revealed marked effects of different planting methods on number of spikelet's per spike. Seed planting with 20 cm row spacing resulted in significantly higher number of spikelets per spike compared to the mean spikelets obtained from broadcasting seed placement. Similarly, seed planting with 15cm spaced rows resulted in relatively higher number of spikelet's per spike compared to conventional planting (broadcasting), although the different is not statistically significant (Table 1). More number of spikelet's per spike in row planting at 20 cm can be referred to the ideal plant population attained in these treatments, which resulted in less crop plant competition. In line with this results [17]also reported that row planting at 22.5 cm resulted in statistically higher number of spikelets (14.47) compared to the number of spikelets (12.2) produced in the case of seed placement at 15 cm spaced rows.

Shoot fresh and dry weights

The analysis of variance for fresh weight shows no-significant difference among treatment at 5% probability level. Whereas, there was a significant difference among treatment on plant dry weight (Table 2). The maximum dry weight was obtained from T3 (20 cm row spacing) but, there was no marked difference on shoot dry weight between this treatment and T2 (15 cm row spacing). On the other hands, minimum shoot dry weight was obtained from the broadcasting treatment. The increased shoot dry weight due to wider spacing might be because of the optimal the plant population dynamics the higher assimilates partitioned to individual plants which result from higher (20cm) row spacing.

Table 2. Mean shoot fresh and dry weight of wheat as affected by variable planting methods

Treatments	Fresh weight	Dry weight
T1 = Broadcasting	2.43	1.33b
T2 = 15cm row spacing	2.76	2.10a
T3 = 20 cm row spacing	3.56	2.46a
LSD	ns	0.384

Means sharing the same superscript letter with in the column do not differ significantly at P = 0.05 according to the LSD test

Grain yield

The analysis variance for grain yield showed statistically significant (P< 0.05) difference among treatments (Table 3). Higher grain yield was obtained from T3 (20 cm spaced rows) but there was no marked differences between this treatment and T2 (15 cm spaced rows). Significantly lower grain yield was obtained from the conventional planting (broadcasting) method. This result is supported by the findings of [17], who reported maximum grain yield production with 22.5 cm spaced row planting compared with 15 cm spaced row planting. Similarly, [15]also confirmed lower grain yield production with increasing seed rate. [11]in their experiment on effects of bed and flat planting method on nitrogen use efficiency and grain yield of wheat, revealed a statistically different grain yield of the crop across different planting methods. The lower grain yield in conventional (broadcasting) planting method might be because of the plant competition for production resources caused due to suboptimal plant population. Less performance of wheat also reported under conventional planting[11]. Similar result was reported by[15], stating a decreasing trend in grain yield of wheat both with increasing and decreasing direction of seed rate beyond the optimal seed rate thereby plant population. [16], confirmed a decline in yield due to increased plant population, which might resulted from the keen competition created between plants for nutrients, moisture and other plant requirements. This indicates the importance of determining and using optimal spacing so as to achieve the potential yield from wheat crop.

Table 3. Mean grain yield of wheat as affected by different planting methods

Treatments	Grain yield (t ha^{-1})
T1 = Broadcasting	1.38b
T2 = 15cm row spacing	2.63a
T3 = 20 cm row spacing	3.24a
LSD	1.112

Means sharing the same superscript letter with in the column do not differ significantly at P = 0.05 according to the LSD test.

CONCLUSION AND RECOMMENDATION

This study was conducted to identify the optimum planting methods for better growth and grain yield performance of wheat crop under the agro-climatic conditions of Hawassa, southern Ethiopia during 2016 cropping season. For this porpose broadcasting, 15 and 20 cm row spacing was used as a treatment and , higher plant height, number of tiller, dry weight and grain yield were recorded from planting wheat with 20cm row spacing. Therefore, 20cm row spacing can be suggested for optimized growth and grain yield performance of wheat with the optimal application of all the recommended husbandries for wheat.

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