American Journal of Biomedical and Life Sciences
2025, Vol. 13, No. 4, pp. 86-89
https://doi.org/10.11648/j.ajbls.20251304.12

Research Article

Effect of Plant Density on Grain Yield of Triticale (Variety Logawshibo) at Hawassa, Sidama Ethiopia

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Abstract

Triticale (×Triticosecale Wittmack) is a synthetic cereal crop developed from crosses between wheat and rye. It has gained importance due to its adaptability to marginal environments, high nutritional value, and multipurpose use as both food and feed. In Ethiopia, triticale is a relatively recent introduction; however, its productivity is often limited by inappropriate agronomic practices, particularly the use of non-optimal seed rates. Seed rate plays a vital role in determining plant population, competition for nutrients, and overall grain yield. Too low a seed rate results in sparse stands and low yield per unit area, while excessively high seed rates cause severe competition and reduce yield performance. Hence, identifying the optimum seed rate is necessary for maximizing yield. The present study was conducted at Hawassa University College of Agriculture research field during the 2020 off-season under irrigation to evaluate the effect of different seed rates on grain yield of triticale variety Logawshibo. Four seed rates (100, 125, 150, and 175 kg ha^{-1}) were evaluated in a randomized complete block design with three replications. Data on grain yield were analyzed using ANOVA, and mean separation was carried out by LSD at 5% significance. Results showed that seed rate significantly influenced yield. The highest grain yield (39.67 q ha^{-1}) was obtained at 150 kg ha^{-1}, while the lowest (22.67 q ha^{-1}) was recorded at 100 kg ha^{-1}. Increasing the rate beyond 150 kg ha^{-1} reduced yield due to excessive competition for growth resources. Therefore, a seed rate of 150 kg ha^{-1} is recommended as the optimum density for triticale production in Hawassa and similar agro-ecologies.

Keywords

Triticale (Logawshibo Variaty), Grain Yield, Crop Density Management

1. Introduction

Triticale, botanically known as *Triticosecale wittmack* belongs to the family poaceae and tribe hordeae. It is relatively a new cereal crop which is a product of crosses between wheat and rye. It is the man-made cereal crop. The first commercial triticale varieties were released in the late 1960s in Hungary [13]. Triticale has comparatively larger kernel size, higher content of lysin (18% of N) and protein (14.7%) than wheat, maize, millet and sorghum [5]. Almost 3 million ha of triticale are grown today in the world [2]. Currently, triticale is cultivated on about 3 million hectares worldwide, particularly in Germany, Poland, France, China, and several African countries including Ethiopia, Kenya, and Tanzania [2, 8]. Present information available at the International Maize and Wheat Improvement Center (CIMMYT) shows that since the mid-1970s more than 200 cultivars have been released in more than 30 countries [2]. The development of

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Received: 11 August 2025; **Accepted:** 26 August 2025; **Published:** 10 October 2025

Plump-seeded triticale types from CIMMYT greatly advanced the potential for triticale in human food and animal feed. Triticale can certainly play a significant role in alleviating poverty for many needy families in some developing countries. The particular interest on triticale is its good performance in stress environments.

The major triticale producers are Germany, Poland, France, and China; and in Africa, the climatic conditions of the countries Kenya, Tanzania, Zambia, Ethiopia and Algeria are suited for triticale production [2].

Triticale can be used for human food as injera, pasta, bread, tella. In southern Gondar the bread and injera of triticale have been well accepted by farmers [7]. In Ethiopia triticale is a recent introduction. It can be cultivated in a wide range of agro- ecologies from sea level to over 3000 m.a.s.l. Drought, frost and acid tolerance and better growth under degraded soils are primary advantages of triticale to produce better yield than other cereal crops [7].

So far about 8 varieties are introduced from CIMMYT Mexico and cultivated in Ethiopia. In Ethiopia, about 8 varieties… new variety 'Kombolcha' was recently released with high yield potential [7, 11]. The cultural practices (land preparation, seed and fertilizer rate, depth of planting and weed control) used for wheat production is also applied for triticale production in Ethiopia [7].

Seed rate is a critical agronomic factor optimum density improves yield stability in cereals including triticale [6, 9, 12]. Seeding rate has significant effect on growth and yield performance of crops, because of competition of plants for resources of light, moisture and nutrients. Plans in less plant population per unit area may produce high tillers or branches per plant and high plant yield but not high yield per unit area. However, high plant population density due to higher seeding rate exposes plants for severe completion of resources and results in low dry matter production, yield and yield components.

Triticale is an aphiploid hybrid derived from the cross between durum wheat (*Triticum durum* L.) and rye (*Secale cereal* L.). In 1875, Wilson reported to the Botanical Society of Edinburgh, Scotland, the first hybrid between wheat and rye. That and subsequent hybrids were highly sterile and did not produce any grain. It was Rimpau who reported the first fertile triticale in 1891 [13]. However, it was only in 1968 that the first commercial cultivars were released. They were quite tall, lodged badly, many were in fact infertile and with shriveled seeds which contributed to poor yields. These traits discouraged rapid expansion of this new crop. It was only during the last 15 - 20 years that some of its undesirable traits were addressed and triticale could be successfully cultivated as a cash crop [9]. Like wheat, triticale can be classified as spring, winter or facultative in growth habit and are adapted to a wide diversity of environments and soil types. With a well-developed root system, triticale can tolerate both drought and waterlogged conditions better than wheat. Some triticale genotypes significantly out yielded wheat (grain and fodder), especially when planted on marginal soils and stressed environments. The high level of disease, aluminum and shattering resistance further added to the profitability of growing triticale [9].

Triticale is cultivated in the world for their grain yield for human food and feed for pigs and livestock and as energy crop for bio-fuel production. The use of excess seeding rate leads to severe competition among plants for nutrients, water, sunlight and other growth factors; and less seeding rate results in low plant density. Both excesses and less seeding rate result in lower grain yield. Therefore optimum seeding rate is required to produce high yield. This study was initiated to evaluate the effect of different seed rate of triticale on grain yield (logawshibo variety).

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at Hawassa University, College of Agriculture research field in 2020 during off season under irrigation. Hawassa College of Agriculture is found at Hawassa city located south of 273 km away from Addis Ababa with 7° 4′ N latitude and 38° 31′ E longitude and its altitude is 1670m above sea level. The amount of rain fall the area receives ranges from 900-1100mm annually, whereas the minimum, mean and maximum temperatures are 12°C, 20°C and 27°C, respectively. The soil has sandy loam texture with the pH of 7.9 [10].

2.2. Treatments, Experimental Design and Field Management

The seed rates (treatments) of triticale variety logawshibo to be used for this study were 100, 125, 150 and 175 kg per ha. The experiment was conducted in a randomized complete block design with three replications, and Plot size for each entry is 1.5m^2 (1.5m x 1m) planted with 20 cm spacing between rows. The pathways between blocks and plots were 1m and 0.5 m respectively. Therefore the required experimental area was 35.75m^2 (6.5m x 5.5m). Urea and DAP Fertilizers at the rate of 100kg/ha each was applied in rows just before planting. The seeds of each rate were drilled in rows at 5 cm depth. Watering, weeding and other field managements were carried out as required.

2.3. Data Collection

Data on grain yield was collected on the middle rows of each plot. Grain yield was collected from five plants and measured by sensitive balance. Yield per plot was determined by weighing sun dried grain harvested from the central rows of each plot and converted to ton per hectare.

2.4. Data Analysis

Data was subjected to analysis of a variance (ANOVA) using scientific calculator and mean comparison among treatments was done by using least significance test (LSD) at 5% probability level [4].

3. Results and Discussions

The grain yield of triticale was influenced by many factors interacting together, among the major one was the independent among the factor in shortage of water, water logging, soil nutrient and plant density. The data was analyzed that different rates of seed was significant effect on grain yield parameters.

Table 1. *Summarized Data of Different Parameters of Mean Variants.*

No	Treatments kg/ha	Grain yield q/ha
1	100	22.667[d]
2	125	30.000[c]
3	150	39.667[a]
4	175	34.333[b]
LSD 5%		3.1939
CV %		5.048

Note: Means within the same column followed by the same letter(s) are not significantly different at the $p < 0.05$ level according to the Least Significant Difference (LSD) test.

Grain Yield

From the above table 1 the results showed highest yield was recorded from T3 that received 150kg/ha was (39.667q/ha) the highest yield (39.67 q/ha) was obtained at 150 kg/ha Increasing seed rate from 100 to 150 kg/ha enhanced yield, but further increase reduced yield, likely due to excessive competition for nutrients [1, 3, 11, 12] and the lowest means of grain yield was recorded from T1 that received 100kg/ha was (22.667q/ha). Grain yield influenced by different rates of seed, when different rates of seed increase; the grain yield weight was different. This result agrees with findings in triticale-pea mixtures where intermediate sowing rates produced the best performance [7, 9]. Similar reports were given for wheat under irrigated conditions in Ethiopia [11, 12] When compared mean difference between treatments T2 with T3 mean difference was (9.667q/ha), T2 with T4 mean difference was (4.333q/ha), T2 with T1 mean difference (7.333q/ha) and T1 with T4 mean difference was (11.666q/ha) due to that mean difference between all treatments were more than LSD 5% (3.1939) at $p<0.05$. The analysis of variance showed that all the treatments of grain yield were significantly different from each other. Our findings confirm that optimizing crop density improves resource use efficiency and sustainability [13]

4. Conclusions and Recommendations

Application of the correct level of seed rate is necessary to achieve maximum yield of triticale crop. As a result the level with optimum seed rate showed good performance for most of the attributes. Based on the result obtained, it was possible to conclude that seed rate with 150kg/ha was promising to enhance yield of triticale.

5. Recommendation

According to statistical analysis of variance, treatment three that received (150kg/ha) seed rate which gave the high grain yield is recommended for the end users.

In general it recommended that investigating the same study in different localities to have a real recommendation for the optimum seed rate to produce triticale.

In addition, it is important to know the optimum seed rate that gives the high production of triticale crops.

Abbreviations

ANOVA	Analysis of Variance
CSA	Central Statistical Agency
EPPA	Ethiopia Pulses Profile Agency
Ho	Null Hypothesis
HI	Alternative Hypothesis
R	Replication
RCBD	Randomized Complete Block Design
T	Treatment
q/ha	Quintal per Hectare

Acknowledgments

Above all I would like to thank my God for the presence with me all ups and downs. Next I would like to thank Hawassa University College of agriculture for providing the resource for this study. Then I would like to express my heartfelt appreciation and thanks to my advisor Dr. Berhanu Abate for his valuable support in advising me during conducting my senior research project and directs me how to through the work smoothly.

Conflicts of Interest

The authors declare no conflicts of interest.

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