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Research Article

Influence of Seeding Rate and Inter-row Spacing on Yield and Yield Components of Tef (*Eragrostis tef Zucc. Trotter)* in Midland of Guji Zone, Southern Ethiopia

Seyoum Alemu*, Aliyi Kedir, Kuma Kebede

Bore Agricultural Research Center, Oromia Agricultural Research Institute, Bore, Ethiopia

Abstract

One of the main factors limiting Tef yield and productivity in the research area is improper seed rate and row spacing. In order to determine the economically feasible seed rate and row spacing for Tef production, a field experiment was carried out to assess the impact of seeding rates and interrow spacing on yield components and yield. Four levels of inter-row spacing (10, 15, 20, and 25 cm) and four levels of seed rate (5, 10, 15, and 20 kg ha^{-1}) were combined in a factorial arrangement with three replications using a Randomized Complete Block Design. Grain yield was greatly impacted by the two components' interaction, but above-ground biomass yield, straw yield, and harvest index were impacted by the main effect. However, neither the main nor the interaction of the two factors influenced plant height, panicle length, days to heading, or days to maturity. The combination of 20 kg seed rate ha^{-1} and 20 cm row spacing produced the maximum grain yield (1557 kg ha^{-1}), while 20 kg seed rate ha^{-1} produced the highest biomass production and straw yield. The combination of 20 kg NPSB and 20 cm row spacing produced an economic advantage of 150,694.22 Birr ha^{-1} with a marginal rate of return of 2465%, according to the results of the economic analysis. Therefore, the use of 20 kg seed rate $ha^{-}$and 20 cm row spacing can be recommended for the production of Tef in the study area and other similar agro ecologies.

Keywords

Significant, Economic Benefit, Grain Yield, Interaction Effect, Main Effect

1. Introduction

Tef (Eragrostis Tef (Zucc.) is a highly valued indigenous cereal crop produced in Ethiopia. It is typically grown by farmers in various sections of the county as a reliable crop to meet their cultural and socioeconomic demands. With an expanse of 3.02 million hectares (23.85%), its national production area surpasses all other cereal crops. Tef comes in second place with a total production of 55.09 million quintals (16.12%) of cereal grains annually (CSA, 2020/21). Approximately 48.86% of the country's total production came from the Oromia regional states, which were followed by Amhara (38.6%), Tigray (4.88%), Southern Nations Nationalities and Peoples (SNNP) (7%), and Benishangul-Gumuz (0.6%). Tef is mostly produced in the South West Shewa Zone of the Oromia Regional State, with an average production of 18 qt/ha. West Shewa Zone produces 3.808 million qt, with an average yield of 18.53 qt/ha. Tef is produced on more than 17,005 ha^{-1} of land in the Guji Zone, yielding more than 230,016 qt. Native American and settler farming cultures mostly use both

*Correspondence: Seyoum Alemu (seyoum23@gmail.com)

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shift and permanent farming techniques to produce it. However, its productivity in the area was less than 1 t ha-1, which is significantly less than the potential yields found in farm verification trials and research stations [1]. Ineffective seeding techniques and seed rates are among the causes of the low yield. Because the majority of Ethiopian farmers use traditional farming methods, the current Tef production system cannot meet customer demand. Contemporary technology does not effectively assist production systems because there is a research gap in selecting the most practical contemporary technology. Thus, one of the biggest issues in Tef production is maintaining seed rate and planting techniques.

The most crucial agronomic factor that requires proper consideration is seed rate. Ethiopia has a general recommendation of 15–55 kg ha Tef seeds, which are cultivated in various parts of the country under various circumstances [2]. Competition between plants for light above ground and nutrients below ground intensifies when plant density surpasses an ideal level [3]. Grain yield declines as a result of slower plant growth. As the seed rate decreased from the highest to the lowest, the yield components of Tef significantly increased. However, by raising the seed rate, the crop's lodging% increased [4]. Therefore, in order to get optimal yields, the ideal plant population density per unit area must be determined.

Among the main constraints restricting Tef production are planting techniques such broadcasting, row planting, and transplanting. The majority of farmers use the conventional sowing technique, which involves casting small seeds widely at a rate of 2530 kg ha [5]. This results in an excessive crop density and increases competition among plants for nutrients, water, sunlight, and CO_2. More over broadcasting methods requires additional seed rate compared to row sowing method thus increases cost of production. Additionally, this seeding technique leads to lodging, which is the primary reason for the low Tef yield because of the high plant density [5]. According to reports, row planting in Tef has a higher yielding advantage than broadcast planting. Low seed rates, row planting, late sowing, and the use of plant growth regulators were employed to reduce the lodging issue on Tef [6].

Tef is produced throughout Ethiopia, particularly in the Guji zone. In the zone, it is grown on 42 hectares of land. Despite being a major crop in the area, its yield is quite low (16.72 q/ha), much lower than the national average yield of 18.82 q/ha [7]. Poor agronomic techniques, including row spacing, seeding rate, sowing date, weeding, and a lack of improved variety, are to blame for these (personal observation). [8] (2013) state that the biggest obstacles to increasing Tef production in Ethiopia's midlands are poor agronomic and soil management, as well as insufficient technology generation and acceptance. Furthermore, no research was done on the proper row spacing and seeding rate. Because of this, the farmers use inappropriate seeding rates and conventional methods like broad casting. In order to establish the best seeding rate and row spacing for Tef productivity and production in the research areas, it is necessary to investigate the effects of various seeding rates and row spacing on Tef yield and yield components. Therefore, the objectives of this research were to determine the economically viable seeding rate and row spacing for Tef production as well as to assess the impact of these factors on yield components and Tef production.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at Adola sub-site of Bore Agricultural Research Center (BOARC), Guji Zone, Oromia Regional State in southern Ethiopia under rain-fed conditions during the 2021-2023 cropping season. The site (55 °36’ 31” N, 38 °58’ 91” E, 1721 m.s.l) is located in Adola town in Dufa Kebele just on the West side of the main road to Negelle town. It is located at about 463 km south from Addis Ababa, the capital city of the country.

The area has a humid, wet climate with a comparatively short growth season. The region experiences 1084 mm of precipitation annually, with a bimodal pattern that runs from April to November. The average yearly temperature ranges from 15.9 ℃ to 9.9 ℃. According to [9] (2011), the soil type is red basaltic soil (Nitisols) and Orthic Aerosols. With a pH of about 5.43, the soil has a clay texture and is rather acidic (Table 1).

2.2. Experimental Materials

2.2.1. Plant Material

As the test crop, Tef variety Dagim was used. Variety was selected due to its environmental tolerance and better performance in the study area.

2.2.2. Fertilizer Materials

Blended NPS (19% N, 38% P_2O_5 and 7% S) and Urea (46% N) was used as the sources of fertilizers.

2.3. Treatments and Experimental Design

The treatments consisted of four seeding rate levels (5, 10, 15, and 20 kg ha^{-1}) and four levels of row spacing (10, 15, 20, 25 cm). The experiment was laid out in a randomized complete block design with three replications in a factorial arrangement of 4 x 4 which constituted 16 treatment combinations. The gross size of each plot was 2.4m × 2.5 m (6 m^2) and the distance between adjacent plots and blocks was 0.5 m and 1 m apart, respectively. The outermost row on both sides of each plot was considered as a border plants and were not used for data collection to avoid border effects.

2.4. Experimental Procedures and Field Management

The experimental field was tilled by tractor and oxen four times, and the plots were leveled by hand. Each treatment was assigned at random to the experimental units within a block, and a field layout was made in compliance with the strategy. In accordance with the concept, tef seeds were manually drilled into rows with varying spacing. As advised for the region, NPS and N fertilizers were applied, with N being applied in split form (half at planting and half at the tillering stage). Weeding, threshing, and harvesting were all done by hand as needed.

2.5. Data Collection and Measurement

Data on days to 50% heading was recorded as the number of days from the date of planting to the date on which the plants from each plot reached 50% of their heading and days to 90% physiological maturity was recorded as the number of days from sowing to the time when 90% of the straw turned a yellow. Plant height was measured in centimeters by averaging the height of ten randomly tagged plants from the net plot area, while panicle length was assessed by measuring ten randomly selected panicles from the base to the tip. Grain yield, expressed in kilograms per hectare, was recorded post-harvest after threshing, and above-ground dry biomass was evaluated by harvesting plants from the net plot area, drying them to a constant weight, and converting this weight to tons per hectare. Straw yield was calculated as the difference between total above-ground dry biomass and grain yield. Finally, the harvest index (HI) was determined as the ratio of grain yield to total above-ground dry biomass, expressed as a percentage.

2.6. Statistical Data Analysis

Using GenStat (18^{th} edition) software, the analysis of variance (ANOVA) approach was used to all gathered data [10]. Using Fisher's protected Least Significant Difference (LSD) test at a 5% threshold of significance, comparisons between treatment means with significant differences for assessed characteristics were conducted.

2.7. Partial Budget Analysis

The economic analysis was carried out using market prices that were in force at the time of planting and harvest, using the methodology described in [11]. Birr per hectare was used to calculate all costs and benefits. The partial budget study included three concepts: the field price of Tef seed (the costs), the mean grain yield for each treatment, and the gross benefit (GB) ha^{-1} (mean yield and straw for each treatment). The marginal rate of return, or the net revenue obtained by incurring a unit cost of seed and its application, was calculated by dividing the net increase in Tef yield caused by the application of each seeding rate. Using the formula NB= (GY x P) – TCV. The net benefit (NB) was computed as the difference between the gross benefit and the total cost that fluctuates (TCV). GY is the adjusted grain yield per hectare, and P is the field price per unit of the crop. 10% of the actual grain yield was deducted. From the range of treatments examined, several were chosen using the dominance analysis method as indicated in [11]. Using this method, the rejected and chosen treatments were referred to as dominated and un-dominated, respectively. The marginal rate of return (MRR) was computed for each pair of ranking treatments using the following formula:

$$\text{MRR (\%)} = \frac{\text{Change in NB (NBb} - \text{NBa)}}{\text{Change in TCV (TCVb} - \text{TCVa)}} \times 100$$

Where NB_a = NB with the immediate lower TCV, NB_b = NB with the next higher TCV, TCV_a = the immediate lower TCV and TCV_b = the next highest TCV.

The return on seeding rate investment was calculated as the percentage MRR between any two un dominated treatments. Changes in NB (increased benefit) divided by change in TVC was used to compute these returns.

3. Results and Discussion

3.1. Physical and Chemical Characteristics of the Soil at the Test Site

A study of some of the physico-chemical properties of the soil prior to seeding is shown in Table 1. With a particle size distribution of 13% clay, 14% silt, and 74% sand, the analysis results of the experimental soil indicated that it belongs to the sandy loam textural class (Table 1). Thus, the soil at the test site is suitable for Tef growth. The soil's pH was 7.00, which is considered neutral, according to [12] (1991). The pH range of 4 to 8 is optimal for most crops and productive soils, according to [13] (2000). As a result, the test soil's pH was within the range that is suitable for productive soils.

The experimental site had a low level of soil organic carbon (1.19%), according to [12] (1991). According to [12] evaluation, the analysis also showed that the soil had a moderate amount of total nitrogen (0.165%). The examination also revealed that the soil has a medium accessible phosphorus level (1.39 ppm), according to [14] (1980). [15] States that the soil sample's low CEC value (10.33 [Cmol (+) kg-1 soil]) suggests that the soil has little capacity to hold onto exchangeable cations.

Table 1. Selected physical and chemical characteristics of the soil at the experiment site before planting.

Parameter	Result	Rating	Reference
Soil texture			
Clay (%)	13		
Sand (%)	74		
Silt (%)	14		
Textural Class	Sandy loam		
pH (1: 2.5 H_2O)	7.00	Neutral	Tekalign (1991)
Total N (%)	0.165	Moderate	Tekalign (1991)
Organic Carbon (%)	1.19	Low	Tekalign (1991)
Cation Exchange Capacity [Cmol(+) kg^{-1} soil]	10.33	Low	Landon (1991)
Available Phosphorus (mg/kg)	1.39	Medium	Cottenie (1980)

3.2. Analysis of Variance (ANOVA)

Analysis of variance indicated that there was a significant difference between parameter of Tef due to different seeding rates and row spacing. All parameters were significantly influenced by either main effects or interaction of the two factors except some phonological parameters like days to heading, days to maturity, plant height and panicle length.

Table 2. Mean squares of ANOVA for growth, yield, and yield component parameters of Tef at midland of Guji.

SV	DF	GY	ADB	HD	MD	PH	PL	SY	HI
Rep	2	6778.	521178	1.698	4.057	115.9	13.86	513228	0.005423
Seed rate	3	108428*	6071257**	2.955NS	4.903NS	169.0NS	2.09NS	4722534**	0.031668*
Row spacing	3	281625**	256498NS	2.649NS	2.347NS	206.5NS	9.72NS	76799NS	0.008793NS
S.rate x R.spacing	9	46714*	795424NS	3.872NS	1.542NS	286.4NS	8.61NS	888570NS	0.011190NS
Error	78	22178	666600	4.057	7.369	378.4	25.57	620102	0.006348
CV (%)		11.70	21.40	3.7	3.00	19.00	12.6	28.7	26.70

GY=grain yield, ADB= above ground dry biomass, DTH=heading days to heading, DTM=days to maturity, PH=plant height, PL=panicle length, SY= straw yield, HI=harvest index, NS= non significant, *= significantly different at 5%, **= significantly different at 1%

3.3. Phenological and Growth Parameters

The results of the analysis of variance showed that neither the two components' main effect nor their interaction had an impact on the days to 90% heading (Table 1). Lack of importance could be that a genotype's genetic composition primarily determines the crop's heading. In a similar vein, the analysis of variance also showed that neither the two components' main effect nor their interaction had an impact on the number of days until 90% maturity (Table 1). Lack of importance could be that a genotype's genetic composition primarily determines the crop's heading.

In other words, neither the main effects seeding rates and row spacing nor the interactions between the factors had a significant ($P<0.05$) impact on the plant height (Table 1). This result indicator that the height of Tef mainly affected by the genetic makeup of the crop. In similar way, panicle length was not significant ($P<0.05$) impacted by the main effects of seeding rates and row spacing as well as the interactions between the factors, according to analysis of variance. This may be due to the genetic effect of the crop since the variety is the same for all treatments (Table 1). The lack of significance might be due to the maturity of the crop is mainly controlled by the genetic makeup of variety.

Table 3*. Influence of seed rate and row spacing on number of days to heading, days to maturity, plant height and panicle lengthof Tef.*

	DTH	DTM	PH (cm)	PL (cm)
Seed rate (kg ha^{-1})				
5	54.08	92.58	102.6	39.87
10	54.75	92.04	100.1	40.46
15	54.71	91.75	105.8	40.05
20	54.17	91.54	100.4	40.44
LSD (0.05)	NS	NS	NS	NS
Row spacing (cm)				
10	54.62	92.08	103.2	39.6
15	54.17	91.75	100.4	40.13
20	54.12	92.38	99.3	40
25	54.79	91.71	105.9	41.1
Mean	54.43	91.98	102.21	40.21
LSD (0.05)	NS	NS	NS	NS
CV (%)	3.7	3.00	19.00	12.6

DTH= days to heading, DTM=days to maturity, PH= plant height, PL=panicle length

3.4. Yield Related Traits and Grain Yield of Tef

3.4.1. Grain Yield

The interaction effects of seeding rate significantly ($P < 0.01$) affected the grain yield of Tef. However, the main effects of row spacing and seeding rate had a significant ($P<0.05$) impact on grain yield (Table 1). Increases in row spacing and seeding rate resulted in higher grain yield (Table 4). Thus, the combination of 20 kg ha^{-1} seeding rate and 20 cm row spacing had the maximum grain yield (1367 C), followed by 20 kg ha^{-1} seeding rate and 20 cm row spacing (1418 kg ha^{-1}) (Table 4). Maximum yield at higher seed rate and spacing implies that, there is a lower plant competition for nutrient and moisture as compared to lower seed rate with lower spacing [16]. In line with the result of this study, [17] reported that increasing the seeding rate and row spacing boosted the grain yield of Tef, with the application of 15 kg ha^{-1} seeding rate and 20 cm row spacing. Similarly [18] reported maximum Tef yield at the 10 kg seeding rate ha^{-1} and 25 cm row spacing. In other words, [19] also reported yield of Tef (1216.8 kg ha^{-1}) at combination of 10 kg seeding rate ha^{-1} and 25 cm row spacing.

Table 4*. Interaction effect of seed rate and row spacing on grain yield of Tef.*

Seed rate (kg ha^{-1})	Grain yield (kg ha^{-1}) Row spacing (cm) 10	15	20	25
5	1275 b-e	1168 d-f	1217 c-e	1137 d-f
10	1290 bcd	1028 f	1360 bc	1232 c-e
15	1405 ab	1177 d-f	1365 bc	1267 b-e
20	1293 b-d	1112 ef	1557 a	1418 ab
Mean				
LSD (0.05)	171.17			

Seed rate (kg ha^{-1})	Grain yield (kg ha^{-1}) Row spacing (cm)			
	10	15	20	25
CV (%)	13.8=11.70			

Means with the same letter(s) in the columns and rows are not significantly different at a 5% level of significance, CV (%) = Coefficient of variation, NS= non-significant, LSD = Least Significant Difference at a 5% level.

3.4.2. Above Ground Dry Biomass

The above ground dry biomass was significantly ($P < 0.05$) affected by the main effects of seeding. But, it did not influenced by the main effect of row spacing and the interaction of the two factors (Table 2).

The application of 20 kg seeding rate ha^{-1} resulted in the largest above ground dry biomass (4321 kg ha-1), while the application of 5 kg seeding rate ha^{-1} produced the lowest above ground dry biomass (3179 kg ha^{-1}) (Table 5). This suggests that the biomass yield increases with increasing planting density or seed rate. The increase in above-ground dry biomass at highest seeding rates is caused by an increase in plant establishment, height, and number of plants per unit area, all of which significantly increase the biomass of the plant.

The result is in line with the findings of [20], who discovered that applying a 25 kg seeding rate ha^{-1} produced the highest biomass yield (6733 kg ha-1). In a similar vein, [17] observed that Tef had the maximum biomass production at Bishoftu with a 15 kg seeding rate ha^{-1} and a 25 cm row spacing. Overall, the biomass produced from the highest seed rate was approximately 35.92% higher than the biomass yield from the lowest seed rate.

3.4.3. Straw Yield

The straw was significantly ($P< 0.05$) affected by the main effects of seeding. But, it did not influenced by the main effect of row spacing and the interaction of the two factors (Table 1). Applying 20 kg of seeding rate ha^{-1} produced the maximum straw yield (3183 kg ha-1), while applying 5 kg of seeding rate ha^{-1} produced the lowest above-ground dry biomass (2170 kg ha^{-1}) (Table 5). The crop competition at the highest seed rate, which favors straw rather than yield, may be the cause of the notable rise in straw yield in response to the highest seed rate. Generally speaking, the straw yield from the greatest seed rate was around 46.68% higher than that from the lowest seed rate. The result is in line with [17] finding that straw output at Ude was not significant for Tef.

3.4.4. Harvest Index

Harvest index was significantly ($P < 0.05$) affected by the main effects of seeding. But, it did not influenced by the main effect of row spacing and the interaction of the two factors (Table 2). Table 5 shows that the application of 5 kg seeding rate ha^{-1} gave the highest harvest index (0.34), while the application of 20 kg seeding rate ha^{-1} produced the lowest harvest index (0.26). The straw yield from the highest seed rate was generally 46.68% higher than the straw yield from the lowest seed rate. When decreased seed rates were applied, a rising harvest index was seen. As the sowing rate declined, the harvest index tended to rise. Greater biomass output, or proportionately higher vegetative biomass yield than grain yield, may be the cause of the increase in the harvest index at lower seed rates. In contrary to this result, [17] reported no significant effect of seed rate and row spacing on harvest index of Tef.

Table 5. *Influence of seed rate and row spacing on above ground dry biomass yield, straw yield and harvest index of Tef.*

	ADB (kg ha^{-1})	SY (kg ha^{-1})	HI (%)
Seed rate (kg ha^{-1})			
5	3179 c	2170 c	0.34 a
10	3676 b	2639 b	0.29 b
15	4096 ab	2983 ab	0.27 b
20	4321 a	3183 a	0.26 b
LSD (0.05)	938.44	905.12	0.09
Row spacing (cm)			
10	3898	2772	0.3121
15	3722	2791	0.2719
20	3916	2748	0.3125
25	3736	2663	0.2951
Mean	3818.04	2743.46	0.30
LSD (0.05)	NS	NS	NS
CV (%)	21.40	28.7	26.70

ADB=above ground dry biomass yield, SY=straw yield and HI=harvest index

3.5. Partial Budget Analysis

Table 6 displays the results of the analysis of the marginal rate of return, net benefits, and total variable expenses. Farmers must be aware of the costs and benefits of treatments in order to adopt technological innovation. The study assessed the financial benefits of the treatments in order to generate recommendations based on the agronomic data. Farmers in the study area are better able to choose the appropriate mix of resources as a result. The results of the study showed that a combination of 20 cm row spacing and a 20 kg seeding rate ha^{-1} resulted in greater net benefits (Table 6).

Table 6 shows that the highest net benefit (Birr 133,594.22 ha-1) was obtained when 20 kg seeding rate ha^{-1} and 20 cm row spacing were combined. This was followed by 15 kg seeding rate ha^{-1} and 10 cm row spacing (121,268.80 Birr ha-1). If fertilizer recommendations are based on the marginal rate of return (MRR%), the minimum acceptable rate of return should be between 50% and 100% [11]. The combination of 20 kg seeding rate ha^{-1} and 20 cm row spacing produced the biggest income in this study, 133,594.22 birr ha-1, with a marginal rate of return of 2465%. The optimal and most economical combination for producing Tef in the study area and other locations with similar agro-ecological conditions is 20 kg seeding rate ha^{-1} and 20 cm row spacing. This treatment was therefore recommended for the research area. According to [18] (2020), Tef at 10 kg seed rate ha^{-1} and 25 cm row spacing increased grain yield and economic advantage in the western region of Ethiopia. For the cultivation of Tef in Ethiopia's central highlands, [17] found that a combination of 10 kg seed rate ha^{-1} and 20 cm inter-row spacing produced the greatest net benefit.

Table 6. *Analysis of the partial budget and marginal rate of return for the Tef as influenced by seeding rate and row spacing.*

Treatments						
Seed rate (kg ha^{-1})	**Row spacing (cm)**	**Adjusted grain yield down wards by 10% (kg ha^{-1})**	**Gross Benefit (Birr ha^{-1})**	**Total variable cost (Birr ha^{-1})**	**Net return (Birr ha^{-1})**	**MRR (%)**
5	10	1147.50	120925.16	500.00	120,425.16	0
5	15	1051.50	113763.62	500.00	113,263.62	D
5	20	1095.00	119254.22	500.00	118,754.22	D
5	25	1023.00	112471.22	500.00	111,971.22	D
10	10	1161.00	126566.68	1000.00	125,566.68	1028
10	15	925.50	103411.50	1000.00	102,411.50	D
10	20	1224.00	133562.44	1000.00	132,562.44	D
10	25	1108.50	120580.62	1000.00	119,580.62	D
15	10	1264.50	139868.80	1500.00	138,368.80	1162
15	15	1059.00	118238.50	1500.00	116,738.50	D
15	20	1228.50	133046.96	1500.00	131,546.96	D
15	25	1140.00	125772.42	1500.00	124,272.42	D
20	10	1164.00	130695.46	2000.00	128,695.46	D
20	15	1000.50	112884.86	2000.00	110,884.86	D
20	20	1401.00	152694.22	2000.00	150,694.22	2465
20	25	1276.50	138578.78	2000.00	136,578.78	D

Where, MRR (%) = Marginal rate of return, D= Dominated treatment,

4. Conclusions and Recommendations

A field experiment was carried out during the main cropping season with the objective to evaluate the impact of seeding rate and inter row spacing on yield components and yield of Tef. Analysis of the data showed that all parameters were significantly (P<0.05) affected by the interaction and main effects of the factors except days to heading, days to maturity, plant height and panicle length. This shows how the factors play a role in the productivity and production of Tef. Thus, yield and yield components of Tef improved by using different seed rate and row spacing. According to the partial budget analysis, combined use of 20 kg seed rate ha^{-1} and 20 cm inter row spacing produced the highest grain yield and the best economic benefit with acceptable MRR. Therefore, use of 20 kg seed rate ha^{-1} and 20 cm inter row spacing can be recommended for the production of Tef for the study area and other places with similar agro-ecologies.

Abbreviations

SNNP	Southern Nations Nationalities and Peoples
BOARC	Bore Agricultural Research Center
ANOVA	Analysis of Variance
MRR	Marginal Rate of Return
IQQO	Oromia Agricultural Research Institute

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Author Contributions

Seyoum Alemu: Data curation, Formal Analysis, Methodology, Writing – original draft, Writing – review & editing

Aliyi Kedir: Formal Analysis, Methodology, Supervision

Kuma Kebede: Formal Analysis, Methodology, Supervision

Conflicts of Interest

The authors declare there are no conflicts of interest.

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