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Research Article

Effect of Nitrogen Fertilizer and Seed Rates on Growth, Yield and Yield Components of Bread Wheat in Jimma Zone South Western Ethiopia

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Abstract

Wheat is one of the most important cereal crops in terms of production and consumption in Ethiopia. The country has the potential to produce a sufficient amount of wheat grain using irrigation, and government also gave attention to produce wheat and export it. But inappropriate agronomic practices, soil fertility depletion, and drought are among the constraints to the low yield of wheat crops in the country. In view of this, the field experiment was conducted during the irrigation season of 2020/2021 in two districts that are selected as irrigation potential and irrigation facilities namely, Sekacokorsa and Tiroafetadistricts of Jimma zone. The field experiment consisted of four N fertilizer rates (0, 23, 46, 69, and 92 kg Nha^{-1}) and three seed rates (125, 150, and 175 kg ha^{-1}). The experiment was laid out in a randomized complete block design with a factorial arrangement in three replications. From the field experiment results, the growth, yield and yield components of the crop were improved by optimizing plant population density and nitrogenfertilizerapplication. Numerically the highest grain yield and above ground biomass of 6.7 and 13.09 t ha^{-1}at Tiroafeta and 3.67 and 9.61 t ha^{-1} at Sekacokorsawas recorded in response to the seed rate of 175 kg ha^{-1} respectively. On other hand in response to N fertilizer rate the maximum grain yield of 6.9 t ha^{-1}and above ground biomass of 14.04 t ha^{-1} at Tiroafetawas recorded from 92kg N ha^{-1}and 69 kg N ha^{-1} respectively. Whereas at Sekacokorsa the highest grain yield of 3.72 t ha^{-1}and above ground biomass of 9.76 t ha^{-1} was obtained from nitrogen fertilizer rate of 46kg N ha^{-1}. In conclusion, N fertilizer rate of 46kg Nha^{-1} and seed rates of 125 kg ha^{-1}in both locationsgavethe optimum yield. But due to the field experiment was done for one year only it should be repeated over the years to give sound recommendationsunder similar agro ecologies.

Keywords

Seed Rate, Nitrogen, Yield, Wheat and Fertilizer

1. Introduction

Bread wheat (*Triticumaestivum* L.) is one of the mostimportant cereal crops of the world and is a staple foodfor about one third of the world's population [1]. It isone of the major cereal crops grown in the highlands up tomid lands and currently produced in clusters at different area ofEthiopia under irrigation. Wheat ranked 3rd in grain crop area and productionafter maize (*Zeamays*) and tef (*Eragrostistef*). The total graincropareawas1.87 million hectare and production of 58.1

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million quintal with average productivity of 31.1 quintal per hectare [2]. But its average yield is still verylow and below theworld's average [3]. The low yield may be due to the use of different or not optimum seed rate, varieties, diseases, low soil fertility and also improper water managements.

Plant density is a major factor determining the ability of the crop to capture resources and generate yield. Also it was the main responsible factors for low yield are less or more than optimum plant population and inadequate crop nutrition application especially nitrogen. It can be developed by using a suitable seeding rate. Growth and yield of wheat are affected by environmental conditions and can be regulated by seeding rate [4]. Maximum genetic potential of high yielding wheat varieties cannot be harvested without ensuring proper seeding rate. As the plant density increases, the competition for resources especially for nitrogen also increases that badly affect the ultimate yield. Provision of additional nitrogen can be hypothesized to further enhance the yield by increasing plant population but up to an optimum level. Further higher nitrogen can lead to the lodging of plants at higher seed rate [5]. Nitrogen occupies a conspicuous place in plant metabolism. Consequently to get more crop production, nitrogen availability is essential in the form of chemical fertilizers. All vital processes in plant are associated with protein, of which nitrogen is an essential constituent. The research work done indicates that appropriate level of nitrogen application has increased wheat yield significantly [6, 7]. Proper use of nitrogen is also considered for farm profitability and environment protection [8].

These all potentially limit crop productivity despite optimum use of nitrogen fertilizer and seed rate. Therefore, in order to set priorities among the different plant nutrients, it is important to identify the status of the limiting nitrogen nutrients in various soils and the seed rate. Thus, this research was carried out to investigate the optimum nitrogen fertilizer rate and seed rate applied for irrigated wheat for better yield and yield components at Jimma South western Ethiopia.

2. Materials and Methods

2.1. Description of the Study Site

The experiment was conducted in Tiroafeta and Sekacokorsa districts of Jimma zone in Oromia National Regional State of Ethiopia under irrigation condition from Mid of December to the end of December 2020. Tiroafeta district is situated at latitude07^{0}58' N and longitude 36^{0}70' E with an elevation of 1675 meters above sea level. The experimental sitereliably receives good rains upto1955 mm per annum and minimum and maximum temperatures of 11.5 ℃ and 25 ℃, respectively. Whereas Sekacokorsa district is located at latitude07^{0}30' N and longitude 36^{0}05' E with an elevation of 1750 meters above sea level. The experimental site reliably receives good rains upto1775 mm per annum and minimum and maximum temperatures of 12.7 ℃ and 25.7 ℃, respectively. The soil of the experimental sites isnitosol type.

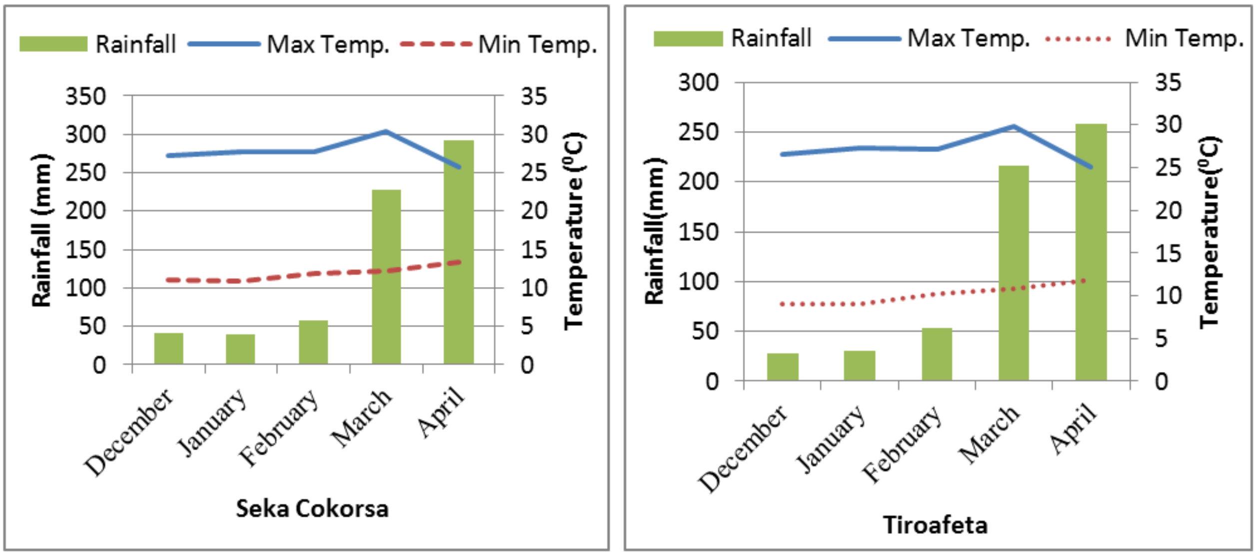

Figure 1. Monthly total rainfall and mean maximum and minimum temperatures in December 2020 up to April 2021 during irrigation wheat growing months at Sekacokorsa and Tiroafeta district.

2.2. Treatments and Experimental Design

The treatments were consisting of four rates of N fertilizer: (0, 50, 100 and 150 and 200 kg urea ha^{-1} or 0, 23, 46, 69 and 92 kg N ha^{-1} respectively) and three seed rates (125, 150 and 175 kg ha^{-1}), arranged in a factorial randomized complete block design (RCBD) with three replications. The Gross area of each plot size was 5 m x 3 m (15m^2). There are 15 rows in each plot with 20 cm inter row spacing. The spacing between adjacent plots and replications were 0.5m and 1m respectively.

2.3. Experimental Materials

The bread wheat variety Kakaba was used as planting material. The variety was selected based on its adaptability to agro-ecological conditions and better performance in yield at the area. Kakabais the most common and widely distributed bread wheat variety in the country. The blended NPS fertilizer rates at 100 kg ha^{-1} (19% of N, 38% of P_2O_5 and 7% of S) were uniformly supplemented for experimental plots except for without fertilizer (negative control plot) at sowing. Urea fertilizer as source of Nitrogen (46% N) was used.

2.4. Experimental Procedures and Field Management

The experimental field was ploughed with tractor and oxen to a fine tilth four times and the plots were leveled manually. Then, a field layout was made and each treatment was assigned randomly to the experimental units within a block. Bread wheat seed was sown at the assigned treatment seed rate of rows of 20 cm spacing manually by drilling. The whole amount of blended (NPS) was applied at sowing and the 1/3 and 2/3of nitrogen was applied at the time of sowing and top-dressed at tillering (30 days after sowing) respectively. The spacing between ridge rows, plots and blocks were 50, 100, 200cm respectively. Weeding was done 3 times and harvesting and threshing was done manually. Other necessary cultural practices were applied to all plots uniformly as needed.

2.5. Data Collection

Plant height, number of total tillers, number of productive tillers, spike length (cm), number of kernels per spike, thousand seed weight (g), grain yield (t ha^{-1}), above ground biomass (t ha^{-1}) and harvest index.

2.6. Statistical Analysis

Data were subjected to analysis of variance (ANOVA) by using the methods described by Gomez and Gomez [9] using SAS computer software 9.3. The comparisons among treatment means with significant difference for measured characters were done by LSD test at 5% level of significance.

3. Results and Discussions

The field trials were conducted at TiroAfeta and Sakacokorsa districts. The three seed rates and five Nitrogen rates were tested using bread wheat (kakaba variety) under irrigation on farmer's fields. The expected wheat stand per square meter was optimized. The effect of different rates of N fertilizer and seed rate on yield and yield related parameters of wheat variety were presented and discussed as follows.

The homogeneity test of the error variances for years indicated that the error variance was not homogenous and hence combined analysis of variance was not conducted over the locations. At both district (Sekacokorsa and Tiroafeta) N fertilizer rates and seed rate didn't show significant ($P > 0.05$) interaction effect on all collected growth, yield and yield related parameters. Grain yield and above ground biomass was highly significantly ($P < 0.01$) influenced by N fertilizer rate, but grain yield was not significantly ($P > 0.05$) affected by seed rate at both locations. Above ground biomass was highly significantly ($P<0.01$) influenced by seed rate at Sekacokorsa district. At Tiroafeta district number of kernels per spike was highly significantly ($P<0.01$) affected by N fertilizer rate and but not significantly ($P > 0.05$) affected by seed rate at Sekacokorsa. Whereas plant height, number of total tillers, number of productive tillers, spike length, thousand seed weight and harvest index was not significantly ($P>0.05$) affected by seed rate and N fertilizer rate at both locations (Tables 1 and 2).

Table 1. *Mean square of the effects of N fertilizer rates and seed rates on growth, yields attributes and yield of wheat at Sekacokorsaworeda, Jimma zone southwestern Ethiopia under irrigation condition.*

Parameter	Seed rate (2)	N rate (4)	Rep (2)	Seed rate x N rate (8)	Error (28)
Plant height (cm)	3.569^{ns}	8.845^{ns}	40.991^{ns}	4.541^{ns}	14.1898
No. of total tillers	0.116^{ns}	0.304^{ns}	15.606**	0.514^{ns}	0.4546
No. of productive tillers	0.170^{ns}	0.069^{ns}	11.991**	0.427^{ns}	0.3795
Spike length (cm)	0.062^{ns}	1.0552^{ns}	1.154^{ns}	0.1901^{ns}	0.5571
No. of kernel per spike	7.0202^{ns}	18.798^{ns}	21.1209^{ns}	14.8022^{ns}	11.3380
Thousand seed weight (gm)	8.435^{ns}	3.497^{ns}	8.828^{ns}	6.094^{ns}	6.1456

Parameter	Seed rate (2)	N rate (4)	Rep (2)	Seed rate x N rate (8)	Error (28)
Grain yield (t ha^{-1})	0.1884^{ns}	0.3361^{**}	0.0341^{ns}	0.1126^{ns}	0.0925
AGB (t ha^{-1})	3.2135^{**}	2.8859^{**}	4.7894^{**}	0.4724^{ns}	0.6511
Harvest index	9.523^{ns}	1.873^{ns}	78.104^{**}	7.035^{ns}	6.5124

Numbers in parenthesis = Degrees of freedom; Ns=not significant (P >0.05)= Significant (P < 0.05); ** = highly significant (p<0.01) difference; AGB= Aboveground biomass; ha = Hectare

Table 2. *Mean square of the effects of N fertilizer rates and seed rates on growth, yields attributes and yield of wheatat Tiroafetaworeda, Jimma zone southwestern Ethiopia under irrigation condition.*

Parameter	Seed rate (2)	N rate (4)	Rep (2)	Seed rate x N rate (8)	Error (28)
Plant height (cm)	0.556^{ns}	41.522^{ns}	12.289^{ns}	51.472^{ns}	29.027
No. of total tillers	0.422^{ns}	0.557^{ns}	14.391^{**}	1.490^{ns}	1.1140
No. of productive tillers	0.296^{ns}	0.867^{ns}	9.689^{**}	1.124^{ns}	0.825
Spike length (cm)	0.800^{ns}	0.144^{ns}	1.267^{*}	0.244^{ns}	0.2905
No. of Kernel per spike	7.990^{ns}	108.107^{**}	16.042^{ns}	13.774^{ns}	13.8718
Thousand seed weight (gm)	5.243^{ns}	0.520^{ns}	0.860^{ns}	3.742^{ns}	3.3709
Grain yield (t ha^{-1})	0.464^{ns}	2.984^{**}	0.027^{ns}	0.246^{ns}	0.5780
AGB (t ha^{-1})	2.468^{ns}	19.669^{**}	2.064^{ns}	2.848^{ns}	4.3971
Harvest index	71.489^{ns}	29.649^{ns}	41.366^{ns}	32.317^{ns}	36.1422

Numbers in parenthesis = Degrees of freedom; Ns=not significant (P >0.05)= Significant (P < 0.05); ** = highly significant (p<0.01) difference; AGB= Above ground biomass; ha = Hectare

3.1. Plant Height

The interaction, seeding rate and nitrogen levels were found non significant (Tables 1 and 2) for both locations. However, comparatively taller plants were observed at seeding rate of 150 kg $ha^{-1}$and 175 kg ha^{-1}at Tiroafeta and Sekacokorsa respectively. Concerning N fertilizer rate taller plants were recorded from 92 kg N ha^{-1} at both locations (Tables 3 and 5). The research findings are in coordinate with Lafond*et al.* [10]; Geleta*et al.* [11] (2002). Ali *et al.* [12] studied that maximum plant height was obtained at a seeding rate of 125 $kgha^{-1}$. Chandra *et al*. [13] concluded that plant height increased significantly by increasing nitrogen levels.

3.2. Number of Total Tillers

Crop yields are generally dependent upon many yield contributing agents. Among these numbers of tillers are the most important because of the contribution in final yield. The interaction, seeding rate and nitrogen levels were found non significant (Tables 1 and 2) for both locations. But, comparatively more number of tillers was observed at seeding rate of 175 kg ha^{-1} and N fertilizer rate of 23 kg N ha^{-1} at Tiroafeta district and at seeding rate of 150 kg ha^{-1} and N fertilizer rate of 92 kg N ha^{-1} at Sekacokorsa (Tables 3 and 5). Increase in number of tillers per unit area is due to increased seeding rate [14, 15]. N fertilizer rate also contributed in increasing tiller production up to an optimum level [16, 17]. Above optimum, the decrease in tillers might be due to the competition for space.

3.3. Number of Productive Tillers

The interaction, seeding rate and nitrogen levels were found non significant (Tables 1 and 2) for both locations. However, comparatively the maximum number of productive tillers per plant was observed at seed rate of 150 kg ha^{-1}at both locations and N fertilizer rate of 69kgN $ha^{-1}$and 46 kg N ha^{-1}at Tiroafeta and Sekacokorsa respectively (Tables 3 and 5). The current result is in agreement with Adinew [18] and Amare [19] who found that maximum productive tiller was recorded from minimum seed rate and vice versa under rain-fed conditions. On the other hand, Iqbal*et al*. [20] reported that maximum productive tillers were obtained at 200 kg ha^{-1} seed rates than at lower seeding rates under rain-fed conditions.

3.4. Spike Length

The interaction, seeding rate and nitrogen levels were found non significant (Tables 1 and 2) for both locations. However, numerically the maximum spike length was observed at seeding rate of 125 kg ha^{-1} and N fertilizer rate of 69 kg N ha^{-1} at Tiroafeta district whereas at Sekacokorsa the highest spike length recorded from the seed rate of 175 kg ha^{-1} and N fertilizer rate of 92 kg N ha^{-1} (Tables 3 and 5). These results are in agreement with those of Hussain *et al*. [21] and Ahmad *et al.* [14]. They concluded that spike length of wheat was increased significantly with increasing nitrogen levels.

3.5. Number of Kernels Per Spike

Seeding rate did not affect number of kernels per spike at both locations; however, nitrogen fertilization highly significantly affected kernels per spike at Tiroafeta but not significantly affected at Sekacokorsa (Tables 1 and 2). Highest number of kernels per spike (46.6) was observed at nitrogen fertilizer rate of 23 kg N ha^{-1} followed by 69 kg N ha^{-1} at Tiroafeta (Table 3). In agreement with this result, Dinkinesh [22] reported the highest number of kernels produced from the highest rate of NPSB fertilizers. In line with this, Seyoum [23] also reported that increasing the rates of N increased the number of kernels produced per spike.

Table 3. Main effect of seed rates on growth and yield components of bread wheat variety at TiroAfetaworeda.

Seed rates (kg ha^{-1})	Plant height (cm)	No. of total tillers	No. of productive tillers	Spike Length (cm)	Number of kernels per spike	Thousand seed weight (gm)
125	82.1	4.6	4.0	7.9	42.7	42.7
150	82.5	4.8	4.2	7.5	43.3	43.2
175	82.1	4.9	3.9	7.9	41.8	42.0
LSD (0.05)	4.03	0.79	0.679	0.403	2.786	1.373
Nitrogen Rates (kg ha^{-1})						
0	79.2	4.8	3.9	7.6	39.8^{cd}	42.4
23	81.4	5.0	4.1	7.8	46.6^{a}	42.8
46	82.7	4.3	3.8	7.8	38.5^{d}	42.9
69	82.8	4.9	4.6	7.9	45.1^{ab}	42.6
92	85.1	4.7	3.9	7.7	43.0^{bc}	42.4
Mean	82.2	4.74	4.04	7.73	42.6	42.6
LSD (0.05)	5.2	1.02	0.877	0.52	3.6	1.77
CV (%)	6.55	22.3	22.5	6.97	8.74	4.31

3.6. Thousand Seed Weight

The interaction, seeding rate and nitrogen levels were found non significant (Tables 1 and 2) for both locations. However, comparatively the highest thousand seed weight was recorded from 150 kg ha^{-1} seed rate and N fertilizer rate of 46 kg N ha^{-1}at Tiroafeta district (Table 3). At Sekacokorsa district the highest thousand seed weight was obtained from seed rate of 175 kg ha^{-1} and N fertilizer rate of 23kg N ha^{-1} (Table 5). The insignificance of N rate might be due to good grain filling period and favorable environmental condition. In line with this Bereket*et al.* [24] also reported that increasing N rate from 92 kg N ha^{-1}to 138 kg N ha^{-1} decreased thousand kernels weight.

3.7. Grain Yield

Grain yield of wheat is the function of its unique yield component in response to nitrogen level and seeding rate for the yield of the crop. Grain yield was highly influenced by N fertilizer rate at both locations but not significantly influenced by seed rate and interaction of seed rate and N fertilizer rate (Tables 1 and 2). The higher grain yield (7.10 t ha^{-1}) was obtained from N fertilizer rate of 69 kg N ha^{-1}which was statically at par with N rate of 92 and 46 kg N ha^{-1}at Tiroafeta (Table 4). N application of 46 kg N ha^{-1} increased the grain yield by 19.8% over the control at Tiroafeta district. At Sekacokorsa the highest grain yield of 3.72 t ha^{-1} was recorded from N fertilizer rate of 46 and 92 kg N ha^{-1}which was statically at par with N rate of 69 kg N ha^{-1} (Table 6). Application of 46 kg N ha^{-1} increased the grain yield by 11.1% over the control at Sekacokorsa. At both locations the seed rate of 175 kg ha^{-1} gave highest grain yield even if non significant difference was not seen between different seed rates (Tables 4 and 6). The maximum grain yield might be attributed to the improvement in number of tillers, spike length, and 1000 grain weight. Similar results were obtained by Pandy*et al.* [25]. He reported that increasing nitrogen rates increased grain yield. Maqsood*et al.* [26] found that application of 150 kg N ha^{-1} gave the highest grain yield. Nitrogen fertilizer up to 150 kg ha^{-1} increased the grain yield, whereas higher levels of N fertilizer decreased both yields [27]. N application increased the grain yield by 9.6% in wheat and deficiency depressed the yield in cereals [28].

Table 4. *Main effect of seed rates on yield and harvest index of bread wheat variety at TiroAfetaworeda.*

Seed rates (kg ha^{-1})	Grain Yield (t ha^{-1})	Above ground BiomassYield (t ha^{-1})	Harvest index
125	6.61	12.28	55.0
150	6.36	12.66	50.8
175	6.70	13.09	51.8
LSD (0.05)	0.569	1.568	4.53
Nitrogen Rates (kg ha^{-1})			
0	5.76^{b}	10.71^{c}	53.9
23	6.15^{b}	11.59^{bc}	54.5
46	6.90^{a}	13.13^{ab}	52.9
69	7.10^{a}	14.04^{a}	51.1
92	6.90^{a}	13.95^{a}	50.2
Mean	6.56	12.68	52.53
LSD (0.05)	0.734	2.025	5.85
CV (%)	11.59	16.5	11.44

3.8. Above Ground Biomass

Above ground biomass represent overall growth performance of the plant as well as the crop and is considered to be the essential yield parameter to get useful information about overall growth of wheat. It is highly inclined by crop nutrition and seed rate. Above ground biomass was highly influenced by N fertilizer rate at both locations but not significantly influenced by seed rate at Tiroafeta and highly influenced by seed rate at Sekacokorsa district (Table 1 and 2). At Tiroafeta the highest above ground biomass (14.04 t ha^{-1}) was obtained at N fertilizer rate of 69 kg ha^{-1} which was statistically at par with N fertilizer rate of 46 and 92 kg ha^{-1} while lowest above ground biomass (10.71 t ha^{-1}) was recorded fromcontrol (Table 4). At Sekacokorsa district the highest above ground biomass (9.76 t ha^{-1}) was obtained at N fertilizer rate of 46 kg ha^{-1} which was statistically at par with N fertilizer rate of 69 and 92 kg ha^{-1} while lowest above ground biomass (8.57 t ha^{-1}) was recorded from control (Table 6). Regarding seed rate the highest above ground biomass (9.61t ha^{-1}) was recorded from 175 kg ha^{-1} which was statistically at par with 150 kg ha^{-1} seed rate at Sekacokorsa district (Table 6). Increased in biomass production might be attributed to the increased plant population due to higher seeding rate. These results were in agreement with Islam *et al.* [17], Mojiri and Arzani [27] and Soylu*et al.* [28]. Otteson*et al.* [29] found that biological yield was increased by increasing nitrogen up to optimum levels. Nayyar*et al.* [30] obtained the highest biological yield at higher seeding rate of 100 kg ha^{-1}.

Table 5. *Main effect of seed rates on yield and yield components of bread wheat variety at Sakacokorsaworeda.*

Seed rates (kg ha^{-1})	**Plant height (cm)**	**Number of total tillers**	**Number of productive tillers**	**Spike length (cm)**	**Number of kernels per spike**	**Thousand seed weight (gm)**
125	82.6	3.4	2.8	9.1	43.5	34.6
150	82.2	3.5	3.0	9.1	42.2	35.9
175	83.2	3.3	2.9	9.2	43.3	36.0
LSD (0.05)	2.82	0.50	0.461	0.56	2.52	1.85
Nitrogen rates (kg ha^{-1})						
0	81.8	3.3	2.8	8.8	42.9	35.8
23	82.3	3.5	2.9	8.9	41.6	36.0
46	81.9	3.4	3.0	9.1	42.3	34.5
69	83.3	3.1	2.8	9.1	42.8	35.3
92	84.0	3.6	3.0	9.7	45.4	35.8
Mean	82.7	3.4	2.91	9.1	43.0	35.5
LSD (0.05)	3.64	0.65	0.59	0.72	3.25	2.39
CV (%)	4.6	19.89	21.2	8.2	7.8	6.99

3.9. Harvest Index

The ability of a cultivar to convert the dry matter into economic yield is indicated by its harvest index. The higher the harvest index value, the greater the physiological potential of the crop for the converting dry matter to grain yield. The interaction, seeding rate and nitrogen levels were found non significant (Tables 1 and 2) for both locations. However, comparatively the highest harvest index was recorded from 125 kg ha^{-1} seed rate and N fertilizer rate of 23 kg ha^{-1}at Tiroafeta district (Table 4). At Sekacokorsa district the highest harvest index was obtained from seed rate of 125 kg ha^{-1} and N fertilizer rate of 92 kg ha^{-1} (Table 6). Increase in nitrogen level increased harvest index [16].

Table 6. *Main effect of seed rates on yield and yield components of bread wheat variety at Sakacokorsaworeda.*

Seed rates (kg ha^{-1})	**GrainYield (t ha^{-1})**	**Above ground Biomass (t ha^{-1})**	**Harvest index**
125	3.44	8.72^{b}	39.6
150	3.57	9.41^{a}	38.2
175	3.67	9.61^{a}	38.3
LSD (0.05)	0.23	0.60	1.92
Nitrogen rates (kg ha^{-1})			
0	3.35^{b}	8.57^{b}	39.1
23	3.36^{b}	8.71^{b}	38.8
46	3.72^{a}	9.76^{a}	38.1
69	3.68^{a}	9.68^{a}	38.3
92	3.72^{a}	9.52^{a}	39.2
Mean	3.56	9.25	38.7
LSD (0.05)	0.29	0.78	2.48
CV (%)	8.5	8.7	6.59

4. Conclusions

From the present study, we observed that the grain yield and yield components of bread wheat that were planted under irrigation were highly improved through optimizing nitrogen application and plant population. At both district (SekaCokorsa and Tiroafeta) N fertilizer rates and seed rate didn't show significant interaction effect on all collected growth, yield and yield related parameters. Grain yield and above ground biomass was highly significantly influenced by N fertilizer rate, but grain yield was not significantly affected by seed rate at both locations. Above ground biomass was highly significantly influenced by seed rate at Sekacokorsa district. At Tiroafeta district number of kernels per spike was highly significantly affected by N fertilizer rate and but not significantly affected by seed rate at Sekacokorsa. The higher grain yield (7.10 t ha^{-1}) was obtained from N fertilizer rate of 69 kg N ha^{-1}which was statically at par with N rate of 92 and 46 kg N ha^{-1}at Tiroafeta whereas at Sekacokorsa the highest grain yield of 3.72 t ha^{-1} was recorded from N fertilizer rate of 46 and 92 kg N ha^{-1}which was statically at par with N rate of 69 kg ha^{-1}. In conclusion, N fertilizer rate of 46 kg N ha^{-1} and seed rates of 125 kg ha^{-1} in both locations gave the optimum grain yield. As a conclusion, since this study was conducted in one season, it should be repeated in more seasons for further recommendation under similar agro ecologies.

Abbreviations

AGB: Above Ground Biomass
ANOVA: Analysis of Variance
CV: Coefficient of Variation
Ha: Hectare
LSD: Least Significant difference
NS: Not Significant
RCBD: Randomized Complete Block Design

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Conflicts of Interest

The authors declare no conflicts of interest.

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