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Effects of Row Spacing and Seed Rate on Yield and Yield Components of Bread Wheat (Triticum Aestivum L.) in Mid Altitude of Sankura District, South Ethiopia

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ABSTRACT

Many farmers in developing countries prefer to use a higher seed rate than recommended, because they perceive it as a good strategy to control weeds and reduce the risks of crop production. A field experiment was conducted to study the effect of seed rate and row spacing on yield and yield components of bread wheat at Sankura district, Siltie Zone on farmer's training center during 2017 and 2018 main cropping season. Four levels of seed rates (100, 125, 150 and 175kg/ha) and three row spacing (20, 30 and 40 cm) were included. The experiment was laid out in randomized complete block design in a factorial arrangement with three replications. All the studied parameters were not significantly affected by the combined effects of row spacing seed rate. In 2017 the treatments did not showed any significant difference for all studied parameters. Also, in 2018, except seeds per spike and grain yield, other yield and yield components were not significantly affected the treatment factors. The lowest grain yield was recorded due to 40 cm compared to 20 cm and 30 cm row spacing. Due to seed rate of 150 kg/ha, 229 kg and 415 kg yield advantage was obtained compared to 100 kg/ha and 125 kg/ha seed respectively. Hence, sowing the seed at the rate of 175 kg/ha in 30cm row spacing is recommended in the study area.

Keywords: *seed rate, row spacing, bread wheat, grain yield*

INTRODUCTION

Wheat is one of the most important cereals cultivated in Ethiopia. It is mainly grown at altitudes ranging from 1500 to 2800 meters above sea level and with mean minimum (Gashaw *et al.*, 2014). Bread wheat in Ethiopia is used in different forms such as bread, porridge, soup and roasted grain. In addition to the grain, the straw of bread wheat is used for animal feed, thatching roofs and bed decking. In spite of its tremendous importance, wheat production in Ethiopia faced immense production constraints that are affecting both its yield potential and industrial quality (Amare *et al.,* 2015).

In Ethiopia wheat is predominantly grown by small scale farmers at a subsistence level, and these farmers experience a wide range of biotic, abiotic and socioeconomic constraints. The average productivity of wheat in Ethiopia is still low; about 2535 kg/ha as which is much below that of the world's average about 2900 kg/ha (CSA, 2016). Among the factors responsible for low wheat yield, delay in sowing, traditional sowing methods, low seed rate and improper row spacing are very important (*Iqba et al., 2010*).

Many farmers in developing countries prefer to use a higher seed rate than recommended, because they perceive it as a good strategy to control weeds and reduce the risks of crop production. Planting higher seed rate than the recommended rate is not encouraged because of its negative impact on seed quality, particularly on seed size and weight. Instead of using higher rates, farmers must pay close attention to all recommended seed production practices. Moreover, plant spacing determines the area available to each plant which in turn determines nutrient and moisture availability to the plant. Row spacing determines resource availability and utilization by individual plants in a given species. Planting decisions require that optimum row widths for the seed crop be determined. If the row is too wide, the crop is unable to rapidly shade the inter-row area to capture sunlight and weeds quickly become established. If the row is too narrow, inter-row crop competition results in poorer yields, difficulties in disease and insect control, and greater likelihood of lodging. Seeding rate above or below the optimum may reduce the yield significantly (Peter *et al*., 1988). Row spacing plays a significant role on growth, development, and yield of bread wheat at its optimum level beside it provides scope to the plants for efficient utilization of solar radiation and nutrients. Hence, this research was proposed to determine optimum row spacing and seed rates for traditional farming system.

Materials and Methodology

Experimental Design and Procedures

A field experiment was conducted to study the effect of seed rate and row spacing on yield and yield components of bread wheat at Sankura district, Siltie Zone on farmer's training center during 2017 and 2018 main cropping season. Four levels of seed rates (100, 125, 150 and 175kg/ha) and three row spacing (20, 30 and 40 cm) were included. The experiment was laid out in randomized complete block design in a factorial arrangement with three replications. The gross plot size was 2.4m x 2m containing 12 rows for 20 cm, 8 rows for 30 cm, and 6 rows for 40 cm inter row spacing. The space between blocks and plots was 1m and 0.5m respectively. The experimental field was ploughed four times by oxen driven local plow in accordance with the local farming practices. The plots were prepared as per the layout, leveled manually and the treatments were assigned randomly and the seed was drilled in furrows manually on treatment basis. Wheat seed lots having a physical purity of 97% and a germination of 85% was used. *Ogolcho* bread wheat was used as testing crop variety. 100 kg/ha NPS and 50 kg/ha urea was applied as band application at sowing and the remaining 100 kg/ha urea was applied as top-dressing at mid tillering. The field was at 40 days after emergence and kept weed free manually until harvesting. Plot wise harvesting was done at harvest maturity of the crop as the crops get matured in each plot and threshed on plot basis.

Data Collection

Plant Height

The average height of ten randomly selected plants from the net plot area of each plot was measured in centimeters from the ground to the top of spike, excluding awns at maturity and means were taken.

Spike Length

The spike length was measured from ten randomly selected plants of the inner rows in centimeter and the mean length was recorded on each plot by measured from the base to the upper most part of the spike excluding awns at maturity.

Number of Seeds Per Spike

Number of seeds per spike was counted from ten randomly selected plants from the middle rows of each plot and the mean number was taken at harvesting.

Thousand Seed Weight

Thousand grains were counted after threshing picking randomly from each plot and their weight measured with sensitive balance.

Grain Yield

Grain yield was recorded by measuring the weight of grains threshed from the net plot area of each plot and converted to kilograms per hectare after adjusting the grain moisture content to 12.5%.

Statistical Analysis

The collected data were subjected to statistical analysis as per the experimental designs for each experiment using SAS. Mean separation of significant treatments were carried out using the least significant difference (LSD at 0.05) test.

Result and Discussion

Plant Height

The analysis of variance indicated that both seeding rate and row spacing had none significant difference ($p>0.05$) effect on plant height in both cropping seasons. Also the combined effect of seed rate and row spacing is not significant. Although, it is none significant, as seeding rate increased from the lowest (100 kg/ ha) to the highest (175 kg/ha), the height of the plant correspondingly increased in 2018 (Table 1). Another research finding by Haile *et al*. (2013) reported that plant height increased with increasing seeding rate. Higher seeding rate caused to changing plant height and stem thickness because of the lower light penetrating in to the plants canopy bed and more inter specific competition to more absorption light. These factors (higher seeding rate and lower light penetration) increasing inter node length, reducing stem thickness and increasing plant height (Otteson *et al*., 2007). Tallest plants were likely from higher seeding rates and narrow row spacing might be due to the presence of increased competition for light as the plant population becomes denser.

Spike Length

Effects of seeding rates and row spacing were none significant on spike length in both seasons. Even though it is none significant, the lower seed rate and narrow row spacing, the spike length was lower compared to higher seed rate and wider rows. This might be due to more free space between plants at the lower seed rates and less intra-plant competition for available resources that resulted in higher spike length. The current finding was in agreement that the finding of Baloch *et al*. (2010) who reported that different seed rate had no significant effect on spike length. Furthermore, Zewdie *et al.* (2014) reported that plant height and spike length are negatively related. Shorter plant produce longer spike and long plant produce shorter spike.

Table1. *Effects of row spacing and seed rate on yield and yield components of bread wheat*

Treatment	2017					2018				
	PH (cm)	SL (cm)	SPS	TSW (g)	GY (kg/ha)	PH (cm)	SL (cm)	SPS	TSW (g)	GY (kg/ha)
Row spacing (cm)										
20	88.08	8.53	42.91	35.97	4761	84.97	7.78	44.85	31.47	4158ab
30	86.78	8.21	37.98	33.48	4956	85.98	7.85	45.74	32.38	4609a
40	86.86	8.23	40.11	32.21	4430	86.19	7.91	47.84	34.43	3926b
LSD (0.05)	ns	Ns	ns	ns	ns	ns	ns	ns	ns	531
Seed rate (kg/ha)										
100	85.31	8.46	42.66	35.87	4238	83.56	7.99	50.13a	34.63	4339ab
125	86.60	8.42	42.42	35.13	4776	86.57	8.14	48.45a	30.22	4153ab
150	88.40	8.13	36.60	30.99	4353	87.54	7.70	45.15ab	31.37	4568a
175	88.66	8.35	39.66	33.55	4428	89.94	7.55	40.85b	34.81	3863b
LSD	ns	Ns	ns	ns	ns	ns	ns	5.07	ns	613
CV (%)	3.38	7.24	24.38	17.14	16.84	5.22	5.76	11.25	16.89	19.42

PH= plant height, SL=spike length, SPS= spike length, TSW= Thousand seed weight, GY=grain yield

Number of Seed Per Spike

Number of seeds per spike was significantly ($p<0.05$) influenced by seeding rate in 2018. Maximum number of seeds per spike (50.13) was obtained due to seed rate of 100 kg/ha and minimum number of seeds per spike (40.85) obtained from the seeding rate of 175 kg/ha (Table 1). Row spacing and its interaction with seed rate did not affected number of seeds per plant. Even though the number of seeds per spike is statistically similar among the 20cm, 30cm and 40 cm between the rows, there was increasing trend as the row spacing get wider. Also similar study by Worku (2008) showed that increasing the rate of seeding decreased the number of grains per spike. Moreover, Hussins and Pan (1993) reported that the number of kernels per spike decreased with an increase in seeding rate.

Thousand Seed Weight

Both seed rates and row spacing did not significantly influence thousand seed weight of bread wheat in this study. Although it was not statistically different, higher value of thousand seed weight was recorded in lower plant population. Similarly, Fani *et al.* (2014) showed that at high densities thousand seeds weight declined whereas in low densities, seed thousand weights increased. Baloch *et al.* (2010) concluded that the higher the seeding rate in bread wheat resulted in decreased thousand seed weight. This may be due to the vigorous seeds as lower intra competition in wider spacing and lower seed rate.

Grain Yield

Analysis of variance showed that the main effect of seed rate had significant effect ($p < 0.05$) on grain yield. The highest grain yield (4568 kg/ha) was obtained at the seed rate of 150 kg/ha. The maximum grain yield obtained from the use of higher seed rate might be due to high density of plants in rows and increased number of spikes per rows as a result number of grains and increased spike number in rows. Due to seed rate of 150 kg/ha, 229 kg and 415 kg yield advantage obtained compared to 100 kg/ha and 125 kg/ha seed respectively.

Similarly with the present finding, Haile *et al.* (2013) reported that the lower seed rate resulted in lower grain yield while higher yield was due to higher seed rate. However, the interaction effect of seed rate and row spacing showed none significant (p>0.05) effect on grain yield. Also the grain yield was, significantly (p<0.05) affected due to row spacing. This may be caused by that the average number of plants were reduced in the wider rows than narrow while narrow rows might result in resource competition. The maximum grain yield (4609 kg/ha) was recorded due to 30 cm row spacing (Table 1). Even though there is none significant difference between 20 cm and 30 cm row spacing, 10.84% yield advantage was recorded due to 30 cm row spacing compared to 20 cm. Not only this, row spacing of 30 cm can be easily managed by lower labor cost compared to 20 cm row spacing. Since narrow row spacing is difficult for farmers using traditional row maker (oxen driven plough) using 30 cm row spacing is advisable. In wider rows, weeding and other agronomic practices can be carried out straightforwardly.

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