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Influence of Seed Rate and Row Spacing on Growth and Yield of Tef (*Eragrostis* tef) Production at Assosa, Benishangul-Gumuz Regional State, Western Ethiopia

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Abstract

The effects of seed rate and row spacing on yield and yield components of tef (*Eragrostis tef*) were studied on the Nitisols of Assosa, Benishangul-Gumuz Regional State. Three levels of seed rate (5, 10 and 15 kg ha^{-1}) factorially combined with three rows spaces (15, 20, 25 cm) and an additional plot of broadcast of tef seed at 25 kg ha^{-1} as a standard check making a total of 10 treatments. They were laid out in a factorial RCBD with three replications. Significant influence on the grain yield of tef due to treatment application was recorded on trial locations. The maximum grain yield (1216.8 kg ha^{-1}) was obtained from application of 10 kg seed per hectare and 25 cm spacing between rows. Grain yield highly significantly increased from 973.8 to 1216.8 kg ha^{-1} with decrease in the seed rate from the broadcast 25 to 10 kg ha^{-1} due to the fact that tef tillers, as there is enough space. 10 kg seed ha^{-1} with 25 cm spacing would be more suitable practices for attaining optimum grain yield for tef at the study area.

Keywords: Tef (*Eragrostis* tef); Seed rate; Row spacing; Grain yield

Introduction

Teff [*Eragrostis tef* (Zucc.) Trotter] is one of the most important food cereal crops in Ethiopia, occupying about 22.6% of the cultivated land from the total area of cereals (86.06%) with accounting 16% of the grain production [1]. It is the major staple cereal crops and highly adapted to diverse agro-ecological zones including conditions marginal to the production of most of the other crops [2]. It is used for making injera, which is a staple and popular food in the national diet of Ethiopian [3]. However, when grown as a cereal, farmers highly value its straw as source of animals feed, especially during the dry season [4]. Tef straw, besides being the most appreciated feed for cattle, it is also used to reinforce mud and plaster the walls of tukuls and local grain storage facilities called gottera [4].

Similarly, Tef is the main staple food crop in the Benishangul-Gumuze region in general and in Assosa zone in particular. Its production is mainly practiced both in shift and permanent farming systems by natives and settlers farming communities respectively. However, its productivity was below 1 t ha^{-1} in the region, this is far lower than the potential yields obtained on research stations and on farm verification trials [1]. One of the reasons for the low yield is ineffective sowing methods and seed rate. Hence, present tef production system is unable to satisfy the consumers demand, since most Ethiopian farmers practice traditional farming system. Production system is not efficiently supported by modern technology due to research gap in choosing most feasible modern technology. Thus, maintaining seed rate and planting methods are one of the main challenges in tef production.

Seed rate is the most important agronomic aspect which needs due attention. In Ethiopia, blanket recommendation of about 15-55 kg ha^{-1} of tef seeds are sown under different conditions in different regions of the country [4]. When the plant density exceeds an optimum level, competition among plants for light above ground and nutrients below ground becomes severe [5]. Consequently, plant growth slows down and the grain yield decreases. There was significant increase in yield components of tef with decreasing seed rate from highest to lowest. On the other hand, the lodging percentage of the crop was increased by increasing the seed rate [6]. It is, hence, necessary to determine the optimum density of plant population per unit area to obtain maximum yields.

Tef planting methods, such as broadcasting, row planting and transplanting, are also among the major factors limiting tef production. Most farmers practice the traditional sowing method by broad casting of the small seed at the rate of 2530 kg ha^{-1} [7], which creates excess crop density and increases competition among plants for nutrients, water, sunlight and CO2. More over broadcasting methods requires additional seed rate compared to row sowing method thus increases cost of production. Furthermore, this sowing method results in lodging; which is the main cause for low yield of tef due to high plant density [8]. Row planting in tef is reported to have better yielding advantage over broadcast planting. To minimize the problem of lodging on tef, low seed rate, row planting, late sowing and application of plant growth regulators were used [9]. To improve production and productivity of tef planting methods (such as planting in rows rather than broadcasting) should be considered [10].

Given to the fact that tef is a recently cultivated crop in region, there is great gap with regards to specific agronomic recommendations for the tef. Hence, this research was initiated to determine the optimum seed rate and planting method for tef production under rain fed conditions in the Nitisols of Benishangul Gumuz Region.

Materials and Methods

Description of the experimental site

This experiment was conducted at Bambasi and Assosa district, Assosa Zone of Benishangul Gumuz Region during the main rainy season of 2012 and 2013. It has been characterized by an altitude ranging from 1300 to 1470 m.a.s.l, minimum and maximum temperatures of 14.5°C and 28.8°C and an average annual rainfall of 1358 mm of which 1128.5 mm were received between May and October during the cropping season.

Experimental details

The treatments considered in the study were consisting of three seed rates (5, 10 and 15 kg ha^{-1}) and three rows spaces (15, 20 and 25 cm). One additional plot of broadcast of tef seed at 25 kg ha^{-1} was considered as a standard check and making a total of ten treatments. The Randomized Complete Block Design factorial arrangement with three replications of plot size of 5 m × 4 m was used. The trial was carried both on research station as well as on three farmers field per location. Urea and triple super phosphate was used as the source of N and P, respectively. Application of urea was in two split, while the entire rate of phosphorus was applied at sowing in band. The experimental sites were prepared well. Each plot and block were separated by 0.50 m and 1.5 m, respectively. Tef variety Kuncho (Dz-Cr-387) was used as a test crop for the experiment. Important agronomic practices like hoeing and weeding were uniformly applied to all experimental plots as often as required.

Agronomic data collection and analysis

Growth indicating parameters such as plant height, panicle length and grain yield were collected. The plant height (cm) was measured from the base of the plant to upper the top most leaves of the plant. The data was taken from five randomly selected plants from the central plants to avoid border effect and the average value was computed. The grain yield from the middle was recorded and grain yield per hectare was calculated. Then, analysis of variance was carried out for these parameters following statistical procedures appropriate for the experimental design using SAS computer software. Whenever treatment effects will be significant, the means will be separated using the least significant difference (LSD) procedures test at 5% level of significance.

Results and Discussion

Significant differences were observed only for the plant height and grain yield of teff as affected by the combination of row spacing and seed rate while panicle length and total biomass yield didn't show any significantly affect by the treatments. Generally, an increasing row space within the same seed rate showed a trend of increasing in plant height. Application of 10 kg seed with 25 cm row spacing gave the highest plant height (102.44 cm) and followed by application of 5 kg seed with 15 cm spacing (100 cm). The lowest plant height was obtained with highest seed rate and no spacing (90.9 cm). Increasing plant height with decreased seed rates with increased spacing (Table 1). This could mainly be attributed to larger seed rate resulting in higher competition for nutrients while in small seed rate less plant competition for nutrients. The same result was reported by Shiferaw Tolosa and Bekalu and Arega [11,12].

Similarly, the grain yield followed similar trends to that of plant height since it is the final fruit of many complex morphological and physiological processes occurring during the growth and development of crop [13]. Accordingly, the highest (1.22 t) and lowest (0.79 t ha^{-1}) mean grain yields were obtained through 10 kg seed in 25 cm and 5 kg seed in 15 cm, respectively. A satellite treatment which is a broadcast of 25 kg of seed is much lower to the 10 kg seed with 25 cm. This implies that in broadcast, there is a higher plant competition for nutrient and moisture and hence the yield is low as compared to lower seed rate with high spacing [12].

Seed rate (kg ha^{-1})	Row spacing (cm)	Plant height (cm)	Panicle length (cm)	Total biomass (kg ha^{-1})	Grain yield (kg ha^{-1})
5	15	97.2^{abc}	36.7	3683.0	789.3^{d}
5	20	94.1^{abcd}	37.7	3433.7	1064.4^{abc}
5	25	100.0^{ab}	42.6	3421.1	1076.8^{abc}
10	15	99.2^{abc}	38.4	3581.4	1174.9^{ab}
10	20	95.9^{abcd}	38.7	3729.2	1139.4^{abc}
10	25	102.4^{a}	43.4	3833.1	1216.8^{a}
15	15	89.4^{cd}	37.9	3420.2	1000.0^{bc}
15	20	95.7^{abcd}	36.0	3538.0	1129.0^{abc}
15	25	91.0^{bcd}	37.3	3665.8	1093.7^{abc}
25	0	90.9^{bcd}	37.4	3310.7	973.8^{c}
LSD (0.05)		4.96	Ns	Ns	89.4
CV (%)		11.13	13.93	18.35	17.8

Table 1: Influence of seed rate and spacing on plant height, panicle length, biomass and yield of tef. (Ns: Non-Significant).

Conclusion

The most important parameters in this study were significant different except the panicle length and biomass due to the application of treatments. The application of 10 kg seed ha^{-1} with 25 cm gave the highest grain yield and plant height and recommended to the study area. This study confirms that spacing was increase grain yield and stood against broadcasting tef as it gave the least yield.

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