: First irrigation; Establishment; Sprouting rate; Number of tillers

Ethiopia is endowed with favorable climatic and soil conditions for sugarcane production. To exploit such an immense resource, besides expanding the existing ones, the country is on the verge of establishing new sugar factories with large tract of sugarcane plantations. Tendaho is one of the new factories under establishment in the tropical areas of the country with 50,000 hectares suitable area for sugarcane production under full irrigation system [1]. In some countries like Australia, Sudan and South Africa about 60% of sugar produced is grown in irrigated areas, a practice which always results in production cost increase [2].

e ultimate goal of commercial sugarcane production system both in Ethiopia and else where in the world, is to increase cane and sugar production per unit area. In order to attain it, implementation of standard cultural practices is imperative. Experiences of some countries indicated that usage of high yielding varieties; provision and timely application of agricultural inputs, availability of su cient soil moisture/irrigation water, and good soil condition have great shares [3]. Limited water resources restrict increasing the amount of sugarcane establishment and growth in many regions throughout the world because sugarcane requires substantial amounts of water during early stages [4]. erefore it is important to apply irrigation water e ciently as possible during sugarcane establishment to produce maximum yields.

Plants are exposed to adverse environmental conditions, and drought is the major abiotic factor that can damage its growth and development. Drought also limits the areas suitable to agriculture. It is known that, as for any crop, during establishment water is essentially required to obtain maximum yield and drought events in this stage can signi cantly decrease productivity [5]. Sugarcane is among the crops which produce a higher amount of biomass per unit of cultivated area and water requirement varies throughout the developing stages, thus for higher sprout, tillering and development of culms, there is a higher water requirement than during the maturation stage [5].

Sugarcane crop is produced from stalk cuttings denominated sets that contain one or more axillary buds. Annual growth of sugarcane can be divided into the following development phases: germination and tillering; stalk -0.05ds.nd

factors are the soil moisture, soil temperature and aeration. e internal factors are the bud health, sett moisture, sett reducing sugar content and sett nutrient status [10]. e germination (shoot emergence from soil) is a critical event in the plant life to assure a good harvest and it is initially dependent on the set nutrients and water, developing its own root system a er about three weeks under proper conditions [11]. e crop establishment phase and formative phase (sprouting, tillering and grand growth stages, have been identi ed as the critical water demand period [12]. is is mainly because 70-80% of cane yield is produced during this phase [13]. Water shortage results a negative impact on establishment of the crop, especially if the drought duration exceeds the capacity of drought tolerance of the plant species [14].

In the drought areas of Tendaho serious consideration should be given to improve the existed germination failure. As explained earlier, temperature of the area during planting time reaches up to 37°C that is good enough to increase the soil temperature. Planting seed cane into such soil (which coincides with the onset of the hottest season of area) even for few days without supplementing water will result in complete dehydration (Figure 1). In support of the fact, the time of rst irrigation a er planting was delayed at least a minimum of six days. Moreover, delay of rst irrigation a er planting and absence of pre-plant irrigation were taken as the main constraints of the drought area of Tendaho Sugar Project. is causes many gap areas in the plantation elds and the re-work in land preparation and planting activities. To alleviate the above problems, this study was initiated with the following objective: To study the e ect of rst irrigation period on sugarcane establishment in the drought areas of Ethiopia

e experiment was conducted at Tendaho Sugar Factory Project in Afar Regional Estate in the Ri Valley of Ethiopia at an altitude and longitude ranging between 110 30' to 110 50' N and 400 45' to 410 03' E, respectively, with elevation ranging from 365 m to 340 m. e area has a mean maximum and minimum temperature of 37.20 and 21.88°C, respectively, with long-term average annual rainfall and relative humidity of 220 mm and 60.4%, respectively. e area has mean sunshine hours of 8.9 hr per day and the mean annual ETo of 7.9 mm/day [1]. e soil type of the experimental eld is clay soils.

Four levels of rst irrigation periods; 5 days pre-planting irrigation (DPI), 1 day a er planting (DAP), 4 days a er planting (DAP) and 8 days a er planting(DAP) and four major varieties; N-14, NCO-334, CO-680 and B52-298 which cover 90% of the area were used in a

Figure 1: Dehydrated setts and sett without root system in delaying ýrst irrigation to 8 days after planting

completely randomized block design with 4*4*3 factorial treatment arrangements. Each plot had six rows with 8s m length and 1.45 m width having plot area of 69.6 m^2 for a single plot. e distance between plots was 2.9 m while it was 4.35 m between replications. Data was collected from four entire rows with 6 m length and 1.45 m width having plot area of 46.4 m^2

Sprouting is counted weekly starting 7 days a er planting until 45 days. It is important to check that tillers are not confused with primary shoots during counting. is is because; there is an overlap in occurrence of tillering prior to the termination of full sprouting. Tillering is the underground branching of the cane. Tiller count will be made starting from 45 days a er planting fortnightly (every 15 days) until 3 months crop age to estimate the number of tiller per ha. Number of buds that establish root and number of dead buds was collected at 30 and 45 days a er planting.

Finally, sprouting rate, percent of sets that establish root and percent of dead setts calculated using the following formula [15].

$$\% \text{ Sprout} = \frac{\text{Number of sprouting seedlings}}{\text{Total number of planted buds}} \times 100$$

$$\% \text{ Buds that establish root} = \frac{\text{Number of buds that establish root}}{\text{Total number of planted buds}} \times 100$$

$$\% \text{ Dead buds} = \frac{\text{Number dead buds}}{\text{Total number of planted buds}} \times 100$$

e e ect of time of rst irrigation on establishing sugarcane varieties was analyzed using the appropriate analytical so ware (SAS 9.2). Mean separation was conducted using Least Signi cant Di erence (LSD) at 5% probability level whenever signi cant di erences were detected in the F-test. All cultural practices were executed based on the current practices of Tendaho Sugar Project except rst irrigation.

To avoid the confusion in terms of soil fertility status of the area, soil analysis was done by taking composite samples from the study site soil analysis result indicated that although the soil of the farm has high pH and low ECe (indicating sodic soils) with low fertility status, it has similar nature with other elds of the area which have good crop stand (Table 1). e soil did not show any peculiar characteristic that hinder germination of sugarcane. For germination, nutrient availability of the seed cane within itself is the limiting factor than that of the soil [10] Sugarcane does not require any speci c type of soil as it can be successfully raised on diverse soil types ranging from sandy soils to clay loams & heavy clays [7].

Analysis of variance (ANOVA) revealed that there was a signi cant interaction e ect between the sugarcane varieties and rst irrigation period (FIP) (Varieties*FIP=p<0.0001) on sprouting rate, number of tillers, root establishment rate and number of dead sett buds in both sugarcane varieties. N-14 gave highest sprouting rate (90.88^{a} ± 9.73 Number of tillers/ha (756.33 ± 120.10^{a}) and root establishment rate (93.73 ± 6.79^{a}) under 5 days pre-planting irrigation applications. e maximum sprouting rate, number of tillers, root establishment rate was also recorded with the application of 5 days pre-planting irrigation in all varieties while the lowest sprouting rate, number of tillers and root establishment rate was recorded on the 8 days a er planting rst irrigation application in all varieties (Table 2). On the other hand, the highest percentage of dead sett buds were recorded on the 8 days a e

planting rst irrigation application in all sugarcane varieties tested in the area (Table 2). e result of the study indicated that, 91-93% of the sugarcane sett buds were not sprouting during the delayed of rst irrigation for 8 days a er planting and only 7-10% were sprouting in extremely scattered manner in all sugarcane varieties (Table 2). Of the total un-sprouting sett buds, almost all of the sett buds did not develop root system and were highly dehydrated (shrinked). is showed that, out of the various factors that in uence sprouting of sugarcane sett buds under eld conditions, water content of the soil is very important for sugarcane establishment. erefore, maintaining optimum moisture during the crop establishment period may be useful for obtaining optimum cane yield in drought areas.

Drought is one of the most important environmental stress factors limiting sugarcane establishment as well as its production worldwide [13]. Water-de cit stress at early stage alters a variety of growth and physiological processes in sugarcane, which cause decreased yields [16,17]. Water de cit during establishment can trigger a negative impact upon growth and development of the crop, compromising plant productivity especially if the drought duration exceeds the capacity of drought tolerance of the plant species [14,18]. Moderate water de cit causes signi cant morphological and physiological changes in sugarcane establishment [19], while severe de cit may lead to plant death [20]. Increasing levels of water stress that occur as a soil dries out, a ect processes in the sugarcane crop at di erent stages [21]. e germination-ability decreased as the soil moisture was reduced, although a dependence of the response to cultivars was ranged from 10 to 59% [22]. Superior germination of cane irrigated at planting and loss of germination with delayed irrigation has been reported in Hawaii [23]. Well watered setts germinated at about twice the rate of un-watered setts [24]. e need for moisture to trigger the shi of the bud from dormancy to activity could explain why setts irrigated at planting to have the highest germination percentages [23]. Delaying rst irrigation a er planting for more than three days will result in poor germination and unsatisfactory crop stands [25] (Tables 1 and 2).

Soil moisture management was one of the major and critical factors

Depth	PH	EC (1:5)	TN	Av. P	Av. K
(Cm)	(1:2.5)	(ds/m)	%	ppm	ppm
0-30	9.03	0.57	0.036	2.26	248
30-60	8.97	0.63	0.035	2.22	228
0-30	9.05	0.71	0.034	1.72	212
30-60	8.84	0.93	0.025	1.28	192
0-30	8.95	0.92	0.027	0.90	238
30-60	8.86	1.12	0.025	0.62	223
0-30	8.16	1.46	0.052	2.26	238
30-60	8.68	0.97	0.025	2.10	172

Table 1:

playing great role during sugarcane establishment in the drought areas. Delay in rst irrigation period signi cantly reduced the germination rate, tillering capacity and root establishment of all varieties forcing to re-work of land preparation and planting activities. erefore, applying rst irrigation, in early times (5 pre-planting irrigation or 1 days a er planting) was highly recommended with better germination rate, tillering capacity and root establishment of all varieties expecting high cane yield and sugar yield.

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