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Effect of biochar and FYM on growth, yield and chemical composition of fodder sorghum

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Abstract
A pot experiment was conducted during Kharif- 2018 in the net house of the department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand to find out the effect of biochar and FYM on growth, yield and chemical composition of fodder sorghum [Sorghum bicolor (L.) Moench] grown in saline soil. The treatment comprised four levels of biochar (B_0: 0 t ha^{-1}, B_1: 2.5 t ha^{-1}, B_2: 5.0 t ha^{-1}, B_3: 7.5 t ha^{-1}) and three levels of FYM (F_0: 0 t ha^{-1}, F_1: 5.0 t ha^{-1}, F_2: 10.0 t ha^{-1}) which were laid out in completely randomized design (factorial). The growth and yield parameters namely germination percentage, plant population, plant height, green forage yield and dry matter yield as well as uptake of nitrogen, phosphorus and potassium by fodder sorghum were significantly increased by treatment of application of biochar @5.0 t ha^{-1} and @7.5 t ha^{-1} as well as application of FYM @10.0 t ha^{-1} alone or in combination.

Keywords: Biochar, FYM, growth and yield.

1. Introduction
Livestock is becoming agriculture's most economically important sub sector. It contributes 25% to the total agricultural income. Availability of green fodder is a major constraint in livestock productivity. At present the country faces net deficit of 61.1% green fodder and 21.9% dry fodder. This indicates that green forage supply has to grow at 32.2% to meet the deficit (Kumar and Faruqi, 2010) [9]. The dearth of green fodder has been a major stumbling block in raising livestock productivity in semi-arid regions.
Sorghum (*Sorghum bicolor* (L.) Moench) belongs to the family *Poaceae*. It is a warm- season, short-day annual grass. Locally known as Jowar, it is dual purpose crop cultivated predominantly in the *kharif* season. It is a hardy crop tolerant to extreme drought conditions which could be attributed to its deep and extensive root system. The crop has been rightfully nicknamed the camel crop. The total area under fodder Jowar is 8.6 million ha with *kharif* crop accounting for 2.6 million ha (Anon., 2013) [1]. It thrives in tropical climate with a temperature range of 25-35°C. Deep well-drained loamy clay soils with pH ranging between 5.5 and 7.5 are ideal for sorghum cultivation. Forage sorghums yields around 35-70 t green matter ha^{-1} annually (Anon., 2017) [2]. In the wake of climate change and impending water scarcity, sorghum is likely to emerge as an exponentially valuable alternative to traditional forage grasses in the 21st century. The unique combination of salt-tolerance and drought tolerance makes it ideal for cultivation in arid and semi-arid regions and on degraded lands. Due to these specific attributes sorghum has been cultivated extensively as a forage crop in Gujarat. It accounts for 52% of total area under forage crops in Gujarat (Yadavendra *et al*., 2003) [19].
The conversion of biomass into biochar through pyrolysis is a viable option for maintaining soil health, environmental quality and crop productivity. Improvement of crop yield in biochar-amended soils have often been attributed to increased nutrient availability resulted from concentration of available basic cations supplied by biochar (Uzoma *et al.*, 2011) [17]. Biochar has received increasing interest due to it's potential in increasing soil carbon storage, improving soil fertility, as well as maintaining the balance of soil ecosystem and it could act as kind of soil fertilizer or amendment as stressed by Glaser *et al.* (2002) [7].
At present, Indian agriculture is facing threat due to decline in organic matter and low level of nutrient content. For high productivity and forage quality, mineral nitrogen is most important

nutrient along with other nutrients. Complementary use of organic and inorganic sources reduces the harmful effects on environment, reduction of total cost or profitability. Farmyard manure (FYM) may substitute mineral N through increasing organic matter and nutrient content in soil. FYM is source of nutrient. Organic matter is the life of soil and the practices that support organic matter build up also ensure sustainable enhancement of productivity. Farmyard manure (FYM) refers to the decomposed mixture of dung and urine of farm animals along with litter and left-over material from roughages or fodder fed to the cattle. On an average, well decomposed FYM contains 0.5% N, 0.2% P_2O_5 and 0.5% K_2O. Therefore, the ultimate objective of this study was to find out the effect of biochar and FYM on growth, yield and chemical composition of fodder sorghum.

2. Material and Methods

A pot house study was conducted on fodder sorghum at net house of the department of Soil Science and Agricultural Chemistry, B.A.C.A., A.A.U., Anand during *kharif*-2018. The experiment was laid out in completely randomized design (factorial). The treatment comprised four levels of biochar (B_0: 0 t ha^{-1}, B_1: 2.5 t ha^{-1}, B_2: 5.0 t ha^{-1}, B_3: 7.5 t ha^{-1}) and three levels of FYM (F_0: 0 t ha^{-1}, F_1: 5.0 t ha^{-1}, F_2: 10.0 t ha^{-1}) with three replications. A bulk soil for pot study was collected from College of Agriculture, Anand Agricultural University, Vaso. After collection, soil was brought to laboratory, air dried under shade, stones, pebbles, roots *etc*. were removed and the soils were pounded with wooden hammer and sieved through 2 mm sieve. After collecting it was grinded, passed through 2.0mm sieve and 10 kilogram soil will be filled in each earthen pot and the entire quantity of Biochar and FYM as per treatment applied as a basal in all the pots before one month sowing of fodder sorghum.

After applying treatments to soil in each pot after one month, initially ten healthy seeds of forage sorghum were sown into each pot at proper depth. Thinning was done after ten days after germination and finally 5 plants were kept for study. Pots were regularly watered and weed free condition was maintained till harvest *i.e.*,60 DAS of forage sorghum crop. Top dressing of nitrogen with urea was done at 30 days after sowing. The observations like germination percentage, plant population and plant height at 20 DAS, 40 DAS and at the time of harvesting as well as green forage and dry matter yield were taken periodically.

Basic properties of the soil and amendments corn stover biochar and FYM are presented in Table 1 and 2. Experimental data generated during the pot experiment were analysed statistically for their test of significance as per Completely Randomized Design (Factorial), using the facilities available at the Department of Agricultural Statistics, B. A. College of Agriculture, AAU, Anand. The results are reported at 5% and 1% level of significance (Steel and Torrie, 1982) [15].

Table 1: Initial Physio-Chemical properties of experimental soil:

A	Mechanical analysis (%)		Method employed	Reference
1.	Coarse sand	4.05	International pipette method	Piper (1966)
2.	Fine sand	75.00		
3.	Silt	10.20		
4.	Clay	6.50		
5.	Textural class	Loamy sand		
B	Physical properties			
1.	Bulk density (Mg m^{-3})	1.38	Laboratory method	Black and Hartage (1986)
2.	Water holding capacity (%)	28.05	Brass cup method	Chopra and Kanwar (1976)
C	Chemical properties			
1.	pH (soil: water, 1: 2.5)	8.0	Potentiometry	Jackson (1973)
2.	EC (dSm^{-1}) (soil: water, 1: 2.5)	1.39	Conductometry	Jackson(1973)
3.	Organic carbon (%)	0.48	Walkley& Black method	Jackson (1973)
4.	Available nitrogen (kg ha^{-1})	188.2	Alkaline $KMnO_4$ method	Subbiah and Asija (1956)
5.	Available P_2O_5 (kg ha^{-1})	39.08	Olsen's method	Olsen (1954)
6.	Available K_2O (kg ha^{-1})	267.3	Flame photometric method	Jackson (1973)
7.	Cation exchange capacity	11.80	Ammonium acetate method	Jackson (1973)
8.	Exchangable Sodium percentage	11.48	Ammonium acetate method	Jackson (1973)
9.	Available micronutrient (ppm)		Atomic Absorption Spectrophotometric method	Lindsay and Norwell (1978)
a.	Fe	5.23		
b.	Zn	1.20		
c.	Mn	1.89		
d.	Cu	0.20		

Table 2: Physio -Chemical properties of biochar and FYM

Particulars	Biochar	FYM
Physical properties		
Bulk density (Mg m^{-3})	1.28	0.86
Water holding capacity (%)	58.05	34.67
Chemical properties		
pH (Soil: water, 1: 2.5)	8.30	6.40
EC (dSm^{-1}) (Soil: water, 1: 2.5)	1.80	0.89
Organic carbon (%)	70.90	38.70
Total Nitrogen (%)	5.30	0.42
Total Phosphorus (%)	2.11	0.18
Total Potassium (%)	10.70	0.67

3. Results and Discussion

3.1. Effect of levels of biochar and FYM on seed germination, plant population and plant height of fodder sorghum

3.1.1 Effect of levels of biochar and FYM on seed germination

The data pertaining to the germination of fodder sorghum seed measured at 20 DAS is presented in Table 3. The germination of seed was influenced significantly by different levels of biochar treatments and it varied from 90.56 to 100.00%. The treatment receiving application of biochar @ 7.5 t ha^{-1} recorded significantly higher germination percentage (100.00%) of sorghum as compared to control (90.56%) but was was found to be at par with treatment of application of biochar @ 5.0 t ha^{-1} (97.78%) and 2.5 t ha^{-1} (97.58%). The application of all levels of biochar have favourably increased the germination as compared to no biochar application. The effect of FYM application on seed germination was also found significant. The result revealed that application of FYM @ 10.0 t ha^{-1} gave significantly higher seed germination (98.75%) of sorghum than control (93.33%) but was at par with application of FYM @ 5.0 t ha^{-1} (97.50%). While, interaction effect of different levels of biochar and FYM on seed germination of fodder sorghum was found to be non-significant.

The improvement in seed germination of fodder sorghum with application of biochar might be owing to the improvement in soil health and build-up of soil fertility. The results are in line with those reported by Sappor *et al*. (2017) [14].

3.1.2 Effect of different levels of biochar and FYM on plant population at 20, 40 DAS and harvest of fodder sorghum

The plant population of fodder sorghum measured at all the stages *i.e.,* at 20, 40 DAS and harvest of crop growth influenced significantly due to different levels of biochar (Table 3). The application of biochar @ 7.5 t ha^{-1} recorded significantly maximum plant population of fodder sorghum over control but it was at par with application of biochar @ 5.0 t ha^{-1} at 20 DAS and with application of biochar @ 2.5 and 5.0 t ha^{-1} at 40 DAS and at harvest of fodder sorghum.

The plant population of fodder sorghum at 40 DAS and harvest responds significantly to application of FYM but at 20 DAS, it was found to be non-significant. The result revealed that application of FYM @ 10.0 t ha^{-1} gave significantly maximum plant population (4.83 at 40 DAS and at harvest) of sorghum as compared to control (4.33 at 40 DAS and at harvest) but was found to be on same bar with FYM @ 5.0 t ha^{-1}. The interaction effect between different levels of biochar and FYM on plant population of fodder sorghum at 20, 40 DAS and at harvest was found to be non-significant. Arif *et al*. (2012) observed that biochar, FYM and mineral nitrogen application alone did not cause any significant variation in maize plant population at harvest although maximum plant population at harvest were recorded in plot where only biochar or biochar plus FYM were applied. Biochar reduced the constraints present in soil and improved physico-chemical properties of soil.

3.1.3 Effect of levels of biochar and FYM on plant height at 20, 40 DAS and harvest of sorghum

The data pertaining to the plant height of fodder sorghum measured at 20, 40 DAS and harvest is presented in Table 4. The variation among the data of different treatments was found to be significant at all stages. Among different levels of biochar, the application of biochar @ 5.0 t ha^{-1} gave significantly maximum plant height (16.56 cm) of fodder sorghum at 20 DAS than rest of the treatments except treatment receiving application of biochar @ 7.5 t ha^{-1} (16.18 cm). Further, the treatment receiving the application of biochar @ 7.5 t ha^{-1} recorded significantly higher plant height at 40 DAS and harvest of fodder sorghum. It was found that the plant height increased with increase in levels of biochar application at 40 DAS as well as at harvest of the crops. Significantly maximum plant height of 61.44 cm and 106.08 cm was recorded under the treatment of application of 7.5 t ha^{-1} at 40 DAS and harvest, respectively over control. As effect of FYM on plant height is concern, FYM reported positive response on plant height at 40 DAS and harvest but at 20 DAS, response was found non-significant. The result revealed that application FYM @ 10.0 t ha^{-1} produced significantly higher plant height of fodder sorghum at 40 DAS and harvest (58.32 cm and 84.90 cm, respectively) over control but was found to be at par with application of FYM @ 5.0 t ha^{-1} (57.22 cm and 81.18 cm, respectively). The plant height of fodder sorghum was recorded 7.74% and 3.03% higher under the treatment of application of 10.0 t ha^{-1} and 5.0 t ha^{-1} FYM over the control at harvest, respectively.

The interaction effect of different levels of biochar and FYM on plant height at 20 and 40 DAS was found significant. The result revealed that application of biochar @ 5.0 t ha^{-1} + FYM @ 10.0 t ha^{-1} (B_2F_2) produced significantly higher plant height (18.67 cm) of fodder sorghum as compared to rest of the treatment combinations except application of biochar @ 7.5 t ha^{-1} + FYM @ 5.0 t ha^{-1} (B_3F_1). In case of plant height at 40 DAS, treatment combination of B_3F_2 *i.e.,* application of biochar @ 7.5 t ha^{-1} + FYM @ 10.0 t ha^{-1} recorded significantly higher plant height (67.80 cm) of fodder sorghum than other treatment combinations but was found to be at par with treatment combination of B_3F_1 (application of biochar @ 7.5 t ha^{-1} + FYM @ 5.0 t ha^{-1}) (67.27 cm) and B_3F_0 (only application of biochar @ 7.5 t ha^{-1}) (64.27 cm). Lowest plant height was observed in control (38.00 cm). The interaction effect of different levels of biochar and FYM on plant height at harvest was found to be non-significant. In general, the plant height was found to increase with the age of the crop. However, biochar had influenced the growth of the sorghum crop at all the stages and it increased with increasing levels of application might be due to the biochar's ability to reduce leaching of nutrients, increase water and nutrient retention, increase microbial activity and aeration in the sandy loam soil and there by slow, steady and balanced supply of nutrients. This is in support with the findings of Laird *et al*. (2009) [10] and Van Zwieten *et al*. (2010) [18] who have reported that plant growth and shoot biomass of oat and alder, respectively were significantly greater in biochar treatments compared with unamended soil (no biochar).

3.2 Effect of different levels of biochar and FYM on green forage and dry matter yield of fodder sorghum

The green fodder yield and dry matter yield of fodder sorghum was influenced significantly by different levels of biochar and FYM, and its values varied from 132.7 g pot^{-1} to 216.7 g pot^{-1} and 27.1 g pot^{-1} to 50.3 g pot^{-1}, respectively due to biochar and 172.4 g pot^{-1} to 193.4 g pot^{-1} and 38.1 g pot^{-1} to 42.5 g pot^{-1} due to FYM (Table 7). The result depicted that with increase in rate of biochar both green forage and dry matter yield were increased. Among the different levels of biochar, treatment receiving application of biochar @ 7.5 t ha^{-1} produced significantly maximum green forage yield (216.7 g pot^{-1}) and dry matter yield (50.3 g pot^{-1}) of fodder sorghum over rest of the treatments. Whereas among different levels of FYM, treatment receiving application of FYM @ 10.0 t ha^{-1} recorded significantly maximum green forage yield as well as dry matter yield (193.4 g pot^{-1} and 42.5 g pot^{-1}, respectively) as compared to other treatments except treatment receiving application of FYM @ 5.0 t ha^{-1} in case of dry matter yield.

The interaction effect of different levels of biochar and FYM was found to be significant in respect of both green forage yield as well as dry matter yield of fodder sorghum. The result revealed that application of biochar @ 7.5 t ha^{-1} + FYM @ 5.0 t ha^{-1} (B_3F_1) produced significantly maximum green forage yield (223.33 g pot^{-1}) and dry matter yield (52.00 g pot^{-1}) of fodder sorghum as compared to rest of the treatment combinations but it was at par with treatment combination of application of biochar @ 7.5 t ha^{-1} + FYM @ 10.0 t ha^{-1} (B_3F_2), biochar @ 7.5 t ha^{-1} alone (B_3F_0) and biochar @ 5.0 t ha^{-1} + FYM @ 10.0 t ha^{-1} (B_2F_2) in case of green forage yield and with treatment combination of application of biochar @ 7.5 t ha^{-1} + FYM @ 10.0 t ha^{-1} (B_3F_2) and biochar @ 5.0 t ha^{-1} + FYM @ 10.0 t ha^{-1} (B_2F_2) in case of dry matter yield. The increase in green forage yield of sorghum in combined application of biochar and FYM may be due the slow release and timely availability of nitrogen from organic sources which were less subjected to losses as compared to mineral N applied which losses from soil more rapidly. Similar results were reported by Uzoma *et al.* (2011) [17].

3.3 Effect on chemical composition of fodder sorghum
The data presented in Table 7 and 11 indicated that the chemical composition *i.e.,* nitrogen, phosphorus and potassium uptake by fodder sorghum was influenced significantly by different levels of biochar and FYM. Significantly maximum nitrogen, phosphorus and potassium uptake by fodder sorghum was recorded with the treatment containing application of biochar @7.5 t ha^{-1} (B_3) over rest of treatments. Similarly, treatment receiving application of FYM @10.0 t ha^{-1} recorded significantly maximum uptake of nitrogen, phosphorus and potassium by fodder sorghum than other treatments except treatment receiving application of FYM @5.0 t ha^{-1}. Effect of interaction between different levels of biochar and FYM was found significant with respect to K uptake by fodder sorghum only. The treatment combination of B_3F_2 *i.e.*, application of biochar @ 7.5 t ha^{-1} + FYM @ 10.0 t ha^{-1} as well as B_2F_2 *i.e.*, application of biochar @ 5.0 t ha^{-1} + FYM @ 10.0 t ha^{-1} recorded significantly maximum K uptake by fodder sorghum as compared to other treatment combinations except B_1F_2, B_2F_0 and B_3F_1. The increase in the nutrient uptake with FYM might be due to release of nutrients as a result of decomposition, which caused enhancement in growth characters, increasing rate of N, P, K and micronutrients availability for longer period from FYM, which met the crop demand. Similar finding was also observed by Elangovan (2014) [6] who found that the significantly higher N, P and K uptake by cotton crop was registered by application of biochar @ 10 t + 100% NPK.

Table 3: Effect of biochar and FYM on plant population of fodder sorghum at 20, 40 DAS and harvest

Sr. No.	Treatments	Germination Percentage	Plant population		
			20 DAS	40 DAS	Harvest
Levels of Biochar (B)					
1.	B_0: Control	90.56	4.44	4.22	4.22
2.	B_1: Biochar @ 2.5 t ha^{-1}	97.58	4.56	4.56	4.56
3.	B_2: Biochar @ 5.0 t ha^{-1}	97.78	4.89	4.89	4.78
4.	B_3: Biochar @ 7.5 t ha^{-1}	100.00	5.00	4.78	4.78
S. Em±		1.67	0.15	0.14	0.15
C.D. @ 0.05		4.87	0.42	0.40	0.43
Levels of FYM (F)					
1.	F_0: Control	93.33	4.67	4.33	4.33
2.	F_1: FYM @ 5.0 t ha^{-1}	97.50	4.67	4.67	4.58
3.	F_2: FYM @10.0 t ha^{-1}	98.75	4.83	4.83	4.83
S. Em±		1.44	0.13	0.12	0.13
C.D. @ 0.05		4.21	NS	0.34	0.37
Interaction effect of B x F		NS	NS	NS	NS
C.V.%		5.17	9.33	8.33	9.62

Table 4: Effect of biochar and FYM on plant height (cm) of fodder sorghum at 20, 40 DAS and harvest

Sr. No.	Treatments	Plant height		
		20 DAS	40 DAS	Harvest
Levels of Biochar (B)				
1.	B_0: Control	9.14	41.62	56.50
2.	B_1: Biochar @ 2.5 t ha^{-1}	13.47	54.11	71.23
3.	B_2: Biochar @ 5.0 t ha^{-1}	16.56	61.56	92.70
4.	B_3: Biochar @ 7.5 t ha^{-1}	16.18	66.44	106.08
S. Em±		0.42	0.72	1.51
C.D. @ 0.05		1.23	2.09	4.41
Levels of FYM (F)				
1.	F_0: Control	13.36	52.27	78.80
2.	F_1: FYM @ 5.0 t ha^{-1}	13.87	57.22	81.18
3.	F_2: FYM @10.0 t ha^{-1}	14.28	58.32	84.90
S. Em±		0.37	0.62	1.31
C.D. @ 0.05		NS	1.81	3.82
Interaction effect of B x F		Sig.	Sig.	NS
C.V.%		9.20	3.84	5.56

Table 5: Interaction effect of biochar and FYM on plant height (cm) of fodder sorghum at 20 DAS

Levels of biochar	Levels of FYM		
	F_0: Control	**F_1: FYM @ 5.0 t ha^{-1}**	**F_2: FYM @ 10.0 t ha^{-1}**
B_0: Control	7.87	9.70	9.87
B_1: Biochar @ 2.5 t ha^{-1}	13.37	13.50	13.53
B_2: Biochar @ 5.0 t ha^{-1}	15.87	15.13	18.67
B_3: Biochar @ 7.5 t ha^{-1}	16.33	17.13	15.07
S. Em±	0.73	C.D. @ 0.05	2.14

Table 6: Interaction effect of biochar and FYM on plant height (cm) of fodder sorghum at 40 DAS

Levels of biochar	Levels of FYM		
	F_0: Control	**F_1: FYM @ 5.0 t ha^{-1}**	**F_2: FYM @ 10.0 t ha^{-1}**
B_0: Control	38.00	41.53	45.33
B_1: Biochar @ 2.5 t ha^{-1}	47.07	59.00	56.27
B_2: Biochar @ 5.0 t ha^{-1}	59.73	61.07	63.87
B_3: Biochar @ 7.5 t ha^{-1}	64.27	67.27	67.80
S. Em±	1.24	C.D. @ 0.05	3.62

Table 7: Effect of biochar and FYM on green forage yield, dry matter yield (g pot^{-1}) and N, P and K uptake by fodder sorghum

Sr. No.	Treatments	Green forage yield (g pot^{-1})	Dry matter yield (g pot^{-1})	N uptake (mg pot^{-1})	P uptake (mg pot^{-1})	K uptake (mg pot^{-1})
Levels of Biochar (B)						
1.	B_0: Control	132.7	27.1	350.3	32.40	261.1
2.	B_1: Biochar@2.5 t ha^{-1}	177.8	39.5	515.5	50.81	393.0
3.	B_2: Biochar@5.0 t ha^{-1}	192.4	45.7	587.9	61.98	475.4
4.	B_3: Biochar@7.5 t ha^{-1}	216.7	50.3	637.7	68.00	545.0
S. Em±		4.1	0.5	9.36	1.65	11.5
C.D. @ 0.05		11.93	1.6	27.3	4.83	33.5
Levels of FYM (F)						
1.	F_0: Control	172.4	38.1	482.0	48.31	371.6
2.	F_1: FYM@ 5.0 t ha^{-1}	174.0	41.3	528.0	54.35	424.4
3.	F_2: FYM@10.0 t ha^{-1}	193.4	42.5	560.5	57.23	459.9
S. Em±		3.5	0.5	8.1	1.43	9.9
C.D. @0.05		10.3	1.3	23.7	4.18	29.0
Interaction effect of B x F		Sig	Sig	NS	NS	Sig
C.V.%		6.81	3.90	5.37	9.31	8.22

Table 8: Interaction effect of biochar and FYM on green forage yield (g pot^{-1}) of fodder sorghum

Levels of biochar	Levels of FYM		
	F_0: Control	**F_1: FYM @ 5.0 t ha^{-1}**	**F_2: FYM @ 10.0 t ha^{-1}**
B_0: Control	121.1	118.3	159.3
B_1: Biochar @ 2.5 t ha^{-1}	175.1	166.6	191.7
B_2: Biochar @ 5.0 t ha^{-1}	176.3	187.8	213.0
B_3: Biochar @ 7.5 t ha^{-1}	217.0	223.3	209.7
S. Em±	7.1	C.D. @ 0.05	20.7

Table 9: Interaction effect of biochar and FYM on dry matter yield (g pot^{-1}) of fodder sorghum

Levels of biochar	Levels of FYM		
	F_0: Control	**F_1: FYM @ 5.0 t ha^{-1}**	**F_2: FYM @ 10.0 t ha^{-1}**
B_0: Control	25.1	26.3	29.3
B_1: Biochar @ 2.5 t ha^{-1}	36.5	41.2	40.8
B_2: Biochar @ 5.0 t ha^{-1}	41.6	45.8	49.7
B_3: Biochar @ 7.5 t ha^{-1}	48.6	52.0	50.3
S. Em±	0.9	C.D. @ 0.05	2.7

Table 10: Interaction effect of biochar and FYM on potassium content (%) of fodder sorghum

Levels of biochar	Levels of FYM		
	F_0: Control	**F_1: FYM @ 5.0 t ha^{-1}**	**F_2: FYM @ 10.0 t ha^{-1}**
B_0: Control	0.99	1.00	0.92
B_1: Biochar @ 2.5 t ha^{-1}	0.86	1.01	1.10
B_2: Biochar @ 5.0 t ha^{-1}	1.04	0.99	1.15
B_3: Biochar @ 7.5 t ha^{-1}	1.00	1.09	1.15
S. Em±	0.04	C.D. @ 0.05	0.13

Table 11: Interaction effect of different levels of biochar and FYM on uptake (mg pot^{-1}) of potassium by fodder sorghum

Levels of biochar	Levels of FYM		
	F_0: Control	F_1: FYM @ 5.0 t ha^{-1}	F_2: FYM @ 10.0 t ha^{-1}
B_0: Control	252.8	262.4	268.1
B_1: Biochar @ 2.5 t ha^{-1}	314.2	414.8	449.9
B_2: Biochar @ 5.0 t ha^{-1}	431.5	453.3	541.4
B_3: Biochar @ 7.5 t ha^{-1}	487.8	566.9	580.3
S. Em±	19.8	C.D. @ 0.05	58.0

4. Conclusion
In this study it was proved that biochar as amendment has potential to increase crop production and nutrient uptake by fodder sorghum in saline soil. Growth and yield parameters like seed germination percentage, plant population, plant height, green forage yield dry matter yield and nutrient uptake were adjudged as ideal parameters to prove the biochar and FYM act as growth promoter. Biochar and FYM have significantly improved agronomic performance by applying them separately or in combination.

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