

Original Research Article

Impact of Foliar application of Zinc and Biofertilizers on Growth of Sorghum

(Sorghum bicolor L.)

Abstract

The field experiment took place in the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, during the *kharif* season of 2021. (UP). The experiment was set up in a Randomized Block Design with ten treatments, including control, that was replicated thrice using various biofertilizers. viz. *Azospirillum* sps. 25g/kg seeds, PSB 25g/kg seeds and combination of *Azospirillum* sps. 25g/kg seeds + PSB 25g/kg seeds and foliar application of 0.5% zinc at 30, 50 and 30 + 50 DAS /ha. The Research revealed that foliar application of zinc 0.5% at 50 DAS/ha along with seed inoculation by *Azospirillum* sps. 25g/kg Seeds + PSB 25g/kg seeds significantly increased the growth parameters of Sorghum viz., plant height (163.31cm), dry matter accumulation (92.71 g), No. of Leaves (12.87), Absolute growth rate (1.33 g/plant/day), crop growth rate (44.31 g/m²/day) and leaf area (414.67 cm²).

Keywords: Sorghum, Biofertilizers, Zinc, *Azospirillum* sps., Phosphate solubilizing bacteria, Growth

1. INTRODUCTION

Sorghum is one of the most significant crops produced in India, and it is used on a daily basis by the majority of Indians. After wheat, corn, rice, and barley, it ranks fifth in cereal production. It is also important in the industrial sector, since it is used in malting, the production of high fructose syrup, breads and many value-added products, and animal feed. Sorghum is a millet with many health benefits and it is recommended to diabetic patients. Sorghum is also a drought tolerant crop, it can be easily grown in areas with dry -

climate and less rainfall. Minimum 350-400 mm of rainfall is good for cultivation, it can tolerate both drought as well as water logging conditions. Sorghum can be grown on wide range of soil but sandy loam soil is considered to be best for its cultivation. Sorghum is a good source of vitamins and minerals, along with providing great protein content and making up for a large portion of your dietary fiber intake. For every 100 grams of sorghum cereal, you get about 3.5 grams fat, out of which only 0.6 grams is saturated fat. The 100 g grain content 10.4 g proteins, 1.9 g fats, 72.6 g carbohydrates, 1.6 g Crude Fiber and 25 g Calcium. Major pest problem is very less in this crop and that's why it can be stored easily for long time. Sorghum has high content in vitamins and fiber rich source. Sorghum is known to be rich in phenolic compounds, many of which act as antioxidants, which helps in reduction of tumor.

The sorghum productivity has been low due to growing of this crop on small and marginal lands and continuous use of harmful fertilizers. Micronutrient deficiency in soil especially zinc, is the most common problem in the soil due to which there is severe yield losses and nutritional quality get affected. The integrated nutrient management is being implemented on many of the crops because of that the use of biofertilizers uses has been increased in all types of crops especially using biofertilizers in the cereal crops has been proven beneficial in many ways for fixing the nitrogen. Use of biofertilizers and foliar application of zinc combined can result in good growth of the sorghum crop. Biofortification of zinc strategy appears to be essential in keeping sufficient amount of available zinc in plants to maintain adequate zinc transport to grain during the reproductive stage and other growth stages.

2. MATERIALS AND METHODS

The experiment was conducted in the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, during the *kharif* season of 2021. (U.P). which is situated at 25° 39' 42" north latitude, 81° 67' 56" east longitude, and 98 meters above sea level. The soil in the experimental plot was sandy loam in texture, pH 7.7, low in organic carbon (0.57 percent), available N (230 kg/ha), available P (32.10 kg/ha), and available K (346.00 kg/ha). The crop was planted on July 19, 2021, with the NTJ-5 variety. The experiment used a Randomized Block Design with three replications and a total of ten treatments. viz. T₁: Control- 80: 40:40 Kg NPK ha/ (Farmer's Practice), T₂: *Azospirillum* sps. 25 g/kg seeds + 0.5% zinc foliar spray 30 DAS, T₃: *Azospirillum* sps. 25 g/kg seeds + 0.5 %

zinc foliar spray 50 DAS, T₄: *Azospirillum* sps. 25 g/kg seeds + 0.5 % zinc foliar spray 30 + 50 DAS, T₅: PSB 25 g/kg seeds + 0.5% zinc foliar spray 30 DAS, T₆: PSB 25 g/kg seeds + 0.5 % zinc foliar spray 50 DAS, T₇: PSB 25 g/kg seeds + 0.5 % zinc foliar spray 30 + 50 DAS, T₈: *Azospirillum* sps. + PSB: 25+25 g/kg seeds + 0.5% zinc foliar spray 30 DAS, T₉: *Azospirillum* sps + PSB: 25+25 g/kg seeds + 0.5 % zinc foliar spray 50 DAS. T₁₀: *Azospirillum* sps. + PSB: 25+25 g/kg seeds + 0.5 % zinc foliar spray 30 + 50 DAS. All nutrients were applied as urea, single super phosphate (SSP), and muriate of potash through the soil (MOP). For each plot, a full dose of P and K was applied basal, and half of the nitrogen (as urea) was applied basal. The remaining half of the nitrogen should be top dressed 30-35 days following sowing. The growth parameters of the randomly selected five tagged plants in each treatment were measured at intervals of 20,40,60,80 DAS and at harvest stage.

3. RESULTS AND DISCUSSION

3.1. Impact of foliar application of zinc and biofertilizers and on growth parameters

Impact of foliar application of zinc and biofertilizers on growth parameters of sorghum are in Table 1.

3.1.1. Plant height

The findings resulted that the treatment with dual inoculation of *Azospirillum* and PSB along with foliar application of 0.5% zinc at 50 DAS/ha recorded maximum plant height (163.31 cm). Similar findings were reported by Rafi and Charyulu *et al.*, [26], Prasad *et al.*, [25] and Priyanka *et al.*, [14]

3.1.2 Number of leaves per plant

The results revealed that maximum number of leaves per plant (12.87) was recorded with dual inoculation of *Azospirillum* sps. and PSB along with foliar application of 0.5% zinc at 50 DAS/ha which was maximum over the other treatment combinations. Similar findings were reported by Anil kumar *et al.*, [2]

3.1.3. Dry matter accumulation

The results recorded that significantly highest plant dry matter accumulation (92.71 g) was observed with dual inoculation of *Azospirillum* sps. and PSB along with foliar application of 0.5% zinc at 50 DAS/ha which was higher over the treatments. It is due to

better availability of nitrogen and phosphorus and the action of biofertilizer which lead in overall better development of the crop. The combined use of biofertilizer and foliar application of zinc just before flowering stage at 50 DAS helped in good foliage and good panicle development in the crop which improved the growth parameters due to increased dry matter production, which in turn contributed to improved yield attributes. Similar findings were reported by *et al.*, [26].

3.1.4. Absolute growth rate

At 80-100 DAS, results revealed that significantly highest absolute growth rate (1.33 g/plant/day) was observed with dual inoculation of *Azospirillum* sps. and PSB along with foliar application of 0.5% zinc at 50 DAS/ha which was superior over the treatments.

3.1.5. Crop growth rate

At 80-100 DAS, significantly highest crop growth rate (44.31 g/m²/day) has been recorded with dual inoculation by *Azospirillum* sps. and phosphate solubilizing bacteria (PSB) along with foliar application of zinc at 50 DAS over control.

3.1.6. Leaf area

At 80 DAS, significantly highest leaf area (414.67 cm²) has been recorded with dual inoculation by *Azospirillum* sps. and phosphate solubilizing bacteria (PSB) along with foliar application of zinc at 50 DAS.

Table 1. Impact of biofertilizers and foliar application of zinc on growth parameters of sorghum

Treatments	Growth parameters (80DAS)					
	Plant height (cm)	No. of leaves per plant	Dry matter accumulation	Absolute growth rate (g/plant/day) 80-100 DAS	Crop growth rate (g/m ² /day) 80-100 DAS	Leaf area (cm ²)
1. Control 80:40:40 kg NPK/ha (Farmer's Practice)	143.98	11.53	75.71	1.12	37.32	312.90
2. <i>Azospirillum</i> sps. 25 gm/kg seeds + 0.5% zinc foliar spray 30 DAS	153.75	11.67	81.66	1.15	38.32	343.03
3. <i>Azospirillum</i> sps. 25 gm/kg seeds + 0.5 % zinc foliar spray 50 DAS	153.90	12.47	83.30	1.19	39.57	337.50
4. <i>Azospirillum</i> sps. 25 gm/kg seeds + 0.5 % zinc foliar spray 30 + 50 DAS	157.07	12.67	85.54	1.25	41.74	383.00
5. PSB 25 gm/kg seeds + 0.5% zinc foliar spray 30 DAS	158.95	11.73	86.03	0.99	32.99	374.90
6. PSB 25 gm/kg seeds + 0.5 % zinc foliar spray 50 DAS	161.30	11.93	85.03	1.15	38.29	362.57
7. PSB 25 gm/kg seeds + 0.5 % zinc foliar spray 30 + 50 DAS	161.67	11.60	90.32	1.02	33.83	396.53
8. <i>Azospirillum</i> sps. + PSB 25+25g/kg seeds + 0.5% zinc foliar spray 30 DAS	155.91	11.53	86.19	0.86	28.81	386.13
9. <i>Azospirillum</i> sps. + PSB 25+25g/kg seeds + 0.5% zinc foliar spray 50 DAS	163.31	12.87	92.71	1.33	44.31	414.67
10. <i>Azospirillum</i> sps. + PSB 25+25g/kg seeds + 0.5% zinc foliar spray 30 + 50 DAS	154.73	12.60	86.69	1.00	33.35	378.07
F test	S	S	S	S	S	S
Sem (\pm)	2.34	0.34	0.83	0.06	0.91	1.46
CD (P=0.05)	6.95	1.00	2.47	0.17	5.67	4.34

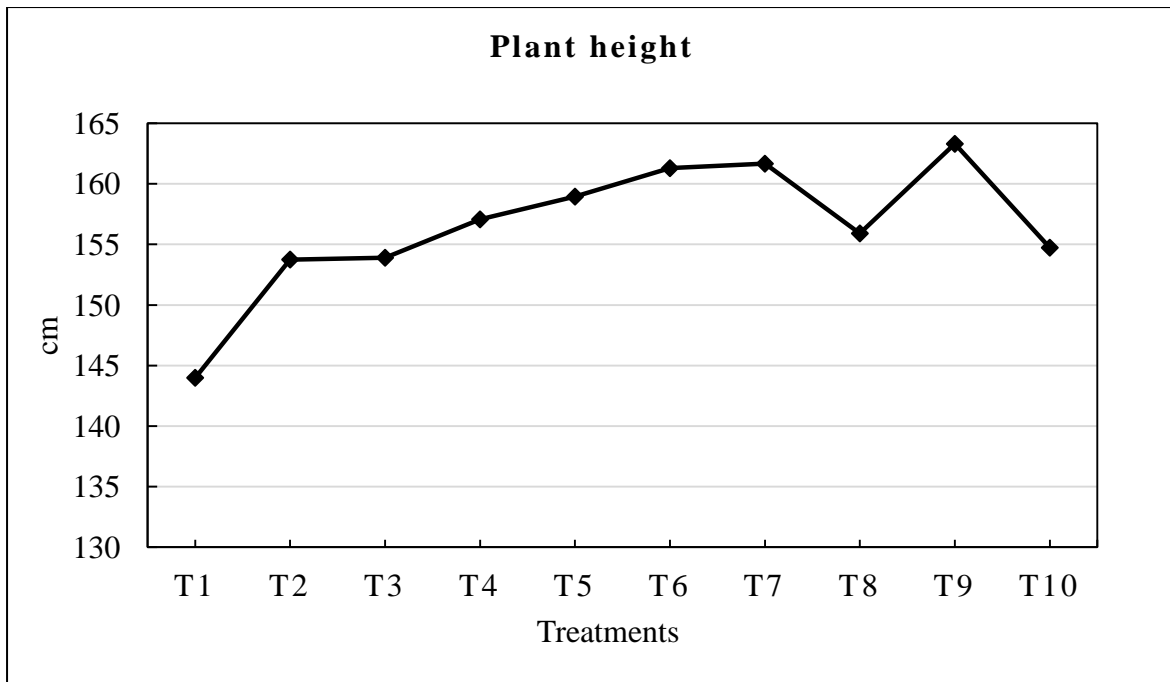


Fig. 1. Impact of biofertilizers and foliar application of seaweed on plant height of sorghum

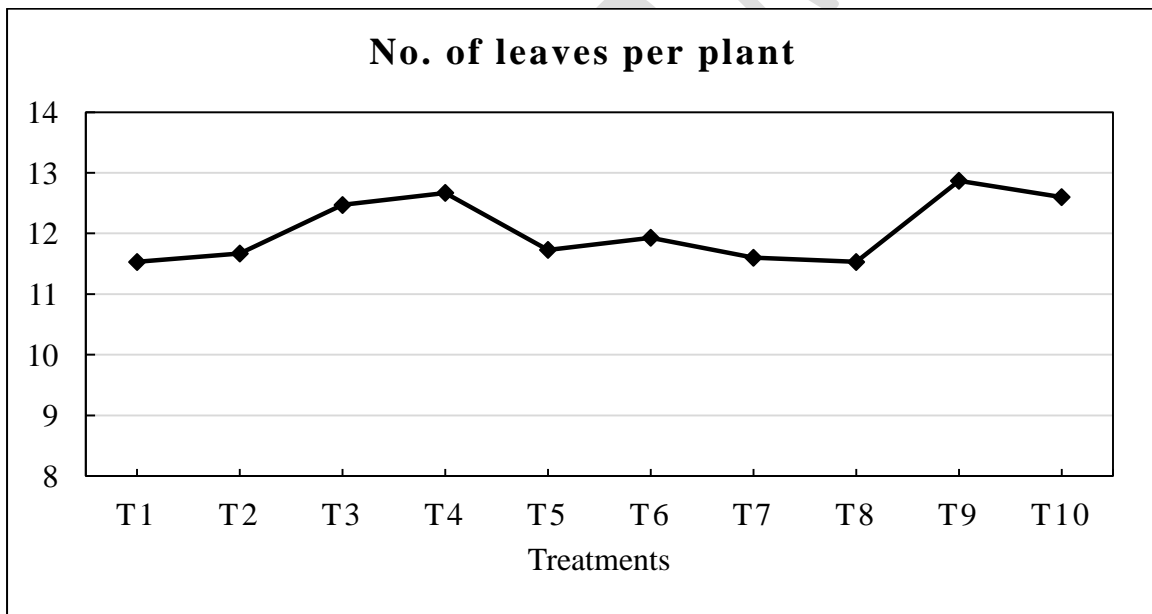


Fig. 2. Impact of biofertilizers and foliar application of seaweed on No. of leaves per plant of sorghum

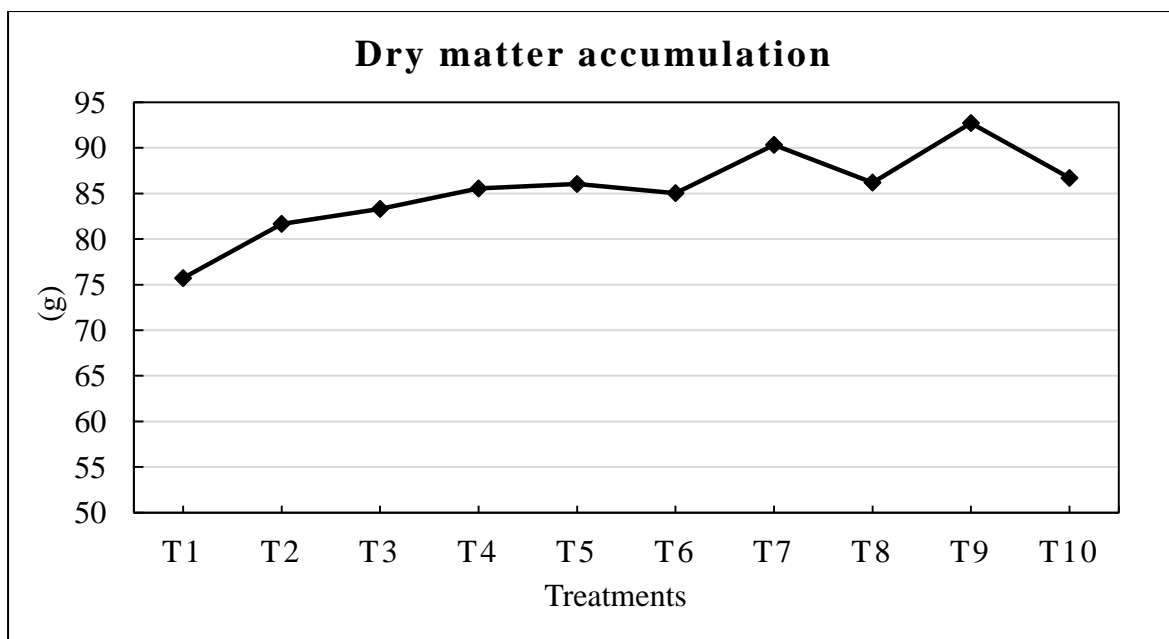


Fig. 3. Impact of biofertilizers and foliar application of seaweed on dry matter accumulation of sorghum

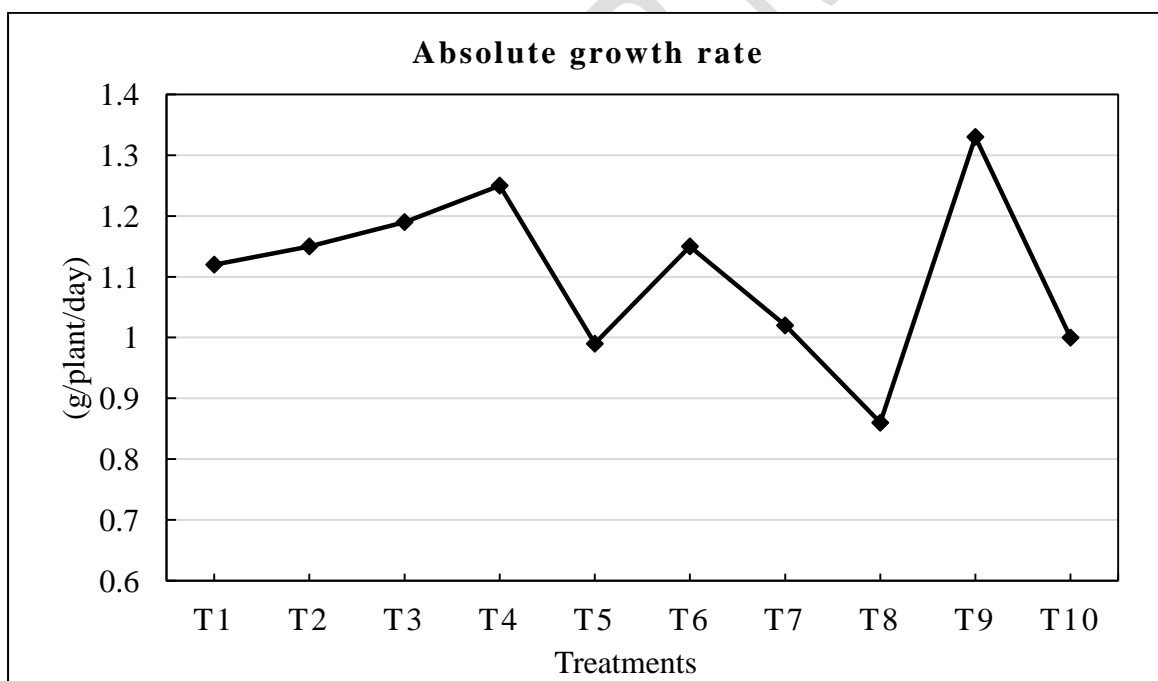


Fig. 4. Impact of biofertilizers and foliar application of seaweed on absolute growth rate of sorghum

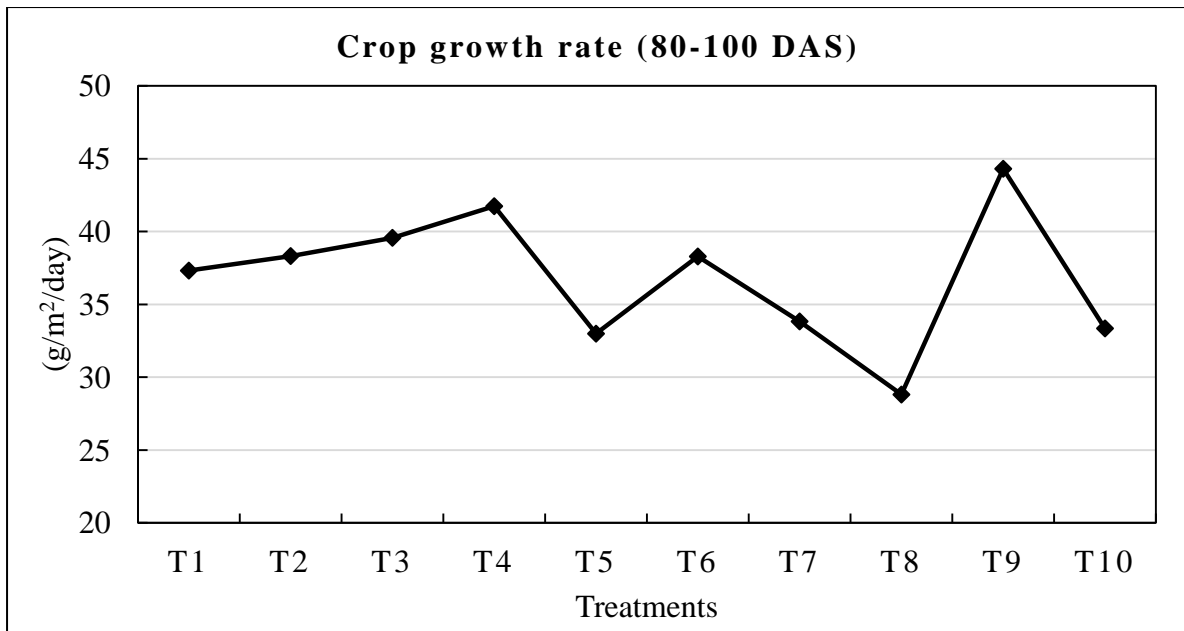


Fig. 5. Impact of biofertilizers and foliar application of seaweed on crop growth rate of sorghum

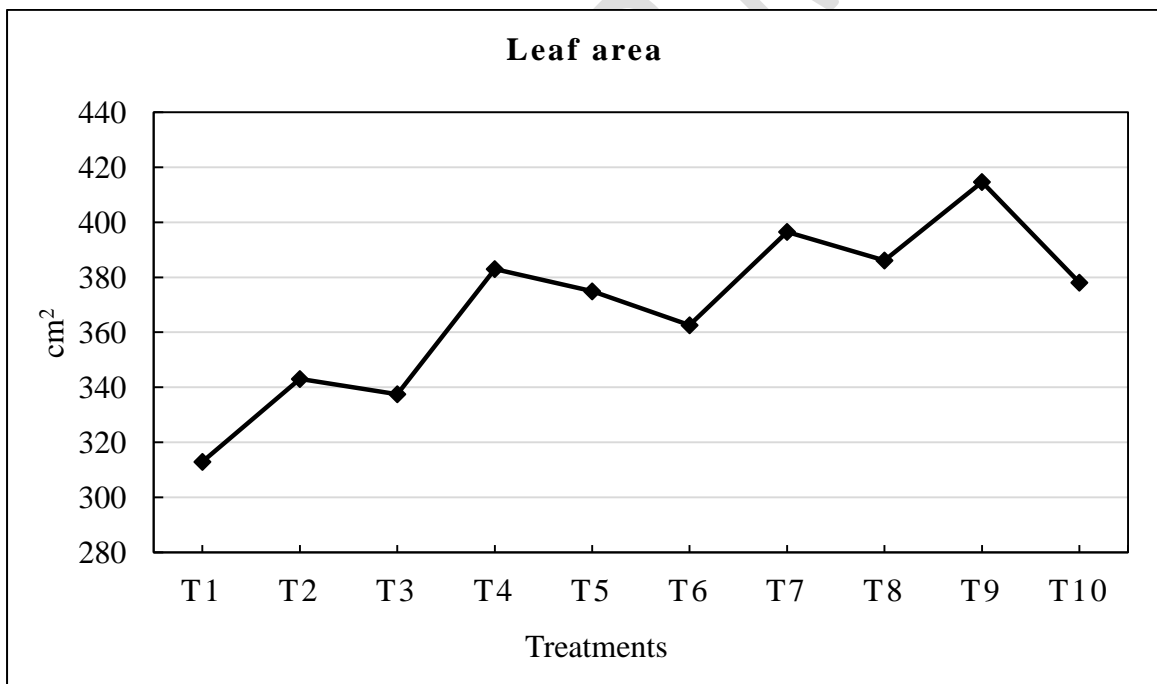


Fig. 6. Impact of biofertilizers and foliar application of seaweed on leaf area of sorghum

Conclusion

The findings of this study suggest that sorghum should be sown with dual inoculation of *Azospirillum* sps. and PSB along with foliar application of 0.5% zinc at 50 DAS/ha as it has resulted in higher growth and development of sorghum.

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