

Original Research Article

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Invitro and Field Evaluation of Compost tea and Seaweed Formulation on Leaf Blight of Sunflower

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ABSTRACT

Sunflower crop suffers from many diseases of which *Alternaria* blight has been considered as a potentially destructive disease. The objective of this study was *in vitro* evaluation and to study field efficacy of compost tea and seaweed formulation on leaf blight of sunflower. *In vitro* evaluation of compost tea revealed that maximum inhibition of *A. helianthi* was recorded in compost tea at 25 per cent (60.5%) followed by compost tea at 20 per cent (58.5%) and 15 per cent (53.8%). In field conditions, foliar spray of compost tea at the rate of 1:10 ratio at 30, 45 DAS and propiconazole at 1mL⁻¹ at 60 DAS increased the growth parameters like plant height (245.93 cm), stem girth (4.60 cm), number of leaves (9.35) and chlorophyll content (42.97). Foliar spray of compost tea with propiconazole was effective in controlling the *Alternaria* blight of sunflower with least disease severity (10.37%) and higher yield (2201.41 Kg ha⁻¹) which was on par with foliar spray of seaweed formulation (LBD-1) at 30, 45 DAS and propiconazole at 60 DAS with disease severity 12.32 per cent and seed yield of 1928.04 Kg ha⁻¹.

Keywords

Alternaria helianthi,
Sunflower,
Compost tea,
Seaweed, *in vitro*

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Introduction

Sunflower (*Helianthus annuus* L.) a member of family Asteraceae (Compositae) is an important edible oilseed crop. In the world, sunflower ranks fourth in area after soybean, rapeseed and groundnut. North America is the native of sunflower and since ancient times it was grown as an ornamental plant. In 1969, it was introduced into India for the first time as

oilseed crop. Presently in India, the sunflower crop occupies an area about 3.81 lakh ha with a production of 2.51 lakh tonnes and productivity of 660 Kg ha⁻¹. Sunflower is being grown in India across Karnataka, Maharastra and Andhra Pradesh. Among these, Karnataka occupies first position accounting to 2.20 lakh ha with a production of 0.98 lakh tonnes and productivity of 445 kg ha⁻¹ (Anon., 2017). Among the major diseases

of sunflower, *Alternaria* blight caused by *Alternaria helianthi* (Hansf.) Tubaki and Nishihara has been considered as a potentially destructive disease in many parts of countries growing sunflower (Allen *et al.*, 1983) and in north Karnataka (Shankergoud *et al.*, 2006).

Balasubramanyam and Kolte (1980a) reported that the *Alternaria* blight significantly reduced average flower size, number of seeds per head, seed weight, seed yield per plant and also oil content. Depending on the extent of infection, the loss in the yield varied from 11.30 to 73.33 per cent (Reddy and Gupta, 1977). Several effective pesticides for the control of *Alternaria* leaf blight have been recommended but they are not regarded to be long term solutions, due to fungicide residue, exposure to health risk, concerns of expense and other environmental hazards. In this experiment, we have used biological controls like compost tea and seaweed formulation. Compost tea is a liquid extract made from compost that contains a variety of nutrients, growth compounds and beneficial microorganisms. The microorganisms in compost tea may potentially produce biomolecules with antibiosis potential, contributing to disease suppression of either *Phytophthora infestans* or *Magnaporthe griseae* (Anil *et al.*, 2017).

Seaweed extract is one of the biostimulants which can be applied as a foliar spray and enhance plant growth, tolerance to abiotic stress, photosynthetic activity and resistance to diseases, improving the yield and productivity of many crops (Sharma *et al.*, 2014). Therefore in view of the importance of the crop and disease management, present investigation on *Alternaria* blight of sunflower was conducted to assess the *in vitro* evaluation of compost tea against *Alternaria helianthi* and to study the field efficacy of compost tea and seaweed formulation on leaf blight of sunflower.

Materials and Methods

The present investigation was undertaken during 2018-19 at Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bengaluru. The experimental site is located in the eastern tract (Zone 5) of Karnataka at 12° 58' N latitude and 77° 35' E longitude and at an altitude of 930 m above mean sea level.

In vitro evaluation of compost tea against *Alternaria helianthi*

The efficacy of compost tea was evaluated against *A. helianthi* on Potato dextrose agar medium at different concentrations using poisoned food technique (Vincent, 1947). Sterilized potato dextrose agar was prepared and autoclaved. The agar medium was cooled to 50 °C. Compost tea was dissolved in sterilized water to make the stock solution. Appropriate quantity of stock solution was added to PDA, to get the desired concentration of the compost tea, the flasks were agitated gently to aid uniform dispersion of the compost tea solution into the medium. About 15 to 20 ml of poisoned PDA was poured into 90 mm Petri plates and allowed to solidify. Three replications were maintained for each treatment. 5 mm disc of the actively growing test fungal culture of *A. helianthi* were obtained with a sterilized cork borer and transferred aseptically to the centre of the poisoned medium in each of the Petri plates. Control was maintained with the pathogen under similar conditions on PDA without poisoning. Inoculated plates were incubated for 21 days at 27±1°C and the colony diameter was recorded by measuring the radial growth of the fungus in two directions at a right angle to each other and the average diameter was calculated. The percent inhibition of the growth over control was calculated by following the equation (Vincent, 1947).

$$I = \frac{C - T}{C} \times 100$$

Where,

I = Per cent inhibition of mycelial growth

C = Radial growth of pathogen in control (mm)

T = Radial growth of pathogen in treatment (mm)

To study the field efficacy of compost tea and seaweed formulation on leaf blight of sunflower

Field experiment was conducted at Zonal Agricultural Research Station, GKVK, Bengaluru during *Kharif* 2018-19 for the management of leaf blight of sunflower.

Plot size : 4.2 m x 4.5 m
Hybrid : KBSH-44
Space : (60 x 30) cm
Date of sowing : 19-08-2018
Design : RCBD
Treatment : 7
Replication : 3

Standard agronomic practices were followed to grow the crop.

Treatment details are as follows

T1: Foliar spray of compost tea (1:10) @ 30, 45 and 60 DAS

T2: Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 and 60 DAS

T3: Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS

T4: Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS

T5: Foliar spray of propiconazole @ 1 mL⁻¹ at 45 and 60 DAS

T6: Foliar spray of mancozeb @ 3.0 gL⁻¹ at 45 and 60 DAS

T7: Control

Observations recorded

Five plants were selected randomly for recording observations and the mean of five plant observations were used for further analysis.

Plant height (cm)

The plant height was measured using a metric scale from the base of the plant to the point of attachment of the capitulum at 90 days after sowing and expressed in centimeters.

Number of leaves (units)

The number of fully opened leaves from the base to the tip of the terminal bud was counted at 90 days after sowing.

Stem girth (cm)

The stem girth was measured at the middle point of stalk at 90 days after sowing by using vernier calipers which is expressed in centimeters.

Chlorophyll content (nmol/mg)

The chlorophyll content was measured using SPAD meter at 90 days after sowing and then values were expressed in nmol/mg.

Seed yield (Kg ha⁻¹)

At harvest stage, the weight of well dried and cleaned seeds from each treatment was recorded in kilograms, extrapolated and expressed in kilograms per hectare.

Disease severity (%)

Assessment of the severity of *Alternaria* leaf blight was simultaneous with the evaluation of leaf area, with the aid of diagrammatic

scale. Marked plants affected by the other diseases were discarded. Per cent disease severity was recorded at 50 per cent of flowering. Disease severity was calculated using the formula.

$$\text{Disease severity (\%)} = \frac{\text{Area of plant tissue affected by disease}}{\text{Total area}} \times 100$$

Statistical analysis

The field experimental data was analysed statistically by Fischer's method of analysis of variance by Panse and Sukhatme (1967). The level of significance used in the F test was $P= 0.05$. The critical difference was worked out wherever F-test was significant.

Results and Discussion

Experiments were conducted on various aspects of *Alternaria* blight of sunflower with reference to *in vitro* and field evaluation studies of biological controls at GKVK, Bengaluru, during 2018-19. The results obtained are presented and discussed below.

In vitro evaluation of compost tea against *Alternaria helianthi*

The effect of compost tea at different concentrations on growth of *A. helianthi* was studied by using poisoned food technique (Table 1).

The radial growth of the pathogen was significantly superior over control in all the concentrations of the compost tea tested. The radial growth of the pathogen was maximum (35.00 mm) in compost tea tested at 2.5 per cent which is on par with compost tea at 5, 10 and 15 per cent.

The radial growth of the pathogen was 29.00 mm in compost tea at 20 per cent which was on par with compost tea at 25 per cent, whereas the radial growth of pathogen in

control (without compost tea) was 70 mm (Plate 1, Fig. 1).

Maximum per cent inhibition (60.50 %) of pathogen was recorded in compost tea at 25 per cent followed by compost tea at 20 per cent (58.50 %) and 15 per cent (53.80 %). Least inhibition of pathogen over control was observed on compost tea at rate of 2.5 per cent.

The above findings are in close agreement with the findings of Luo *et al.*, (2019) who reported that mycelial growth was reduced in *B. cinerea* and *A. alternata* by up to 49 and 53 per cent, respectively due to different bacterial antagonists present in disease suppressive composts for controlling fruit rot of bell pepper.

Haggag and Saber (2007) also conducted an *in vitro* evaluation of compost tea against *Alternaria porri* in onion and *Alternaria solani* in tomato and results revealed that there was inhibition of fungal growth up to 80.2 and 83.8 per cent, respectively.

Pane *et al.*, (2012) also showed compost tea was most effective in suppressing the growth of three pathogens of tomato *viz.*, *Alternaria alternata* (72.5%), *Botrytis cinerea* (37.5%) and *Pyrenochaeta lycopersici* (57.5%) implicating an antibiotic like antagonism effect due to the presence of active microorganisms in suspension.

Choanephora cucurbitarum mycelial growth was reduced by 100 per cent in plates amended with compost tea due to the presence of beneficial microorganisms in compost tea utilized the nutrients required for the germination of conidia and prevented the germination or growth of the conidium germ tube leading to lysis of the conidia of the pathogen (Siddiqui *et al.*, 2009).

To study the field efficacy of compost tea and seaweed formulation on leaf blight of sunflower

Field experiment was conducted to evaluate the relative efficacy of compost tea and seaweed formulation against *Alternaria* blight of sunflower during 2018-19 at Zonal Agricultural Research Station (ZARS), Gandhi Krishi Vignana Kendra, Bengaluru.

Growth parameters

The plant height of sunflower recorded at 90 DAS (Table 2) was found significantly higher in all the treatments compared to control (184.84 cm). Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (T3) recorded maximum plant height (245.93 cm) which was on par with other treatments. These results are in accordance with El-Din and Hendawy (2010) who reported that plants sprayed with compost tea significantly improved plant growth characters expressed as plant height, fresh and dry weight of aerial parts, number of suckers and seed weight of *Borago officinalis* compared to untreated plants.

The effect of different treatments on the number of leaves per plant was recorded at 90 DAS was significantly higher in all the treatments compared to control (5.96). Maximum number of leaves was recorded in foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (9.35) which is on par with foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (8.33) followed by other treatments. Foliar spray of compost tea @ 30, 45 DAS and propiconazole @ 60 DAS (T3) was significantly superior over other treatments and remaining other treatments were on par with each other.

Similar type of results were obtained by Siddiqui *et al.*, (2008) who reported that compost extracts promoted significant enhancement on morphological characters of okra such as shoot length, tap root length, number of leaves per plant, and leaf area variations in respect to other treatments.

The stem girth of sunflower recorded at 90 DAS was found significantly higher in all the treatments compared to untreated control (2.73 cm). Among the treatments, maximum stem girth was recorded in foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (4.60 cm) which is on par with foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (4.20 cm) and foliar spray of propiconazole @ 1 mL⁻¹ at 45 and 60 DAS (4.16 cm).

Due to fermentation more accumulation of nitrates in the compost tea may take place which will contribute to increase in biomass of the compost tea treated plants. Similar results were reported in lettuce growth by Kim *et al.*, (2015).

Chlorophyll content

The SPAD value of sunflower recorded at 90 DAS (Table 3) was significantly higher in all treatments compared to the untreated control (30.18). Among the treatments, highest SPAD value was recorded in foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (42.97) and it was followed by foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS (41.22), foliar spray of propiconazole @ 1 mL⁻¹ at 45 and 60 DAS (39.65) and foliar spray of mancozeb @ 3.0 gL⁻¹ at 45 and 60 DAS (37.07). However, chlorophyll content in foliar spray of compost tea @ 30, 45 DAS

and propiconazole @ 60 DAS (T3) was superior over all other treatments.

These results are in accordance with Naidu *et al.*, (2013) who reported that microbial enriched compost tea increased significantly chlorophyll content in muskmelon plants. Xu *et al.*, (2012) reported that higher chlorophyll content in compost tea treatments could be due to external supply of nitrogen as a foliar spray from the compost tea. Aerated compost tea showed more greenness or more chlorophyll content; this may be due to aeration of compost tea, which may increase the availability of nitrogen and accumulation of nitrogen in plants.

Disease severity

The effect of different treatments on per cent disease severity was recorded at 50% flowering stage and is presented in Table 4, Fig. 2. There was significant difference in the treatments with respect to disease severity.

The result obtained revealed that all the treatments reduced the disease significantly compared to the untreated control. Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS recorded least severity of 10.37 per cent which is on par with T4 (foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS) 12.32 per cent. The highest disease severity in control plants (T7) was 44.36 per cent.

The results are in accordance with Weltzien and Ketterer (1986) who reported that application of compost tea significantly suppress several diseases including gray mold, apple scab, collar rot, downy mildew, powdery mildew and damping-off. Morales-Corts *et al.*, (2018) showed suppressive effect of aerated compost tea on *Rhizoctonia solani* and *Fusarium oxysporum* f. sp. *lycopersici* on tomato plants.

Table.1 *In vitro* evaluation of compost tea against *A. helianthi*

Concentrations (%)	Radial growth of pathogen (mm)	Per cent inhibition over control (%)
2.5	35.00	50.00 (44.99)*
5.0	34.33	51.40 (45.80)
10.0	33.33	52.40 (46.37)
15.0	32.33	53.80 (47.17)
20.0	29.00	58.50 (49.91)
25.0	27.66	60.50 (51.06)
Control	70.00	0.00 (0.00)
S. Em±	0.42	1.23
C.D @ 1%	2.22	6.46

* Figures in parenthesis are arc sine transformed values

Table.2 Effect of different treatments on growth parameters

Treatment	Plant height (cm)#	Number of leaves #	Stem girth (cm) #
T1: Foliar spray of compost tea (1:10) @ 30, 45 and 60 DAS	226.74 ^a	7.35 ^b	3.74 ^{bc}
T2: Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 and 60 DAS	224.60 ^a	7.20 ^b	3.46 ^c
T3: Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS	245.93 ^a	9.35 ^a	4.60 ^a
T4: Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS	236.27 ^a	8.33 ^{ab}	4.20 ^{ab}
T5: Foliar spray of propiconazole @ 1 mL⁻¹ at 45 and 60 DAS	232.13 ^a	8.07 ^b	4.16 ^{abc}
T6: Foliar spray of mancozeb @ 3.0 gL⁻¹ at 45 and 60 DAS	227.73 ^a	7.87 ^b	3.82 ^{bc}
T7: Control	184.84 ^b	5.96 ^c	2.73 ^d
S.Em±	11.09	0.39	0.23
CD at 5%	34.18	1.21	0.71

Mean of three replications

Table.3 Effect of different treatments on chlorophyll content

Treatment	Chlorophyll SPAD value #
T1: Foliar spray of compost tea (1:10) @ 30, 45 and 60 DAS	33.34 ^f
T2: Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 and 60 DAS	35.25 ^e
T3: Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS	42.97 ^a
T4: Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS	41.22 ^b
T5: Foliar spray of propiconazole @ 1mL⁻¹ at 45 and 60 DAS	39.65 ^c
T6: Foliar spray of mancozeb @ 3.0 gL⁻¹ at 45 and 60 DAS	37.07 ^d
T7: Control	30.18 ^g
S.Em±	0.30
CD at 5%	0.94

Mean of three replications

Table.4 Effect of different treatments on disease severity and yield

Treatment	Disease severity (%)	Yield (Kg ha ⁻¹) #
T1: Foliar spray of compost tea (1:10) @ 30, 45 and 60 DAS	21.06 ^{bc} (26.73) *	1632.80 ^b
T2: Foliar spray of seaweed formulation (LBD-1) @ 2 mL ⁻¹ at 30, 45 and 60 DAS	22.76 ^b (28.82)	1692.24 ^b
T3: Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL ⁻¹ at 60 DAS	10.37 ^c (18.29)	2201.41 ^a
T4: Foliar spray of seaweed formulation (LBD- 1) @ 2 mL ⁻¹ at 30, 45 DAS and propiconazole @ 1 mL ⁻¹ at 60 DAS	12.32 ^e (19.42)	1928.04 ^{ab}
T5: Foliar spray of propiconazole @ 1mL ⁻¹ at 45 and 60 DAS	13.79 ^{de} (21.87)	1783.77 ^b
T6: Foliar spray of mancozeb @ 3.0 gL ⁻¹ at 45 and 60 DAS	18.11 ^{cd} (25.19)	1715.23 ^b
T7: Control	44.36 ^a (42.73)	1262.81 ^c
S.Em±	1.48	118.10
CD at 5%	4.56	363.93

* Figures in parenthesis are arc sine transformed values

Mean of three replications

Plate.1 *In vitro* evaluation of compost tea at different concentrations on radial growth of *A. helianthi*



Fig.1 Effect of compost tea on radial growth of *A. helianthi*

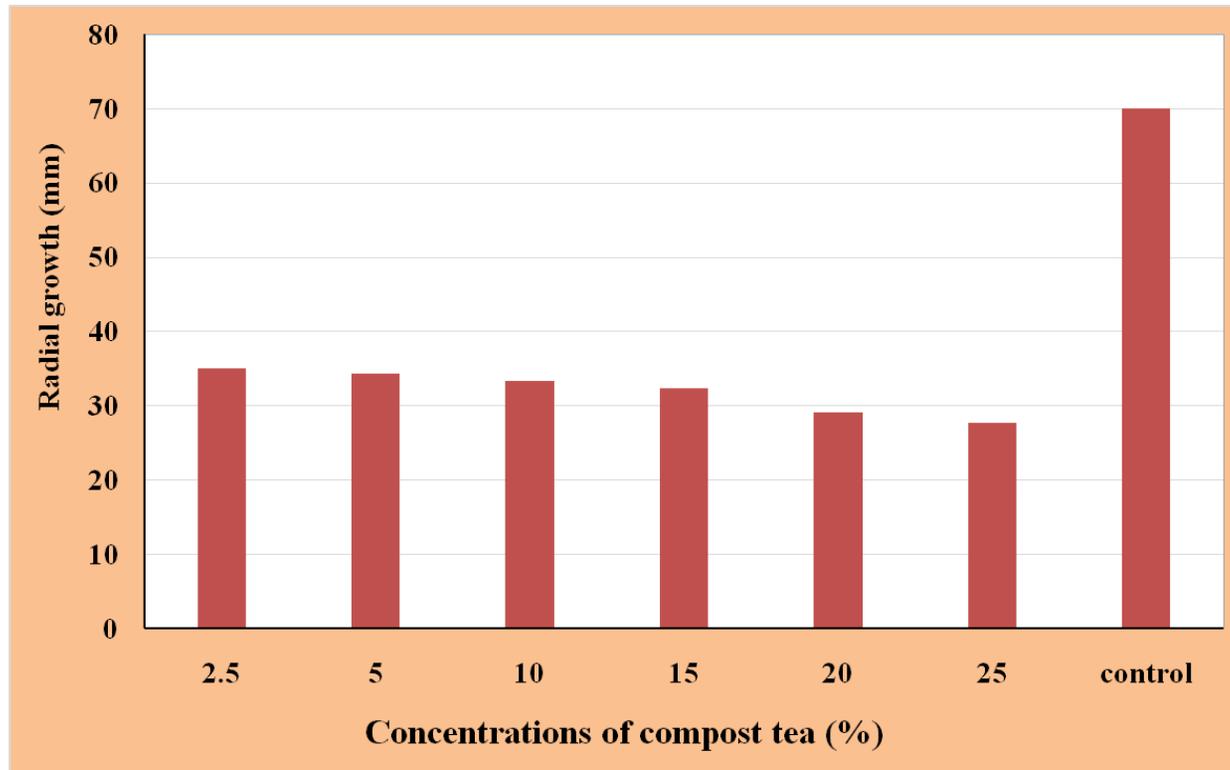


Fig.2 Effect of different treatments on disease severity of *Alternaria* blight of sunflower

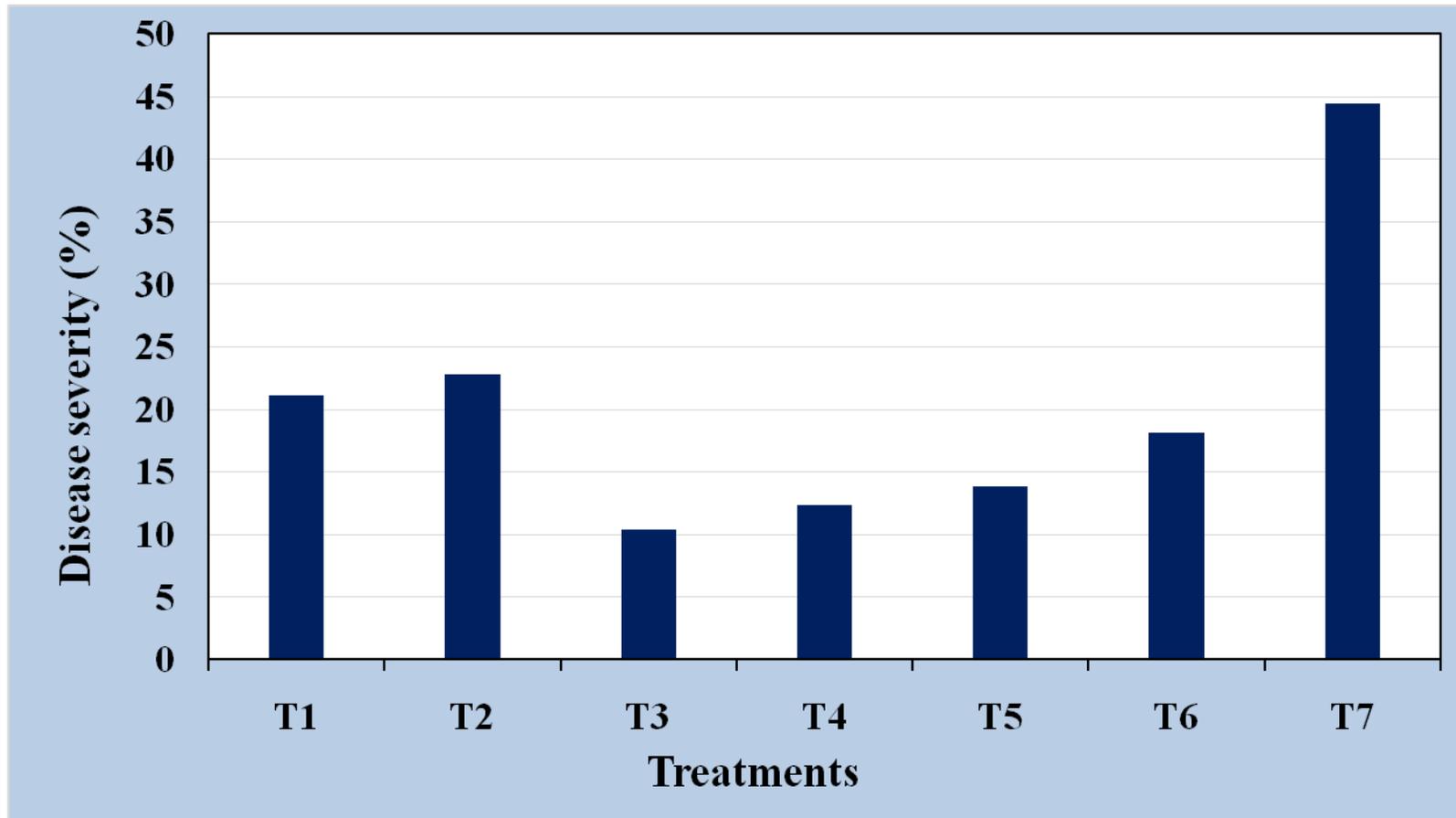
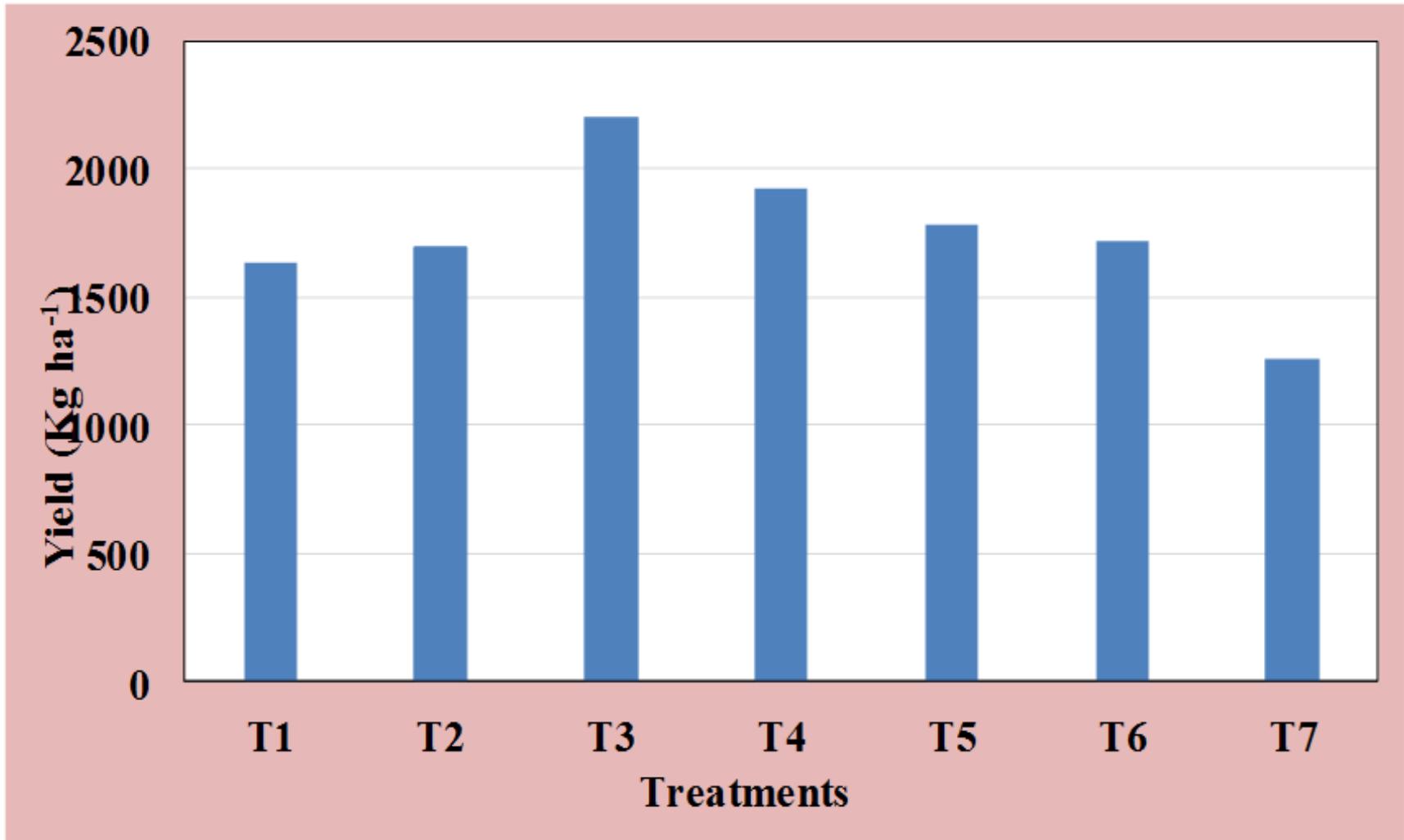


Fig.3 Effect of different treatments on yield of Alternaria blight of sunflower



Seed yield

The seed yield obtained in the different treatments is presented in Table 4, Fig. 3. All the treatments were significantly superior over control. Foliar spray of compost tea (1:10) @ 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS recorded significantly higher seed yield of 2201 Kg ha⁻¹ followed by T4 (Foliar spray of seaweed formulation (LBD-1) @ 2 mL⁻¹ at 30, 45 DAS and propiconazole @ 1 mL⁻¹ at 60 DAS) 1928 Kg ha⁻¹. Whereas, lowest seed yield (1262 Kg ha⁻¹) was obtained in treatment T7 (control).

Similar type of results were obtained by Lopez-Martin *et al.*, (2018) who reported that garden waste compost tea increased the yield by 9.47 per cent on potato against *Rhizoctonia solani*. Hassan *et al.*, (2013) reported that foliar spray of both compost tea and Bavistin was found 79.62 per cent higher yield over control.

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