International Research Journal of Pure & Applied Chemistry

22(2): 66-73, 2021; Article no.IRJPAC.66643
ISSN: 2231-3443, NLM ID: 101647669

Influence of Foliar Application of Compost tea on Growth, Yield and Quality of Soybean [*Glycine max* (L)]

N. Shrinivas[1], P. H. Vaidya[1] and P. H. Gourkhede[1*]

[1]Department of Soil Science and Agriculture Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, 431401, Maharashtra, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IRJPAC/2021/v22i230387
Editor(s):
(1) Dr. Hao-Yang Wang, Shanghai Institute of Organic Chemistry, China.
Reviewers:
(1) Ali Hussein Jasim, Al-Qasim Green University, Iraq.
(2) Rajendra Bhatt, G. B. Pant University of Agriculture and Technology, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/66643

Original Research Article

Received 25 January 2021
Accepted 01 April 2021
Published 11 April 2021

ABSTRACT

A field experiment was conducted during *kharif* season of the year 2016-17 with soybean variety MAUS -71 as test crop in *Vertisol*. With three replication and eight treatments *viz,* T_1 - Control (RDF 100%), T_2-100% RDF + Water spray, T_3 - RDF + Compost tea @ 10% foliar spray, T4 - RDF + Compost tea @ 15% foliar spray, T_5-RDF + Compost tea @ 20% foliar spray, T_6 - RDF + Compost tea @ 25% foliar spray, T_7 - RDF + Compost tea @ 50% foliar spray,T_8 - RDF + Compost tea @ 75% foliar spray. The results revealed that Among the different doses of foliar application of compost tea with RDF," application of RDF + compost tea @ 50% foliar spray significantly superior growth attributes viz. plant height, leaf area, number of leaves, dry matter and minimum growth attributes were observed in the control treatment at flowering, pod development and harvest stage. Maximum yield of soybean (2050.0 kg ha^{-1}) was recorded with application of RDF + Compost tea @ 50% foliar spray. The quality of soybean grain improved due to application of T_7 - RDF+ compost tea @ 50% foliar spray which recorded higher values of oil content (19.90%) protein content (31.44%) and protein yield (644.29 kg ha^{-1}).This indicated that the

**Corresponding author: E-mail: pathrikar2012@gmail.com;*

application of 30:60:30 kg ha^{-1} N : P_2O_5 : K_2O with foliar application of compost tea @ 50 percent (30,45,60 DAS) to soybean was found beneficial for increase in growth, yield and quality of soybean.

Keywords: Compost tea; foliar application; soybean; growth; yield and quality.

1. INTRODUCTION

Compost teas are a sustainable, economic, and feasible way to efficiently utilize nutrients from pre and post consumer food waste and vegetative wastes from modern agriculture. Compost tea is an umbrella term referring to a nutrient and microorganism rich solution prepared by releasing compost nutrients and microbiology into solution. Recently, compost teas have been recognized for their ability to suppress several foliar diseases as well as seed and root rot [1]. Compost tea can be tailored to its desired use. The tea improves the nutrient retention of the soil thus stimulating plant growth. If your soil can retain its nutrients it helps minimize the need to use fertilizer. Increasing the nutrients available to the root system leads to a stronger healthier plant. Compost tea assists in reducing the negative impact that chemical-based pesticides, herbicides and fertilizers have on beneficial micro-organisms in the ecosystem. The application of organic amendments can potentially stimulate crop growth and development through the actions of plant growth-promoting hormones, including cytokinins, auxins, and gibberellins. The use of solid organic material and foliar application of compost teas, enhanced the plant growth, yield and quality.

2. MATERIALS AND METHODS

This study was carried out at the research farm, Department of Soil Science and Agriculture Chemistry, College of Agriculture, Latur. The soil of the experimental site was deep, black with good drainage and as per USDA soil Taxonomy classification this soil belongs to Vertic Haplustepts. The required quantity of compost tea was be prepared and its characterization *Viz*. pH, Electrical conductivity, Organic carbon, available nutrients N P K and DTPA extrac table micronutrients. The Compost tea was prepared by decomposing 2.5 kg gliricida green leaves with 2.5 kg of fresh cow dung mixed well and tied it in a gunny bag and this gunny bag kept it on the bottom at the drum. A brick is placed on the gunny bag and pore the 100 liter water and stirred daily for a period of 5 minutes and this to be continued up to 20 days. The manure becomes ready within 3 weeks and the liquid manure is fully prepared, the gunny bag is taken out from the drum and adds 100 to 125 grams of molasses and mix. It will increase the quality of liquid manure. Their quality of liquid manure remains good for a period of 4 to 6 weeks if it is preserved in cool and shady place. The end product was filtered jto remain the large derbies and the liquid extract make ready for foliar application and its use immediately. The experimental plot was laid out in a randomized block design replicated three times. The plot size was 4 x $5m^2$ and row to row distance was 45 cm and a plant to plant distance of 5 cm. The popular variety MAUS-71 of soybean was used for this experiment with eight treatments *viz,* T_1 - control (RDF 100%), T_2-100% RDF + water spray, T_3 - RDF + compost tea @ 10% foliar spray, T4 - RDF + compost tea @ 15% foliar spray, T_5-RDF + compost tea @ 20% foliar spray, T_6 - RDF + compost tea @ 25% foliar spray, T_7 - RDF + compost tea @ 50% foliar spray,T_8 - RDF + compost tea @ 75% foliar spray. The foliar application of compost tea at 30, 45, 60 DAS. The data on growth, yield, yield attributes and quality were recorded and statistically analyzed.

3. RESULTS AND DISCUSSION

3.1 Chemical Composition of Compost Tea

The chemical characteristics of prepared compost tea revealed that the compost tea was alkaline pH 7.12) and electrical conductivity was 1.35 dSm^{-1}. Organic carbon content was 0.24 percent. The total N, P and K content in compost tea were 0.75 percent 0.38 percent and 0.63 percent respectively. The micro nutrient content were observed their concentration as Cu 0.98 mg L^{-1} Fe 15.71 mgl^{-1}, Mn 6.77 mgl^{-1} and Zn 2.13 mgl^{-1}. Similar findings also reported by (Naidu et al.2010). The compost is gaining importances an alternative to chemical fertilizers and pesticides. The chemical composition of compost tea was observed higher content of nitrogen, phosphorus, potassium, calcium, iron, and manganese content significantly higher in microbial enriched compost tea.

3.2 Effect of Compost Tea on Growth of Soybean

3.2.1 Plant height (cm)

The data regarding plant height were recorded at flowering; pod formation and harvesting stage of crop are presented in Table 1. It was evident from the results that the plant height was significantly affected due to foliar application compost tea at different growth stages of crop and it was increased with advanced stage. The treatment T_7 - RDF + Compost tea @ 50% foliar spray recorded significantly higher plant height at flowering stage (47.13 cm), pod formation stage (57.97 cm) and harvesting stage (63.2 cm) over rest of the treatments. Whereas the minimum height of plant was observed with treatment T_1 – control at flowering (37.40) pod formation (43.00) and harvesting stages (50.1) of soybean and all other treatment were significantly superior to it However, the resultant treatment T_7 showed at par result with the treatment T_8- RDF + Compost tea @ 75% foliar spray, and T_6 (RDF + Compost tea @ 50% foliar spray)at flowering, pod formation and harvesting stage. This increase in plant height might be due to foliar application compost tea which helped in acceleration of various metabolic processes in plants resulting greater apical growth. Above result are in line with Pant et al. [2] the results showed that the application of compost tea increase the shoot length when compost tea was applied in weekly at the rate 150 ml plot^{-1} to root zone and foliage of plant for four weeks.

3.2.2 Mean leaf area plant^{-1} (dm^2)

The data regarding Mean leaf area plant^{-1} recorded at flowering, pod formation and harvest stage was presented in Table 1. It was evident from the results that, the number of leaves plant^{-1} were significantly affected due to foliar application of compost tea. The maximum mean leaf area plant^{-1} was bserved with the treatment T_7 - RDF + Compost tea @ 50% foliar spray at flowering (6.79 dm^2), pod formation (8.18 dm^2) and harvesting stage (1.31 dm^2) which was at par with T_8- RDF + Compost tea @ 75% foliar spray T_6, T_5, T_4, and T_3. The minimum Mean leaf area plant^{-1} was observed with treatment T_1 – control at flowering (4.65 dm^2) pod formation (6.04 dm^2) and harvesting stage (0.97 dm^2) of soybean and all other treatment were significantly superior to it. The increasing the number of leaves and its expansion might be due to the vailability of nutrients through foliar application of compost tea to the soybean crop which increased number of leaves plant^{-1} [3].

3.2.3 Number of leaves plant^{-1}

The data on umber of leaves recorded at flowering, pod formation and harvest stage was presented in Table 2. It was evident from the results that, the number of leaves plant^{-1} were significantly affected due to foliar application of compost tea. The maximum number of leaves plant^{-1} were observed with the treatment T_7 - RDF + Compost tea @ 50% foliar spray at flowering (14.53), pod formation (19.90) and harvesting stage (17.71) which was at par with T_8- RDF + Compost tea @ 75% foliar spray and T_6- RDF + Compost tea @ 25% foliar spray. The minimum number of leaves were observed with treatment T_1 – control at flowering (11.18) pod formation (15.32) and harvesting stage (13.63) of soybean and all other treatment were significantly superior to it. The increasing number of leaves per plant might be due to availability of nutrients through foliar application of compost tea to the soybean crop which increased number of leaves plant^{-1} [3]. When nutrient required by plant are applied through foliage, there is enhancement in uptake, translocation and synthesis of photosynthetic assimilates which results to increase in various plant growth characters such as plant height, leaf area, total dry matter which ultimately results into increase in seed yield [4].

3.2.4 Number of branches plant^{-1}

The data regarding plant branches were recorded at flowering, pod formation and harvesting stage of crop are presented in Table 2. It was evident from the results that the branches per plant were significantly affected due to foliar application compost tea at different growth stages of the crop and it was increased with advanced stage. The treatment T_7- RDF + compost tea @ 50% foliar spray recorded maximum branches per plant at flowering (3.31), pod formation (4.60) and harvesting stage (5.53) which was at par with T_8- RDF + compost tea @ 75% foliar spray and T_6- RDF + compost tea @ 25% foliar spray and significantly superior over rest of the treatment. Whereas the minimum branches per plant were bserved with treatment T_1 - controlatflowering (2.14), pod formation (2.85) and harvesting stage (3.43) of soybean. This increase of plant branches might be due to foliar application compost tea which helped in acceleration of various metabolic processes in plants resulting greater apical growth.

Arsode et al. [4] reported that two foliar spray of growth hormones on mustard increased plant height and number of branches plant^{-1} it might be due to moderate and constant supply of carbohydrate within the plant and increased uptake of NPK and all other essential nutrients as a result of increased vegetative growth.

3.3 Yield and Yield Attributes

3.3.1 Number of pods plant^{-1}

The number of pods was significantly affected due to foliar application compost tea at different stages of the crop and it was increased with advanced stage. The maximum number of pods plant^{-1} were observed with the treatment T_7 - RDF + Compost tea @ 50% foliar spray recorded at pod formation stage (28.94) and harvesting stage (33.57).which was at par with T_8- RDF + Compost tea @ 75% foliar spray and significantly superior over the rest of the treatments. Whereas the minimum number of pods per plant was observed with treatment T_1 – control at pod formation (21.63) and harvesting stage (25.09) of soybean. This increase in number of pods might be due to foliar application compost tea which helped in acceleration of various metabolic processes in plants resulting increase in the number of pod plant^{-1}.Similar results were also found by Hegazi et al. [5]. The results showed in cowpea field 25% NPK + 75% compost tea as foliar spray significantly increase the number of pod plant^{-1} (51.64) compared with other foliar treatment.

3.3.2 Plant dry matter kg ha^{-1}

The data indicated the periodical increase in total biomass of soybean. The accumulation of dry matter of plant was relatively more at the later part of the crop. This may be attributed to the productive phases of soybean. Results indicated that the significant higher plant dry matter was recorded with treatment T_7- RDF + Compost tea @ 50% foliar spray at flowering (2401.37 kg ha^{-1}), pod formation (4562.60 kg ha^{-1}) and harvest stage (6003.42 kg ha^{-1}) which was at par withT_8- RDF + Compost tea @ 75% foliar spray. Whereas the minimum plant dry matter was observed with treatment T_1– control at flowering (1880.12), pod formation (3572.23 kg ha^{-1}) and harvest stage (4700.3kg ha^{-1}).Increasing the plant dry matter with foliar application of the compost tea can potentially stimulate the crop growth and development through the action of plant growth promoting hormones increasing cytokinies, auxins, gibberllines it helps to enhance the yield. This result is in line with Sanjutha et al. [6]. The result showed that integrated nutrient management in *Andrographis paniculata.* When application of FYM @ 15 t ha^{-1} + NPK @ 75:75:50 kg/h + panchagavya @ 3% foliar spray increases the total dry matter (2794.07 kg ha^{-1}) compared to other treatments.

3.3.3 Straw and Grain yield kg ha^{-1}

The data regarding straw yield and grain yield recorded at harvest stage was observed from the results that the treatment T_7- RDF + Compost tea @ 50% foliar spray recorded maximum straw yield (39.53 q ha^{-1}) and grain yield (20.50. q ha^{-1}) it was at par with the treatment T_8- RDF + compost tea @ 75% foliar spray and T_6- RDF + compost tea @ 25% foliar spray and significantly superior over the rest of the treatments. The lowest grain yield was recorded by treatment T_1 - control straw yield (31.20 q ha^{-1}) and grain yield (15.80 q ha^{-1}).

The increasing straw and grain yield in soybean might be due to the foliar application of compost tea. similar result also reported by Hegazi et al. [5] The results showed in cowpea yield 25% NPK + 75% compost tea as foliar spray significantly increase the seed yield compared with other foliar treatment.

3.4 Quality Attributes

3.4.1 Test weight

Data on test weight of soybean as influenced by various treatments presented in Table 5. Test weight was found statistically significant with the application of different doses of compost tea. The higher test weight (11.98 g) was found in treatment T_7-RDF + Compost tea @ 50% foliar spray and which was par with treatment T_8andsignificantly superior over rest of treatments. The lowest test weight (10.27 g) was recorded in treatment T_1-control (only RDF).The result is in line with Kumawat et al. [7] reported 100 seed weight significantly increased with application of panchagavya + neem leaf extract.

Table 1. Effect of foliar application of compost tea on plant height (cm) and leaf area plant^{-1} (dm^2) of soybean

Treatment	Plant height (cm)			Mean leaf area plant^{-1} (dm^2)		
	At Flowering stage	At pod formation stage	At harvest stage	At Flowering stage	At pod formation stage	At harvest stage
T_1 - Control (RDF 100%)	37.4	46.0	50.1	4.65	6.04	0.97
T_2-100% RDF + Water spray	38.2	46.9	51.2	4.70	6.09	0.97
T_3 - RDF + Compost tea @ 10% foliar spray	38.4	47.2	51.5	5.59	6.98	1.12
T4 - RDF + Compost tea @ 15% foliar spray	41.6	51.2	55.9	5.89	7.28	1.16
T_5-RDF + Compost tea @ 20% foliar spray	43.1	53.0	57.8	6.19	7.58	1.21
T_6 - RDF + Compost tea @ 25% foliar spray	44.2	54.3	59.3	6.38	7.77	1.24
T_7 - RDF + Compost tea @ 50% foliar spray	47.1	57.9	63.2	6.79	8.18	1.31
T_8- RDF + Compost tea @ 75% foliar spray	45.7	56.2	61.3	6.54	7.93	1.27
General mean	41.9	51.6	56.2	5.84	7.23	1.16
SE(m) ±	1.307	1.608	1.753	0.490	0.490	0.078
CD at 5%	3.919	4.821	5.255	1.469	1.469	0.235

Table 2. Effect of foliar application of compost tea on total number of leaves plant^{-1} and number of branches plant^{-1}at different growth stage soybean

Treatment	Total number of leaves plant^{-1}			Number of branches plant^{-1}		
	At Flowering stage	At pod formation stage	At harvest stage	At Flowering stage	At pod formation stage	At harvest stage
T_1 - Control (RDF 100%)	11.18	15.32	13.63	2.14	2.85	3.43
T_2-100% RDF + Water spray	11.26	15.43	13.73	2.04	2.82	3.4
T_3 - RDF + Compost tea @ 10% foliar spray	11.98	16.41	14.61	2.29	3.05	3.76
T4 - RDF + Compost tea @ 15% foliar spray	12.38	16.96	15.09	2.35	3.29	4.05
T_5-RDF + Compost tea @ 20% foliar spray	12.93	17.71	15.76	2.47	3.67	4.53
T_6 - RDF + Compost tea @ 25% foliar spray	13.4	18.36	16.34	2.71	3.74	4.66
T_7 - RDF + Compost tea @ 50% foliar spray	14.53	19.9	17.71	3.31	4.6	5.53
T_8- RDF + Compost tea @ 75% foliar spray	14.2	19.45	17.31	3.00	4.2	5.2
General mean	12.73	17.44	15.52	2.54	3.53	4.32
SE(m) ±	0.391	0.536	0.477	0.201	0.296	0.388
CD at 5%	1.172	1.606	1.429	0.604	0.887	1.163

Table 3. Effect of foliar application of compost tea on number of pod plant^{-1} and plant dry matter kg ha^{-1}at different growth stages soybean

Treatment	Number of pods plant^{-1}		Dry matter kg ha^{-1}		
	At pod formation stage	At harvest stage	At Flowering stage	At pod formation stage	At harvest stage
T_1 - Control (RDF 100%)	21.63	25.09	1880.12	3572.23	4700.3
T_2-100% RDF + Water spray	21.76	25.24	1898.43	3607.02	4746.08
T_3 - RDF + Compost tea @ 10% foliar spray	22.18	25.73	1960.94	3725.79	4902.35
T4 - RDF + Compost tea @ 15% foliar spray	23.77	27.57	2047.83	3890.88	5119.58
T_5-RDF + Compost tea @ 20% foliar spray	24.56	28.49	2163.24	4110.15	5408.1
T_6 - RDF + Compost tea @ 25% foliar spray	25.9	30.04	2273.25	4319.17	5683.12
T_7 - RDF + Compost tea @ 50% foliar spray	28.94	33.57	2401.37	4562.6	6003.42
T_8- RDF + Compost tea @ 75% foliar spray	27.12	31.46	2339.09	4444.27	5847.73
General mean	24.48	28.4	2120.53	4179.45	5301.33
SE(m) ±	0.74	0.858	55.017	105.08	137.542
CD at 5%	2.218	2.572	164.922	315.02	412.306

Table 4. Effect of foliar application of compost tea on straw yield, grain yield and total dry matter yield of soybean (kg ha^{-1})

Treatments	At harvesting stage		Total dry matter Kg ha^{-1}
	Straw yield kg^{-1} ha	Grain yield kg^{-1} ha	
T_1 - Control (RDF 100%)	3120.3	1580	4700.3
T_2-100% RDF + Water spray	3167.1	1578.97	4746.08
T_3 - RDF + Compost tea @ 10% foliar spray	3251.35	1651	4902.35
T4 - RDF + Compost tea @ 15% foliar spray	3389.58	1730	5119.58
T_5-RDF + Compost tea @ 20% foliar spray	3582.1	1825.99	5408.1
T_6 - RDF + Compost tea @ 25% foliar spray	3763.08	1920.03	5683.12
T_7 - RDF + Compost tea @ 50% foliar spray	3953.42	2050	6003.42
T_8- RDF + Compost tea @ 75% foliar spray	3831.73	2016	5847.73
General mean	3507.33	1794	5301.3
SE(m) ±	104.73	59.12	137.54
CD at 5%	313.94	177.23	412.31

Table 5. Effect of foliar application of compost tea on test weight, oil (%), protein (%) and protein yield, of soybean

Treatments	Test weight (gm 100^{-1} seeds)	Oil (%)	Protein (%)	Protein yield kg ha^{-1}
T_1 - Control (RDF 100%)	10.27	17.16	28.12	444.52
T_2-100% RDF + Water spray	10.39	17.15	28.41	448.53
T_3 - RDF + Compost tea @ 10% foliar spray	10.9	18.3	29.32	485.58
T4 - RDF + Compost tea @ 15% foliar spray	11.1	1843	29.7	514.5
T_5-RDF + Compost tea @ 20% foliar spray	11.34	18.99	30.09	549.01
T_6 - RDF + Compost tea @ 25% foliar spray	11.6	19.12	30.67	589.69
T_7 - RDF + Compost tea @ 50% foliar spray	11.98	19.9	31.44	644.29
T_8 - RDF + Compost tea @ 75% foliar spray	11.91	19.37	31.11	627.77
General mean	11.19	18.55	29.86	537.99
SE(m) ±	0.076	0.424	0.66	23.89
CD at 5%	0.228	1.271	1.978	71.63

3.4.2 Protein content and protein yield

The protein content in seed and protein yield were significantly affected due to different doses of foliar application of compost tea. The maximum protein content (31.44%) was observed with treatment T_7 - RDF + Compost tea @ 50% foliar spray and which was at par with the treatment T_8- RDF + Compost tea @ 75% foliar spray (31.11%), (T_6) and (T_5) significantly superior over rest of treatment. The lower protein content (28.12%) in seed was observed with treatment T_1.The obtained results are in agreement with the findings of Lende et al. [8].

3.4.3 Oil content

Oil content was found statistically significant with the foliar application of different doses of compost tea. The maximum oil content (18.23%) was found in treatment T_7. RDF + Compost tea @ 50% foliar spray and which was at par with treatment T_8 and T_6 while it was significant over rest of treatment. While the lowest oil content was recorded in treatment T_1-(control).The foliar application of compost tea along with RDF increased the oil content in soybean. This might be due to increased vegetative growth and nutrient uptake by plant. Similar finding where also reported by Lende et al. [8] foliar application of 200 ppm vermiwash which contain sulphur, it involved in the synthesis of fatty acids and also increased protein quality through the synthesis of certain amino acids such as cysteine and methionine this may be a reason for increases the oil content.

4. CONCLUSION

The foliar application of compost tea on growth, yield and quality of soybean concluded that all growth parameters of soybean improved with application of RDF + Compost tea @ 50% foliar spray followed by RDF + Compost tea @ 75% foliar spray which was superior over the control. Maximum yield (2050.0 kg ha^{-1}) and quality were recorded with application of RDF + Compost tea @ 50% foliar spray. This indicated that the foliar application of compost tea @ of 50% along with RDF beneficial for increasing the plant growth, yield and quality of soybean.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Scheuerell SJ, Mahaffee WF. Compost tea as container medium drench for suppressing seedling damping-off caused by (*pythium ultimatum*). Phytopathology. 2004;94:1156-1163.
2. Pant AP, Radovich TJK, Hue NV, Paull RE. Biochemical properties of compost tea associated with compost quality and effects on pakchoi growth. Scientia Horticulturae. 2012;148: 138–146.
3. Loganathan V, Wahab K. Influence of panchagavya foliar spray on the growth attributes and yield of baby corn (*Zea mays*) cv. COBC-1. J. Appl. & Nat. Sci. 2014;6(2):397-401.
4. Arsode SV, Deotale RD, Sawant PP, Sahane AN, Baginwar AD. Influence of foliar spray of humic acid through cowdung wash and NAA on morpho-physiological parameters, growth and yield of Mustard. J. Soil and Crops. 2014;24(1) :119-127.
5. Hegazi AZ, Algharib AM. Studied the utilizing compost tea as a nutrient amendment in open field cowpea seed production system. J. Bio and Env. Sci. 2014;2:318-328.
6. Sanjutha S, Subramanian S, Indu Rani C, Maheswari J. Integrated nutrient management in (*Andrographis paniculata*). J. Agric. & Bio. Sci. 2008;4(2):141-145.
7. Kumawat RN, Mahajan SS, Mertia RS. Responce of cumin to panchgavya and leaf extracts in arid western Rajasthan. J. spice and Aromatic Crops. 2009;18(2): 92- 99.
8. Lende SR, Deotale RD, Kamble PS, Ghadge PP, Suryapujary SM. Influece of foliar spray of vermi wash and cowdung wash on biochemical and yield contributing parameters and yield of soybean. J. Soil and Crops. 2007;17(2): 398-402.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/66643