Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 2566-2569
Received: 25-11-2020
Accepted: 27-12-2020

Sidana Priya
Research Scholar, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur Rajasthan, India

Kaushik MK
Professor, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur Rajasthan, India

Chaudhary Roshan
Assistant Professor, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Kumar Deepak
Ph.D. Scholar, Department of Agronomy, ICAR-NDRI, Karnal, Haryana, India

Corresponding Author:
Sidana Priya
Research Scholar, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur Rajasthan, India

Effect of soil and foliar applications of compost tea on growth characters, quality and nutrient content of soybean [*Glycine max*. (L.) Merrill] under organic cultivation

Sidana Priya, Kaushik MK, Chaudhary Roshan and Kumar Deepak

Abstract
An experiment was conducted on **"**Effect of soil and foliar application of compost tea on growth characters, quality and nutrient content of soybean [*Glycine max* (L.) Merrill**"** crop was undertaken at Organic Farm, RCA, Udaipur to get knowledge on influential effects of soil and foliar application of compost tea on the growth characters, quality and economics of soybean under organic cultivation. Soybean plants were planted in factorial RBD with three replications during the *Kharif* season 2019 using RKS-24 variety of soybean with 30 cm row to row and 10 cm plant to plant distance. Treatments applied in soil at the time of sowing were control, 500, 750, 1000 and 1250 lit ha^{-1} compost tea, respectively and treatments applied as foliar spray at branching and pre flowering stage were control, 25%, 50%, 75% and 100% compost tea. Compost tea was prepared by steeping 1part compost in 20 parts of water for about 14 days. Increasing dose of compost tea in soil as well as on foliage simultaneously increase all studied parameters *i.e*, growth parameters, quality characters and nutrient content of soybean. The best results obtained with application of 1250 lit ha^{-1} + 100% compost tea followed by 1000 lit ha^{-1} + 75% compost tea. Obtained results described the positive effects of compost tea on growth, quality and nutrient status under soybean cultivation.

Keywords: compost tea, soybean, growth, quality, nutrients

Introduction
After Green Revolution, India became self-sufficient in aspects of food production, but still relies on imports for crops such as pulses and oilseeds, where production has not kept pace with demand from a burgeoning population. Organic farming is an alternative agricultural production method that relies on ecological processes, biodiversity and cycles adapted to local conditions with the aim of sustaining the health of soils, ecosystems and people (IFOAM, 2008). In India, total annual oilseed crops are cultivated over 26.67 million hectares and a production of 30.06 million tonnes (NMOOP, 2018) [10]. Major states that grow soybean are Madhya Pradesh, Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, Andhra Pradesh and Gujarat. In comparison with the annual production of decade 1990-2000, there is an increasing trend observed during the period of 2001-2013. Reason behind this increased production was area increment and higher productivity led by technological advancement. (NMOOP, 2018) [10]. Still, we are far behind from average global world's productivity (2310 kg ha^{-1}) and our national soybean productivity (1353 kg ha^{-1}) (Directorate of Economics and Statistics, 2017) [3]. So, to fulfil the increasing demand of population for oilseeds and its by-products like edible oil etc, we should adopt new strategies to meet out the demands and to accelerate the exports. Despite being 5th largest producer of oilseeds among all the oilseed growing countries, India still depends on other countries for its pulses and edible oils demand. Almost 70 per cent of the cultivated area of oilseeds comes under rainfed condition. Rajasthan contributes 10.8 per cent in area and 14.5 per cent in oilseed production (GOI, 2013) [6]. Organically grown crops have dual advantages- less input intensive as well as rich in nutrition with no chemical residues. But over use of chemical fertilizers to enhance its production causes serious health issues and high cost input makes it less attracted to farmers for its sowing. Organically grown crops have dual advantages as it is less input intensive as well as rich in nutrition with no chemical residues. Compost tea is an emerging tool used in organic agriculture. "Compost tea" or "Compost leachate" or "Compost extract" can be defined as a liquid extract made from composted that may contain organic and inorganic soluble nutrients, large number of organisms including bacteria, fungi, actinomycetes, protozoa and nematodes (ROU, 2003) [13]. The present study was conducted in soybean [*Glycine max*. (L.) Merrill] with objectives to find out the effect of

compost tea on growth characters, quality and nutrient content.

Materials and Methods

A field experiment was conducted on **"**Effect of soil and foliar application of compost tea on growth characters, quality and nutrient content of soybean [*Glycine max* (L.) Merrill]" during *Kharif* season 2019 at Organic Farm, Rajasthan College of Agriculture, Udaipur which is situated at an altitude of 581.13 metre above mean sea level with 24°35′ N latitude and 74 °42′ E longitude using soybean plant variety RKS-24 (Pratap Raj- 24) which generally matures in 95-98 days. The experiment was laid out in Factorial Randomised Block Design replicate thrice. Plants were grown at 30 cm row to row and 10 cm plant to plant distance with a seed rate of 80 kg ha^{-1}. Nutrient requirement of soybean is fulfilled by applying fully decomposed NADEP compost @ 5 tonnes ha^{-1} prior to sowing. Other agricultural practices such as weeding and pest control were carried out as recommended organic practices. The 25 treatment combinations were applied on soybean crop having both five soil that are control (water spray), compost tea @ 500 lit ha-1, 750 lit ha^{-1}, 1000 lit ha^{-1}, 1250 lit ha^{-1} and foliar application are control (water spray), compost tea @ 25%, 50%, 75%, 1000% respectively. Compost tea was prepared by taking a small cloth bag filled with 1 kg compost hanged over an earthen pot or bucket which is filled with 10 litres water and kept for 7 days. The submerged compost is stirred at least twice a day and finally prepared compost tea sprayed with ordinary sprayer with concentrations decided as per treatments. Growth characters were measured after sowing, using ten random plants from each treatment: plant height (cm), dry matter accumulation (g plant^{-1}), chlorophyll content (mg g^{-1} fresh weight) and number of effective root nodules plant^{-1}. While, quality characters i.e. protein content and oil percent in seed was determined at the end of harvesting stage, seeds were grinded for estimation and both determined according to A.O.A.C (1965). For nutrient content analysis in seeds and haulm of soybean, plant samples were collected at harvest from each plot and dried at 65°C in hot air oven, finely grounded and used for determination of NPK content in seed and haulm.

Results and Discussion

Growth characters

Data regarding growth characters recorded at various growth stages are presented in Table 1. and Table 2. The maximum plant height, dry matter accumulation, chlorophyll content weight and number of effective root nodules plant^{-1} were observed with the treatment application of 1250 lit ha^{-1} compost tea in soil. However, foliar application of 100% compost tea at branching and flowering stage gave maximum plant height, dry matter accumulation, chlorophyll content and number of effective root nodules plant^{-1} which was at par with treatment application of 75% compost tea as foliar spray. Whereas the minimum plant height was observed with treatment S_1- control and F_1- control. The increase in growth parameters might be due to an increased availability of nutrients at initial stage through organic manures in addition to nutritional and other benefits from compost tea. Similar results were found by Mahmoud *et al*. (2015) and Geires *et al*. (2012) that soil and foliar application of compost tea at different growth stages of crop lead to better photosynthesis activity and more extensive root system and thus enabled plant to extract nutrient from soil thereby resulting in better development of growth characters.

Table 1: Effect of soil and foliar application of compost tea on plant height and dry matter accumulation of soybean [*Glycine max* (L.) Merrill

Treatments	Plant height (cm)		Dry matter accumulation (g plant^{-1})	
	60 DAS	Harvest	60 DAS	Harvest
Soil Application				
Control (Water spray)	37.3	59.1	10.17	19.41
Compost Tea 500 lit ha^{-1}	40.0	60.5	11.07	20.96
Compost Tea 750 lit ha^{-1}	42.4	62.7	12.67	21.89
Compost Tea 1000 lit ha^{-1}	44.7	65.3	13.37	24.23
Compost Tea 1250 lit ha^{-1}	46.8	68.8	15.17	26.67
S.Em ±	0.5	0.5	0.24	0.28
C.D (P=0.05)	1.5	1.4	0.69	0.78
Foliar application				
Control (Water Spray)	38.5	58.4	10.87	20.83
Compost Tea 25%	41.3	62.6	11.81	22.06
Compost Tea 50%	42.8	64.1	12.67	22.85
Compost Tea 75%	44.3	65.6	13.37	23.49
Compost Tea 100%	44.3	65.7	13.73	23.92
S.Em ±	0.5	0.5	0.24	0.28
C.D (P=0.05)	1.5	1.4	0.69	0.78

Table 2: Effect of soil and foliar application of compost tea on chlorophyll content and number of effective root nodules plant^{-1}of soybean [*Glycine max* (L.) Merrill

Treatments	Chlorophyll content (mg g^{-1} fresh weight)	Number of effective root nodules plant^{-1}
	50 DAS	60 DAS
Soil Application		
Control (Water spray)	2.16	33.07
Compost Tea 500 lit ha^{-1}	2.29	34.45
Compost Tea 750 lit ha^{-1}	2.42	37.07
Compost Tea 1000 lit ha^{-1}	2.67	38.73
Compost Tea 1250 lit ha^{-1}	2.87	40.00
S.Em ±	0.04	0.38
C.D (P=0.05)	0.13	1.08

Foliar application		
Control (Water Spray)	2.24	33.00
Compost Tea 25%	2.38	35.93
Compost Tea 50%	2.51	37.20
Compost Tea 75%	2.64	38.30
Compost Tea 100%	2.65	38.89
S.Em ±	0.04	0.38
C.D (P=0.05)	0.13	1.08

Quality parameters

Data in Table 3. regarding quality parameters *i.e.* protein content determined by multiplying the nitrogen percentage in seed with factor 6.25 as described by AOAC (1975) [2]. While, oil content in seeds from each net plot sample was determined by Soxhlet ether extraction method (AOAC, 1975) [2] and expressed as per oil content in seed. Results revealed that the maximum protein content (40.57%) was recorded with the application of 1250 lit ha^{-1} (S_5) compost tea over the rest of the treatments. However, maximum protein content (40.49%) was recorded with the application of 100% compost tea (F_5) which was found statistically at par with protein content (40.23%) with application of 75% compost tea (F_4). The maximum oil content (20.59%) was recorded with the application of 1250 lit ha^{-1} (S_5) compost tea over treatments. The maximum oil content (20.13%) was recorded with the application of 100% compost tea (F_5) over the other treatments. The reason behind this is promotional effect of compost tea on nutrient uptake especially phosphorus, sulphur. Similar results were found by El-Din *et al* (2010) [4] in *Borage officinalis* plant and Ali (2015) [1] in faba beans and explained the role of compost tea in increasing the protein and carbohydrate synthesis. t had a promoting effect on nutrient uptake especially N, P and K. Similar results as seed quality improvement was recorded by Khafaga *et al*., (2014) [8].

Nutrient content

Data given in Table 4. regarding nutrient content shown the maximum nitrogen content in seed (6.47%) were recorded with application of 1250 lit ha^{-1} (S_5) compost tea which was followed by 1000 lit ha^{-1} (S_4) compost tea. While, maximum nitrogen content (6.48%) was recorded with the application of 100% compost tea (F_5) over other treatments.

Table 3: Effect of soil and foliar application of compost tea on quality characters of soybean [*Glycine max* (L.) Merrill]

Treatments	**Protein (%)**	**Oil (%)**
Soil Application		
Control (Water spray)	38.40	18.41
Compost Tea 500 lit ha^{-1}	38.53	18.95
Compost Tea 750 lit ha^{-1}	39.18	19.17
Compost Tea 1000 lit ha^{-1}	40.01	20.00
Compost Tea 1250 lit ha^{-1}	40.57	20.59
S.Em ±	0.35	0.18
C.D (P=0.05)	0.99	0.53
Foliar application		
Control (Water Spray)	37.73	18.59
Compost Tea 25%	38.77	19.07
Compost Tea 25%	39.47	19.43
Compost Tea 75%	40.23	19.89
Compost Tea 100%	40.49	20.13
S.Em ±	0.35	0.18
C.D (P=0.05)	0.99	0.53

Significantly, maximum nitrogen content in haulm (1.65%) were recorded with application of 1250 lit ha^{-1} (S_5) compost tea which was followed by 1000 lit ha^{-1} (S_4) compost tea. The maximum nitrogen content (1.50%) was recorded with the application of 100% compost tea (F_5) followed by other treatments. Significantly, maximum phosphorus content in seed (0.78%) were recorded with application of 1250 lit ha^{-1} (S_5) compost tea which was followed by 1000 lit ha^{-1} (S_4) compost tea. The maximum phosphorus content (0.72%) was recorded with the application of 100% compost tea (F_5) followed by other treatments. Phosphorus content in haulm of soybean after harvest is influenced by soil application of different doses of compost tea over control and varies in range of 0.13-0.20 per cent. The maximum phosphorus content (0.72%) in haulm was recorded with the application of 100% compost tea (F_5) followed by other treatments. Significantly, maximum potassium content in seed (1.68%) were recorded with application of 1250 lit ha^{-1} (S_5) compost tea which was followed by 1000 lit ha^{-1} (S_4) compost tea. The maximum potassium content (1.60%) was recorded with the application of 100% compost tea (F_5) over the other treatments. Significantly, maximum potassium content in seed (0.85%) were recorded with application of 1250 lit ha^{-1} (S_5) compost tea which was followed by 1000 lit ha^{-1} (S_4) compost tea. The maximum potassium content (0.82%) was recorded with the application of 100% compost tea (F_5) over the other treatments. Compost tea has pH (6.76), EC (0.905 Ds m^{-1}), N (205 ppm), P (7.6 ppm), K (206 ppm), chemolithotrophs and autotrophic nitrifiers (ammonifers and nitrifers) which increase nutrient content, uptake, protein and oil content in seed and haulm in soybean. Pant *et al*. (2012) [11] suggested that the nutrient analysis of vermicompost tea supplied a considerable amount of soluble mineral nutrients and humic acid to plant which may increase the nutrient content and uptake in seed and haulm of soybean. Ali (2015) [1] a promotional effect of compost tea on nutrient content *i.e*., N, P and K faba beans (*Vicia faba*). The application of compost tea as soil drench to a level of 1250 lit ha^{-1} leads to increase the NPK content of seed and haulm.

Table 4: Effect of soil and foliar application of compost tea on NPK content in seed and haulm of soybean [*Glycine max* (L.) Merrill]

Treatments	Nutrient content (%)					
	Nitrogen		Phosphorus		Potassium	
	Seed	Haulm	Seed	Haulm	Seed	Haulm
Soil Application						
Control (Water spray)	5.99	1.24	0.60	0.12	0.69	1.39
Compost Tea 500 lit ha^{-1}	6.16	1.33	0.65	0.15	0.75	1.47
Compost Tea 750 lit ha^{-1}	6.26	1.45	0.70	0.16	0.77	1.55
Compost Tea 1000 lit ha^{-1}	6.40	1.56	0.73	0.19	0.80	1.61
Compost Tea 1250 lit ha^{-1}	6.47	1.65	0.78	0.20	0.85	1.68
S.Em ±	0.05	0.01	0.02	0.01	0.02	0.02
C.D (P=0.05)	0.16	0.02	0.05	0.03	0.06	0.06
Foliar Application						
Control (Water Spray)	6.04	1.37	0.63	0.14	0.74	1.45
Compost Tea 25%	6.20	1.41	0.69	0.16	0.76	1.53
Compost Tea 50%	6.30	1.46	0.70	0.19	0.79	1.57
Compost Tea 75%	6.41	1.49	0.71	0.20	0.80	1.58
Compost Tea 100%	6.48	1.50	0.72	0.22	0.82	1.58
S.Em ±	0.05	0.01	0.02	0.01	0.02	0.02
C.D (P=0.05)	0.16	0.02	0.05	0.03	0.06	0.06

These results are in agreement with those attained by Hussein and Radwan (2001) [7]. The obtained increases in enhancing macronutrient concentration in haulm and seeds may be due to the decrease of soil pH, soil salinity, and the increased activity of microorganisms in soil Lobna *et al.* (2006) [9]. Compost tea contains beneficial microorganisms like *azobacter*, *agrobacterium and rhizobium* species, P solublising bacteria reported by El Gizawy (2013) [5]. Increasing the soil nitrogen boost up the production of endogenous phytohormones, that have a significant role in profuse root structure formation that allows more nutrient uptake by plant. Similar results related to potassium content in seed was found by Radin and Warman (2011) [12] that K in plant tissues increased. Organic manure improves microbial biomass and activities in soil, increase potassium dissolving bacteria, and therefore increase available K for the plant which ultimately enhance the content and uptake of K in plant.

References

1. Ali OA. Role of humic substances and compost tea in improvement of endogenous hormones content, flowering and yield and its components of faba bean (*Vicia faba* L.). Annals of Agricultural Science, Moshtohor 2015;53(3):373-384.
2. AOAC. Official method of analysis (12th ed.). Washington, DC: Association of Official Analysis Chemists 1975.
3. Directorate of Economics and Statistics MOA & FW, New Delhi 2017, 2-3.
4. El-Din AAE, Hendawy SF. Effect of dry yeast and compost tea on growth and oil content of *Borago officinalis* plant. Research Journal of Agriculture and Biological Sciences 2010;6(4):424-430.
5. El-Gizawy ESA, Atwa AAI, Talha NI, Mostafa RAI. Effect of compost and compost tea application on faba bean crop and some soil biological and chemical properties. Journal of Soil Sciences and Agricultural Engineering 2013;4(9):863-874.
6. GOI Report. State of Indian Agriculture 2012-13, Ministry of Agriculture, Department of Agriculture and Cooperation, Directorate of Economics and Statistics, Government of India, New Delhi 2013.
7. Hussein HF, Radwan SM. Effect of bio-fertilization with different levels of nitrogen and phosphorus on wheat and associated weeds under weed control treatments. *Journal* of Biological Science 2001;4(4):435-441.IFOAM, 2008. Definition of Organic Farming. http://www.ifoam.org/growing organic/definions/doa/index.html. Retrieved 2011-09-3.
8. Khafaga EEE, Hasanin SA, El-Shal R. Fffect of foliar application with ascorbic, humic acids and compost tea on nutrients content and faba bean productivity under sandy soil conditions. Journal of Soil Sciences and Agricultural Engineering 2014;5(6):767-778.
9. Lobna A, Moussa SS, Shaltout M. Evaluation of some bacterial isolates and compost tea for biocontrolling *Macrophomina phaseolina* and *Sclerotium rolfsii* infected sunflower. Egyptian Journal of Agricultural Research 2006;48(5):1331-1344.
10. National Mission on Oilseeds and Oil Palm Report 2018.
11. Pant AP, Radovich TJK, Hue NV, Paull RE. Biochemical properties of compost tea associated with compost tea quality and effects on pakchoi growth. Scientia Horticulturae 2012;148:138-146.
12. Radin AM, Warman PR. Effect of municipal solid waste compost and compost tea as fertility amendments on growth and tissue element concentration in container-grown tomato. Communications in soil science and plant analysis 2011;42(11):1349-1362.
13. Recycled Organics Unit (ROU), Recycled organics products in intensive 2003.