International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(1): 793-797

Received: 17-11-2020
Accepted: 22-12-2020

Shailaja Nimmala
PG Student, Division of Soil Science and Agricultural Chemistry, College of Agriculture, Karad Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

SS Kolape
Assistant Professor, Division of Soil Science and Agricultural Chemistry, College of Agriculture, Karad Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Archana Tathe
Assistant Professor, Division of Soil Science and Agricultural Chemistry, College of Agriculture, Karad Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Corresponding Author:
Shailaja Nimmala
PG Student, Division of Soil Science and Agricultural Chemistry, College of Agriculture, Karad Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Effect of levels of fulvic acid through foliar sprays on yield and quality of green chilli

Shailaja Nimmala, SS Kolape and Archana Tathe

DOI: https://doi.org/10.22271/chemi.2021.v9.i1k.11323

Abstract
A pot culture experiment was conducted with Chilli (cv. Phule Jyoti) at College of Agriculture, Pune (MS), during 2009-10. The soil used for experiment was alkaline in nature with medium in organic carbon, having low available N, medium available P and very high available K. The FYM used for extraction of fulvic acid had pH 7.63, EC 1.42 dSm^{-1} and C/N ratio 19.8 indicated good quality and maturity. The experiment was laid in completely randomized design (CRD) keeping water and fulvic acid sprays (water, 50, 100, 200, 300 and 400 mg L^{-1}) with three replications. The recommended dose of fertilizers (100:50:50 kg ha^{-1}N:P2O5:K2O) and FYM @ 20 t ha^{-1} were applied to all treatments. The water and fulvic acid sprays were applied at 30 and 45 days after transplanting of Chilli. The results of the experiment revealed that the application of 200 mg L^{-1} fulvic acid significantly increased yield of green Chilli and nutrient uptake over the other treatments. The significant increase in length of fruit (8.96 cm), girth of fruit (4.50 cm) number of fruits per plant (40.3), green fruit yield (89.9 g $plant^{-1}$) and dry matter of stalk (39.6 g $plant^{-1}$) and ascorbic acid content (109.8 mg 100^{-1} g) were reported under foliar spray of 200 mg L^{-1} fulvic acid with some few exceptions found at par with 100 mg L^{-1} FA. The results summarized that the application of 200 mgL^{-1} fulvic acid as foliar spray extracted from good quality FYM at 30 and 45 days after transplanting to Chilli along with recommended dose of fertilizers and 20 t FYM ha^{-1} found beneficial to improve the quality, yield and uptake of nutrients by chilli.

Keywords: Quality of FYM, fulvic acid, foliar sprays, yield and quality of green Chilli

Introduction
Chilli crop is considered as one of the important vegetable crop in the world. India contribute about 13 percent of the world vegetables production. India is the next only to china in area and production of vegetables. India is the largest producer of chillies in the world. Cultivated area under Chilli in India as per latest statistics is 9, 30,000 ha, with production of 800,100 tons (Anonymous 2010) [1]. Andhra Pradesh stands first in the list of Chilli producing states in India and also has the maximum acreage under Chilli cultivation in the country. Chilli is a universal spice of India. It is much simpler crop to cultivate. It can survive on different soil types and several climatic conditions. Thus there is wide scope to increase the production with integrated manner using organic manures and humic substances with chemical fertilizers. In recent years, the concept of sustainable agriculture coupled with environmental concerns and ever increasing prices of chemical fertilizers have created a renewed interest in the use of organic manures in different ways by extracting the humic like materials from the organic sources (Stevenson, 1982) [7]. It was well established that humic substances applied in soil as well as foliar feed to crops, improved the quality and yield of crops (Poapst and Schnitzer, 1971; Vimal, 1972) [6]. Generally farmers prefer to use farm yard manure (FYM) as a source of plant nutrients as soil application. However, there is little information on application of fulvic acid as foliar spray extracted from the FYM, in relation to quality and yield of vegetable crop like Chilli. Therefore the present investigation is undertaken to study the effect levels of fulvic acid through foliar sprays on yield and quality of green Chilli.

Materials and Methods
The present investigation was carried out in *summer* season 2009- 2010, under the pot culture condition in wire house at division of Soil Science and Agricultural Chemistry, College of Agriculture, Pune-5.

The soil was an Inceptisol, The Chilli cv. Phule Jyoti was transplanted in 15 kg soil in cemented pots and applied recommended dose of chemical fertilizers (100:50:50 $Kgha^{-1}$ N:P2O5:K2O and 20 t ha^{-1} FYM. The well decomposed farm yard manure (FYM) was collected from Agronomy division, College of Agriculture, Pune-5 and used for extraction of fulvic acid (FA) by following the standard method (Stevenson, 1982) [7], dried, powdered and used for foliar sprays with seven treatments *viz*., T1-Control (No spray), T2-0 ppm FA (Water spray), T3-50 ppm FA, T4 -100 ppm FA, T5-200 ppm FA, T6 -300 ppm FA and T7 - 400 ppm FA with three replications in completely randomized design. The fulvic acid (FA) applied at 30 and 45 days after transplanting. The observations on number of green fruits per pot, length, girth and weight of fresh fruit were recorded at the time of picking of green fruits. After seven pickings of green Chilli fruits the whole plant was harvested at ground level and washed with distilled water. The washed plants and fruit samples were dried in shade and then in oven at 70 ºC till constant weight. The whole plant and fruit samples from each treatment were ground with wooden mortar and pestle and further used for estimation of N, P, K, Fe, Mn, Zn and Cu in whole plant and fruits (Piper, 1961) [11]. The fresh green Chilli fruits were analysed for content of ascorbic acid (Vitamin-C) by following the procedure given by Sawhney and Singh (2000) [15]. The data on biometric parameters, yield, quality, nutrient concentration and uptake by Chilli were tabulated and analysed statistically by the methods described by Panse and Sukhatme (1985) [10].

Results with Discussion

Physico-chemical properties of soil: Soil used for pot culture experiment was belonging to Inceptisol order, slightly alkaline with medium organic carbon and calcareous in nature. The available nitrogen and phosphorus content was medium while available potassium was high. The soil was sufficiently supplied with available micronutrients Fe, Mn, Zn, and Cu (DTPA extractable).

Quality parameters, nutrient status of FYM and content and characteristics of humic substances extracted from FYM

a. Quality parameters: The farm yard manure (FYM) collected from college of Agriculture Farm; Pune was neutral in pH (7.63) with 1.42 dSm^{-1} electrical conductivity, while the moisture and ash content were 31.2 and 29.1 per cent respectively. The total organic carbon and total organic matter content found to be 16.9 and 29.2 per cent respectively with 19.8 C/N ratio, indicated that the FYM collected was found to be matured and good quality when compared with standard quality parameters reviewed by Kolape (2009) [4].

b. Nutrient status of FYM: The total N, P and K content in good quality FYM were found to the tune of 0.85, 0.19 and 0.90 per cent respectively. While the micronutrient cations *viz*., Fe, Mn, Zn and Cu were 2409, 754, 309 and 113 mg kg^{-1} respectively might be due to presence of highly humified and stabilized material present in the FYM. The higher concentrations of nutrients in good quality FYM also reported by Kolape (2009) [4] and Patil (1994) [2].

c. Content and characteristics of humic substances extracted from FYM: The humic substances particularly humic acid (HA) and fulvic acid (FA) content found to be 8.54 and 34.62 g $100g^{-1}$ OM respectively with 0.25 HA/FA ratio indicated high degree of humification and formation of more low molecular weight substances at later stage of decomposition. The extinction coefficient (E4/E6 ratio) of HA was 3.1suggested that the high molecular weight material synthesized during humification was aromatic in nature, while the E4/E6 ratio of FA was 6.8,indicated that fulvic acid formed was aliphatic in nature. Similar results also reported by Kolape (2009) [4] and Patil (1994) [2].

Effect of levels of fulvic acid as foliar sprays on yield of Chilli: The data on yield of green, dry fruits and dry stalk and number of fruits per plant influenced due to different levels of fulvic acid as foliar sprays are reported in Table.1

Number of fruits per plant: The application of different levels of fulvic acid significantly increased the number of fruits per plant over the control and water spray. The significantly highest number of fruits per plant were recorded under the treatment (T5) i.e. 200 mgL^{-1} FA as foliar spray (40.3) but found at par with treatment (T4) i.e. 100 mgL^{-1} FA, indicated that the fulvic acid concentration level from 50 to 200 mgL^{-1} found to be beneficial for increasing the number of fruits per plant while FA concentration above 200 mgL^{-1} significantly decreased the number of fruits per plant might be due to the higher concentration affected physiological activity and absorption. Similar results with higher concentration of fulvic acid as foliar sprays also reported by Fortun and Polo (1982) [5].

Green fruit yield (g plant-1)

Fresh fruit yield: The data presented in Table 1 revealed that application of different levels of fulvic acid as foliar sprays significantly increased the fresh green fruit yield of Chilli per plant over the control (No spray) and water spray along with recommended dose of chemical fertilizers and FYM. But the concentration of fulvic acid increased over 200 mgL^{-1} significantly decreased fresh fruit yield by 300 mgL^{-1} (T6) and 400 mgL^{-1} (T7).This indicated that highest (89.9 mgL^{-1}) fresh green fruit yield responded up to 200 mgL^{-1} FA as foliar sprays at 30 and 45 days of transplanting coincided for better physiological and metabolic activities of plant. The higher concentration over the 200 mgL^{-1} FA were found detrimental effect on absorption of ions. The lowest yield (68.89 $plant^{-1}$) was noticed under control (No spray) and found at par with water spray (T2). Similar observations for yield levels due to the fulvic acid sprays were also reported by Norhayati-Moris (1984) [9] and Xudan (1986) [16].

Dry fruit yield: The application of different levels of fulvic acid as foliar sprays (50-400 mgL^{-1} FA) at 30 and 45 days of transplanting of Chilli significantly increased the yield of dry green fruits over the control (No spray) and water spray along with recommended dose of fertilizers and FYM. The significantly highest (19.1 g $plant^{-1}$) dry fruit yield was noticed under treatment of 200 mgL^{-1} FA (T5) but found at par with level of 100 mgL^{-1} FA (T4) treatment, while treatment T4 was at par with treatment T3 (50 mg L^{-1} FA) indicated that the yield increased from 50 mg L^{-1} FA to 200 mg L^{-1} FA responded well for significant yield increase. The dry fruit yield levels ignificantly decreased at concentration of 300 and 400 mg L^{-1} FA might have inhibitory effect on growth of higher concentrations (Lulakis and Petsas, 1995) [3]. The lowest dry fruit yield (13.8 g $plant^{-1}$) was noticed under control (No spray) and found at par with water spray only.

Stalk yield of Chilli (g plant-1): The data regarding fresh and dry stalk yield of Chilli presented in Table 1, noticed that the application of different levels of fulvic acid (50- 400 mg L^{-1} FA) extracted from the good quality FYM significantly increased the fresh and dry stalk yield of Chilli. The fresh and dry stalk yield significantly and consistently increased from the level of 50 mg L^{-1} FA (128.9 g $plant^{-1}$ and 33.7 g $plant^{-1}$ respectively) to the 200 mg L^{-1} FA (148.5 g $plant^{-1}$ and 39.6 g $plant^{-1}$ respectively) over other treatments. The higher concentrations (300 and 400 mg L^{-1} FA) might have affected the root and shoot growth due to inhibitory metabolic activities. The lowest fresh and dry stalk yields were recorded under treatment control and found at par with treatment water spray only (T2) for fresh stalk yield only. Similar results for different levels of fulvic acid application were also reported by Raina and Goswami (1988) [12].

Effect of levels of fulvic acid as foliar sprays on quality of fresh green Chilli fruits

The tender green matured Chilli fruits were harvested from every picking and tested for quality parameters namely fruit length, fruit girth and ascorbic acid (vit. C) content in laboratory. The results obtained in this regards are presented in Table 2.

a. Fruit length: The data regarding fruit length of fresh green Chilli fruits presented in Table 2 revealed that application of different levels of fulvic acid as foliar sprays along with recommended dose of fertilizers and FYM significantly increased the fruit length over control (No spray) and water spray. The significantly highest fruit length (8.96 cm) was recorded due to the FA level of 200 mgL^{-1} (T5). Further, it was observed that the fruit length, significantly increased with levels from 50 to 200 mgL^{-1} might be due to the presence of number of functional groups in humic substances exerted specific physiological action in biological tissues such as mineral uptake and metabolic effects, stimulated in improved plant growth. But there were significant decrease in fruit length was noticed under the levels of 300 and 400 mgL^{-1} FA might be due to theinhibitory effect of higher concentration of FA beyond 200 mgL^{-1} FA. These results are in conformity with results reported by Lulakis and Petsas (1995) [3].

b. Fruit girth: The application different levels of fulvic acid as foliar sprays along with recommended dose of fertilizers and FYM also significantly increased the fruit girth of Chilli as compared to the control (No spray) and water spray only. The significantly highest fruit girth (4.50 cm) was noticed due to the level 200 mg L^{-1} FA but found at par with 50 mg L^{-1} FA (4.20 cm) and 100 mg L^{-1} FA (4.30 cm). The girth of fruit was steadily increased from level of 50 to 200 mg L^{-1} FA but significantly decreased over 200 mgL^{-1} FA i.e. at levels beyond 200 mgL^{-1} affected the physiological activity such as cell division.

c. Ascorbic acid content: The data regarding Ascorbic acid content (mg100 g^{-1}) in fresh green fruit presented in Table 2 observed that the application of different levels of fulvic acid as foliar sprays along with recommended dose of chemical fertilizers and FYM significantly increased the ascorbic acid content over the control (No spray) and water spray. The significantly highest ascorbic acid content (109.80 mg 100 g^{-1} fresh fruit) was recorded under the level 200 mgL^{-1} FA followed by 100 mg L^{-1} FA level (107.70 mg $100g^{-1}$), while the lowest ascorbic acid content was noticed under control (No spray) but found at par with treatment of water spray. The levels of fulvic acid increased over the 200 mgL^{-1}, significantly decreased the ascorbic acid content under 300 and 400 mgL^{-1} might have toxic effect on formation of ascorbic acid content. The observations are in conformity with results reported by Senn and Kingman (1973) [14] and Xuhang *et al*. (1992) [17].

Effect of levels of fulvic acid as foliar sprays on uptake of nutrients by green Chilli fruits.

The data pertaining to the uptake of macronutrients namely N, P and K and micronutrients cations *viz*., Fe, Mn, Zn and Cu due to the levels of fulvic acid as foliar sprays are presented in Table 3 and 4 respectively.

Uptake of macronutrients: The different levels of fulvic acid as foliar sprays along with recommended dose of chemical fertilizers and FYM significantly increased the N, P and K uptake by Chilli fruits as compared to the control (No spray) and water spray along with recommended dose of chemical fertilizers and FYM application (Table 3). Among the different levels of fulvic acid as foliar sprays significantly highest N (435.48 mg $plant^{-1}$), P (74.49 mg $plant^{-1}$) and K (471.7 mg $plant^{-1}$) uptake was observed due to the level of 200 mg L^{-1} FA and P uptake was found at par with 100 mg L^{-1} FA. While the lowest uptake of these nutrients by Chilli fruits was due to the control
(No spray) and found at par under treatment of water spray only for N and P nutrients. Further, it was also observed that the higher levels of 300 and 400 mgL^{-1} FA found significantly detrimental which decreased the uptake of nutrients and affected the growth. Similar results also corroborated by Rauthan and Schnitzer (1981) [13].

Uptake of micronutrients: The uptake of micronutrient cations *viz*., Fe, Mn, Zn and Cu (Table 4) was significantly increased due the different levels of fulvic acid as foliar sprays along with recommended dose of chemical fertilizers and FYM over the control (No spray) and water spray. The significantly highest uptake of Fe, Mn, Zn and Cu (8.0, 3.3, 2.1, and 0.9 mg $plant^{-1}$ respectively) by Chilli fruits was noticed under the level of 200 mg L^{-1} FA, however Cu uptake (0.9 mg $plant^{-1}$) was also noticed highest due to the 100 mg L^{-1} FA level. Further it was also noticed that fulvic acid levels increased from 50 to 200 mg L^{-1}, the uptake of all nutrient cations also increased while the concentration levels of 300 and 400 mgL^{-1} FA significantly decreased the uptake of micronutrient cations. The significantly lowest uptake of Fe, Mn, Zn and Cu (5.6, 2.2, 1.3 and 0.5 mg $plant^{-1}$ respectively) by Chilli fruit was occurred due to the control (No spray) and Zn uptake under control and water spray only.

Effect of levels of fulvic acid as foliar sprays on uptake of nutrients by Chilli stalk

The data regarding uptake of nutrients by Chilli stalk due to the application of fulvic acid as foliar sprays along with recommended dose of chemical fertilizers and FYM is presented in Table 5 and 6 for macronutrients and micronutrients respectively.

Uptake of macronutrients: The application of different levels of fulvic acid from 50 to 400 mg L^{-1} along with recommended dose of chemical fertilizers and FYM significantly increased the uptake of N, P and K nutrients by

Chilli stalk as compared to the control (No spray) and water spray only. Among the different levels of fulvic acid as foliar sprays significantly highest N, P and K uptake (736.56, 75.24 and 1168.2 mg plant^{-1} respectively) by Chilli stalk was recorded under the treatment 200 mg L^{-1} FA, while the significantly lowest uptake of these nutrients (416.30, 31.80 and 783.5 mg plant^{-1} respectively) was noticed under control (No spray) but found at par with the treatment of water spray for P and K uptake only. The higher concentration levels (300-400 mg L^{-1} FA) of fulvic acid recorded significantly decreased uptake of these nutrients and found at par with each other.

Uptake of micronutrients: The data presented in Table 6, revealed that the application of different levels of fulvic acid as foliar sprays along with recommended dose of chemical fertilizers and significantly increased the uptake of micronutrient cations *viz*., Fe, Mn, Zn and Cu over the control and water spray. Among the different levels of fulvic acid as foliar sprays significantly highest Fe, Mn, Zn and Cu uptake (19.0, 8.94, 7.08 and 1.50 mg plant^{-1} respectively) was observed under of 200 mg L^{-1} FA and found at par with treatment of 100 mg L^{-1} FA for Cu uptake only by the Chilli stalk. The uptake of these micronutrient cations increased steadily with increased levels of FA from 50 to 200 mg L^{-1} FA. However, the concentration of 300 and 400 mg L^{-1} FA significantly decreased the uptake of these micronutrients might be because of higher concentration of FA may inhibited the absorption and physiological activity of plant. The significantly lowest uptake of Fe, Mn, Zn and Cu was noticed due to the treatment of control (No spray) and found at par with water spray. The results are in conformity with results reported by Rauthan and Schnitzer (1981) [13]. Therefore, application of 200 mgL^{-1} fulvic acid extracted from good quality FYM as foliar sprays at 30 and 45 days after transplanting along with recommended dose of chemical fertilizers and 20 t ha^{-1} FYM to Chilli, increased the yield, improved quality and uptake of nutrients under pot culture condition.

Table 1: Effect of levels of fulvic acid as foliar sprays on yield of green Chilli.

Tr. No.	Treatment	Number of fruits per plant	Yield g plant^{-1}			
			Green fruit		Stalk	
			Fresh	Dry	Fresh	Dry
T1	Absolute control (RDF+ 20 t ha^{-1} FYM)	23.5	68.8	13.8	110.5	28.91
T2	0 mg L^{-1} FA control (water spray) + RDF + 20 t ha^{-1} FYM	25.7	69.3	14.2	111.6	29.7
T3	50 mg L^{-1} fulvic acid (FA) + RDF + 20 t ha^{-1} FYM	35.7	86.0	18.3	128.9	33.7
T4	100 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	38.0	88.0	18.7	134.5	37.5
T5	200 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	40.3	89.9	19.1	148.5	39.6
T6	300 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	31.7	89.3	18.7	126.2	38.7
T7	400 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	30.3	83.9	16.8	124.7	32.6
SE+		0.89	0.23	0.15	0.47	0.36
CD at 5%		2.62	0.69	0.46	1.39	1.07

Table 2: Effect of levels of fulvic acid as foliar sprays on quality of fresh green chilli fruits

Tr. No.	Treatment	Fruit length (cm)	Fruit girth (cm)	Ascorbic acid content (mg100g^{-1})
T1	Absolute control (RDF+ 20 t ha^{-1} FYM)	6.73	3.32	87.90
T2	0 mg L^{-1} FA control (water spray) + RDF + 20 t ha^{-1} FYM	7.00	3.53	88.90
T3	50 mg L^{-1} fulvic acid (FA) + RDF + 20 t ha^{-1} FYM	7.80	4.20.	105.86
T4	100 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	8.50	4.30	107.70
T5	200 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	8.96	4.50	109.80
T6	300 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	7.53	4.07	101.16
T7	400 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	7.23	3.87	96.20
SE+		0.13	0.10	0.45
CD at 5%		0.39	0.30	1.33

Table 3: Effect of levels of fulvic acid as foliar sprays on uptake of macronutrients by green Chilli fruits

Tr. No.	Treatment	Uptake (mg plant-1)		
		N	P	K
T1	Absolute control (RDF+ 20 t ha^{-1} FYM)	263.58	37.26	327.06
T2	0 mg L^{-1} FA control (water spray) + RDF + 20 t ha^{-1} FYM	274.06	41.18	339.38
T3	50 mg L^{-1} fulvic acid (FA) + RDF + 20 t ha^{-1} FYM	409.92	65.88	448.3
T4	100 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	422.62	71.06	460.0
T5	200 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	435.48	74.49	471.7
T6	300 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	390.25	61.25	427.0
T7	400 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	371.28	55.44	406.56
SE+		3.98	1.62	3.54
CD at 5%		11.73	4.77	10.41

Table 4: Effect of levels of fulvic acid as foliar sprays on uptake of micronutrients by green Chilli fruits.

Tr. No.	Treatment	Uptake mg plant-1			
		Fe	Mn	Zn	Cu
T1	Absolute control (RDF+ 20 t ha^{-1} FYM)	5.6	2.2	1.3	0.5
T2	0 mg L^{-1} FA control (water spray) + RDF + 20 t ha^{-1} FYM	5.8	2.3	1.3	0.6

T3	50 mg L^{-1} fulvic acid (FA) + RDF + 20 t ha^{-1} FYM	7.6	3.1	1.8	0.8
T4	100 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	7.8	3.2	1.9	0.9
T5	200 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	8.0	3.3	2.1	0.9
T6	300 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	7.3	2.9	1.7	0.8
T7	400 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	7.0	2.8	1.7	0.7
SE+		0.06	0.02	0.02	0.008
CD at 5%		0.019	0.07	0.06	0.025

Table 5: Effect of levels of fulvic acid as foliar sprays on uptake of macronutrients by Chilli stalks

Tr. No.	Treatment	Uptake (mg plant-1)		
		N	P	K
T1	Absolute control (RDF+ 20 t ha^{-1} FYM)	416.30	31.80	783.5
T2	0 mg L^{-1} FA control (water spray) + RDF + 20 t ha^{-1} FYM	451.44	35.64	810.8
T3	50 mg L^{-1} fulvic acid (FA) + RDF + 20 t ha^{-1} FYM	596.49	57.29	943.6
T4	100 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	675.00	67.5	1065. 0
T5	200 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	736.56	75.24	1168. 2
T6	300 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	537.90	52.80	914.1
T7	400 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	518.34	48.90	893.2
SE+		7.57	2.26	10.91
CD at 5%		22.29	6.65	32.09

Table 6: Effect of levels of fulvic acid as foliar sprays on uptake of micronutrients by Chilli stalks

Tr. No.	Treatment	Uptake mg plant-1			
		Fe	Mn	Zn	Cu
T1	Absolute control (RDF+ 20 t ha^{-1} FYM)	13.64	5.14	3.87	0.89
T2	0 mg L^{-1} FA control (water spray) + RDF + 20 t ha^{-1} FYM	14.01	5.37	4.45	0.95
T3	50 mg L^{-1} fulvic acid (FA) + RDF + 20 t ha^{-1} FYM	16.10	7.34	5.62	1.24
T4	100 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	17.96	8.43	6.67	1.42
T5	200 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	19.00	8.94	7.08	1.50
T6	300 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	15.74	6.79	5.28	1.08
T7	400 mg L^{-1} FA + RDF + 20 t ha^{-1} FYM	15.48	6.68	4.98	1.10
SE+		0.16	0.07	0.07	0.02
CD at 5%		0.48	0.21	0.23	0.08

References

1. Anonymous 2010. Website of www. ikisan.com
2. Patil GD. Characterization of spent wash / spent slurry-press mud composts and their effects on yield, nutrient uptake by maize and soil properties. Ph.D. Thesis submitted to MPKV Rahuri (MS) 1994.
3. Lulakis MD, Petsas-SI. Effect of humic substances from vine- canes mature compost on tomato seedling growth. Bioresource Technology 1995;54(2):179-182.
4. Kolape SS. Evaluation of quality indices of compost, FYM and their effects on soil humic substances, growth and yield of sunflower and succeeding groundnut in Inceptisol. Ph. D. Thesis submitted to MPKV, Rahuri 2009.
5. Fortun C, Polo A. Effects of several humic compounds in Zea mays seedling growth. Agrochimica 1982;26(1):44-54.
6. Poapst PA, Schnitzer M. Fulvic acid and adventitious root formation. Soil Biol. Biochem 1971;3:367-372.
7. Stevenson FJ. Humus Chemistry, Genesis, Composition, Reactions, John Wiley and Sons, New York 1982, 196.
8. Vimal OP. Humic substances and plant growth J., Sci. Ind. Res. 1972;31(8):439-445.
9. Norhayati-Moris. Effects of humic substances and micronutrients on plant growth. UPM Agricultural University 1984.
10. Panse VG, Sukhatme RV. Statistical methods for agricultural workers, I.C.A.R., New Delhi 1985.
11. Piper CS. Soil and Plant Analysis. Prentice Hall, Co., New Delhi 1961.
12. Raina JN, Goswami KP. Effect of fulvic acid and fulvates on growth and nutrient uptake by maize plant. J. Indian Soc. Soil Sci 1988;36:264-268.
13. Rauthan BS, Schnitzer M. Effects of soil fulvic acid on the growth and nutrient content of cucumber (*Cucumis sativus*) plnts. Plant and Soil 1981;63:491-495.
14. Senn TL, Kingman AR. A review of humus and humic acids. Clemson University, Department of Horticulture, Research Series No. 145, March 1973.
15. Sawhney SK, Singh R. Estimation of ascorbic acid in lemon juice. Introductory practical biochemistry. Norosa publishing house 2000, 104.
16. Xudan X. Effects of foliar application of humic acid on water use, nutrient uptake and yield in wheat. Australian Journal of Agricultural Research 1986;37(4):343-350.
17. Xuhang L, Weiyi Y, Limei S. Preliminary investigation of physiological and biochemical mechanisms on drought –resistance of wheat enhanced by leaf spraying fulvic acid. Chinese-Bulletin – Botany 1992;9(2):44-46.