J. Indian bot. Soc. ISSN - 0019 - 4468 Vol. 94 (3 & 4) 2015 : 252-256

ENHANCEMENT OF SOIL MICROORGANISMS AND VEGETATIVE GROWTH OF TOMATO PLANT BY THE TREATMENT OF NEEM LEAF COMPOST AND UREA

VICHITRA TYAGI AND SANJEEV KUMAR

Botany Deptt., D.A.V.College, Muzaffarnagar.
E-mail: vichitramicro@gmail.com

The number of fungi and bacteria (microorganism) and vegetative growth (in term of root, stem length, fresh, dry weight, leaf area) of tomato plant is enhanced by urea treatment, being maximum at the amendment of soil with neem leaf compost (3:1).The neem leaf compost treatment significantly promote the root growth of 15-d old tomato plant. The urea treatment shows a negative effect on root growth of 30 and 45-d old tomato plant.

Keywords : Neem leaf compost, Urea, microorganisms.

There are two ways to feed the plant directly or feed the soil and lets nature's soil processes feed the plant. Chemical fertilizers directly feed the plant (Steiner *et al.* 2007) and organic fertilizers feed the soil (Abdel Mouty *et al.*, 2001). Among organic fertilizers compost is widely used as it improves soil structure and texture, provide nutrients, improves aeration, retains moisture, increase number of beneficial organisms in soil, regulate pH of soil and increases heat absorption of soil (Bayoumi 2005, Awad 2002, Hafez *et al.* 2004). Urea [$CO(NH_2)_2$] is supplied as fertilizer in agricultural plant production. The nutrient supplied by compost depends on composting materials. The supplementation of fertilizer (either organic or chemical) can cause either direct effect on growth and productivity of agricultural crop or an indirect effect through the impact on microbial population around plant root i.e. rhizospheric microflora (Mohammadi 2011, Bunemann *et al.* 2006, Gomes *et al.* 2006). The aim of this work is to investigate the effect of organic and chemical fertilizer on vegetative growth of tomato and on soil microbes.

MATERIALS AND METHODS

For composting the green neem leaves were shredded and mixed with composted cattle dung in the ratio 4:1 and filled in earthen pots and watered with tap water and covered and left for composting for 4 months. During composting period, the composting material was turned on for aeration after 15 days and moistened with water.

In earthen pots, labelled as C- soil without fertilizer was filled and in other earthen pots, labeled as NL- soil was mixed with neem leaves compost in the ratio 3:1. The serial dilution-agar plating method was used for isolation of fungi and bacteria from soil (Johnson and Curl, 1972). The soil sample was serially diluted from 10-1 to 10-10 dilutions and 0.1 mL diluted sample was plated on Czapeks dox agar (CDA) and nutrient agar medium (NAM) for isolation of fungi and bacteria, respectively. The inoculated petri plates were incubated at 28±2°C for 5 days and 35±2°C for 24hr for fungal and bacterial growth respectively.

The bacterial and fungal colonies developed on NAM and CDA plates after incubation were counted with the help of a colony counter. The number of microorganisms present in soil was then calculated with the help of following formula-

$$\text{Number of bacterial/fungal cell per g of soil} = \frac{\text{(Nunber of cfu/mL x dilution factor)}}{\text{(weight of soil (g)}}$$

cfu = colony forming unit
dilution factor = 1/ dilution number

Certified seeds of *Lycopersicon esculentum* variety Sania were obtained from IARI, Pusa, New Delhi. Surface sterilized seeds equal in size, shape, weight and colour were sown in each earthen pot and allowed to germinate. After germination the pots with seedlings

Received on June 5, 2015 www.indianbotsoc.org Accepted on August 12, 2015

were transferred to sunlight. All pots were watered when necessary with tap water.

The surface sterilized seeds of tomato were sown in soil without fertilizer and then allowed to grow 15 days after seed germination the soil was supplemented with chemical fertilizer (urea) at varying concentration (0.015, 0.030, 0.060, and 0.120% w/v). The concentration of urea (0.03%) which support maximum plant growth and rhizospheric microbial number (table1) was selected for further analysis.

The effect of NL compost and UR on tomato plant growth was studied in terms of the root length, shoot length, leaf area index, and their fresh and dry weight after different intervals (i.e., 15, 30, 45 and 60 days) of seed germination. 10 tomato seedlings were uprooted after different days of germination from all pots. After growth measurement the plant parts were dried in an oven at 70°C till constant weight and then dry weight of all plant parts were measured.

RESULTS AND DISCUSSION

The effect of varying concentration (0.015%, 0.03%, 0.06% and 0.12% w/v) of urea on tomato plant growth and rhizospheric microbial count is shown in table 1. The 0.03% w/v concentration of urea shows maximum plant growth (146% of control) and microbial number compared to other concentrations.

Table 2. showed that the bacterial count and fungal count in soil amended with compost NL is 516% of control and 302% of control, respectively. The bacterial and fungal count at 0.03% concentration of urea is 558% and 126% of control, respectively. The supplementation of fertilizer in soil shows significant impact on bacterial compared to fungal population.

The microorganisms are usually limited by carbon in soil (Demoling *et al.* 2007). The NL compost provides sufficient carbon and nitrogen to support microbial growth. The C: N ratio of green leaves compost vary from 35: 1 to 80: 1 (Gducke 1972) and in urea i.e. 0.4: 1 (web). This may be the reason for a significant increase in microbial number in NL compost amended soil. The NL compost amendment in soil shows significant impact on bacterial compared to fungal population due to the faster response of saprotrophic bacteria than that of the slower saprotrophic fungi, which can proliferate in the short term when there is a readily available source of energy, as in the case of the organic treatments (Cardon and Gage 2006). The chemical fertilizers provide nutrients in an easily available form that can be directly utilized by microbes and plants (Steiner *et al.* 2007). As the bacteria are best chelators of nitrogen compared to fungi, the bacterial number significantly increase after chemical fertilizer (urea) amendment in soil.

Table 3 represent the influence of neem leaves compost and urea on growth of 15, 30, 45 and 60-d old tomato plant. The leaf area index, stem length and root length of 15-d old plant in NL compost treatment is 145%, 160%, 360% of control respectively. The leaf area index, stem length and root length of NL treated 30-d plant leaf is 247%, 142%, 222%, of control, respectively. The leaf area, stem and root length of UR treated 30-d old plant is 190%, 124% and 97% of control, respectively. The leaf area index of leaf of 45-d old plant treated with NL and UR is 236% and 220% of control, respectively. The length of stem and root in NL treated plant is 242% and 213% of control, respectively. The UR treatment positively influence the stem length, i.e. 189% of control and adversely affect the root length, i.e. 93%of control in 45-d old plant. The leaf surface area and stem length found in NL treated 60-d old plant is 170% and 306% of control, and in UR treatment it is 120% and 193% of control. The root length of NL and UR treated 60-d old plant is 113% and 102% of control, respectively. Similar trend is found on fresh and dry weight measurement of tomato plant grown in soil treated with neem leaves compost and urea.

Table 1. Effect of varying concentration of urea on plant growth and rhizospheric microbial count of 30-d old tomato plant.

Soil with urea(%w/v)	Plant height(cm)(arithmetic mean ±S.D.)	Bacterial count (10^{10})(cfu/g of soil) (arithmetic mean ±S.D.)	Fungal count (10^{3})(cfu/g of soil))(arithmetic mean±S.D.)
0	2.8± 0.05	0.38±0.01	1.61±0.02
0.015	3.2± 0.04	1.23±0.02	2.17±0.02
0.03	4.1± 0.02	2.12±0.02	2.28±0.01
0.06	3.3± 0.03	1.4± 0.03	1.78±0.03
0.12	1.6± 0.02	1.1± 0.04	0.82±0.02

Table 2. The impact of NL compost and urea (0.03%) application on soil biological index.

Soil treatment	Bacterial count (10^{10})(cfu/g of soil)(arithmetic mean ±S.D.)	Fungal count (10^{4})(cfu/g of soil) (arithmetic mean ±S.D.)
Control	0.341± 0.053	0.152± 0.037
NL	1.760 ± 0.312	0.459 ± 0.181
UR	2.12± 0.02	2.28± 0.01

Table 3. The effect of NL compost amendment and urea supplementation on vegetative parts of tomato plant at different plant age.

(a) Length/area measurement

Plant age (days)	Length(cm) (arithmetic mean ±S.D.)						Leaf area Index(cm^2) (arithmetic mean ±S.D.)		
	Root			Stem					
	C	NL	UR	C	NL	UR	C	NL	UR
15	1.6± 0.056	5.8 ± 0.112	-	1.5± 0.101	2.4 ± 0.126	-	0.42± 0.059	0.61 ± 0.071	-
30	3.60± 0.112	8.01 ± 0.114	3.51 ± 0.108	2.25± 0.138	3.20 ± 0.050	2.30 ± 0.118	0.63± 0.030	1.56 ± 0.023	1.20 ± 0.026
45	4.50± 0.011	9.6 ± 0.080	4.17 ± 0.021	4.35± 0.038	10.56 ± 1.35	8.25 ± 0.092	2.32± 0.032	5.48 ± 0.043	5.12 ± 0.026
60	8.4± 0.092	12.4 ± 0.090	8.6 ± 0.118	7.42± 0.038	22.73 ± 0.135	14.34 ± 0.123	4.35± 0.130	7.40 ± 0.073	5.26 ± 0.126

(a) Fresh and dry weight measurement

Plant age (days)	Fresh Weight (mg) (arithmetic mean ±S.D.)									Dry Weight (mg) (arithmetic mean ±S.D.)								
	Root			Stem			Leaf			Root			Stem			Leaf		
	C	NL	UR	C	NL	UR	C	NL	UR	C	NL	UR	C	NL	UR	C	NL	UR
15	5± 0.21	15± 0.14	-	8± 0.04	10± 0.16	-	13± 0.31	21± 0.26	-	0.6± 0.10	1.2± 0.08	-	0.6± 0.04	0.9± 0.011	-	1.1± 0.013	1.2± 0.012	-
30	26± 1.23	31 ± 1.44	25± 1.18	17± 0.04	36± 1.47	28± 1.19	23± 1.23	61 ± 1.15	42± 1.29	2.2± 0.03	2.8± 0.04	2.1± 0.06	1.2± 0.01	2.2± 0.06	1.5± 0.04	2.3± 0.04	4.5± 0.06	4.2± 0.06
45	46± 1.32	99± 1.21	39± 1.10	185± 0.12	456± 2.26	314± 2.25	145± 2.31	552 ± 5.52	449± 2.19	3.4± 0.63	7.0± 0.84	3.1± 0.86	12.4± 0.11	25.4± 2.26	19.2± 1.23	9.8± 0.41	32.6± 2.25	28.1± 1.15
60	243± 8.40	421± 10.57	285± 11.60	214± 0.34	634± 14.66	421± 9.55	284± 9.37	721 ± 13.75	556± 12.69	14.2± 1.33	22.7± 1.29	15.4± 1.56	13.9± 0.03	32.1± 2.16	17.7± 1.73	15.2± 1.24	37.7± 1.43	283± 1.42

The NL compost treatment significantly increases the fresh and dry weight of all vegetative plant parts at all studied plant age. The UR treatment also increases the fresh and dry weight of leaves and stem of tomato plant but adversely affect the fresh and dry weight of 30-d (96% and 95% of control) and 45-d (85% of control)old tomato plant root.

Lokanandhan *et al.* (2012) reported that neem was a natural soil conditioner that helps improve the quality of soil by increasing the nitrogen and phosphorus content in the soil. The positive effect of compost fertilizers on vegetative growth characters may be due to the improvement in soil physical and biological properties and also contains higher levels of relatively available nutrients elements, which are essentially required to plant growth (Abdel Mouty *et al.* 2001, Awad 2002, Hafez *et al.* 2004). This could be the reason for significant growth in plant grown in NL compost compared to control. N as necessary element was required for initial growth of plants for synthesizing new cells and organic compounds (Troeh and Thompson 1993). Chemical fertilizer was composed of pure synthetic nutrients facilitating higher plant growth during initial application. Nutrients in the chemical fertilizer (urea) were in the form easily available to plants. That is why a significant increment in growth was recorded immediate after urea application in soil. Liu *et al.* (2005) showed that the root length to be the most sensitive indicator among the growth parameters. That is why a significant influence was found on root length at 15-d of plant growth. Mehdizadeh *et al.* (2013) showed that addition of organic fertilizers (municipal waste compost, poultry manure, cow manure and sheep manure) at rate 20 ton.ha $^{-1}$ significantly increased tomato growth and yield compared to control (no fertilizer application). Compost and poultry manure had a synergistic effect on both fresh and dry weights of tomato shoots and roots and compared to other treatments. Olaniyi and Ajibola (2008) reported that organic fertilizer (poultry manure) showed increased growth in terms of plant height and number of leaves, comparable to urea application at 60 kg ha^{-1} in tomato plants. However, Toor *et al.* (2006) found that plant shoot biomass was significantly higher in the inorganic fertilizer compared to organic (chicken manure and grass clover mulch) fertilizer treatment in tomato plant.

Thanks are due to Prof. Vimala, Y., Botany deptt., C.C.S. Univ., Meerut for her valuable suggestions.

REFERENCES

Abdel-Mouty MMA, Ali H and Rizk AF 2001 Potato yield as affected by the interaction between bio and organic fertilizers. *Egypy J Appl Sci* **16**(6) 267-286.

Awad EM 2002 Effect of compost and some bio-fertilizers on growth, yield and quality of potato crops (*Solanum tubersum* L.). *J Agric Sci* Mansoura Univ **27**(8) 5525-5537.

Bayoumi YA 2005 *Studies on organic production of tomato crop*. Ph.D. Thesis, Fac Agric Kafr El-Sheikh, Tanta Univ., Egypt.

Bunemann EK, Schwenke GD and Zwieten LV 2006 Impact of agricultural inputs on soil organisms–a review. *Australian Journal of Soil Research* **44** 379–406.

Cardon ZG and Gage DJ 2006 Resource exchange in the rhizosphere : molecular tools and the microbial perspective. *Annual Review of Ecology Evolution and Systematics* **37** 459-488.

Demoling F, Figueroa D and Bååth E 2007 Comparison of factors limiting bacterial growth in different soils. *Soil Biology and Biochemistry* **39** 2485-2495.

Gducke C 1972 *Composting a study of the process and its principle*. Rodale Press. Inc. Emnaus Pennsylvania USA pp. 265.

Gomes L, Godoy WAC and Von Zuben CJ 2006 A review of postfeeding larval dispersal in blowflies : implications for forensic entomology. *Natur wissen schaften* **93** 207-215.

Hafez M Magda and Asmaa R Mahmoud 2004 Response of snap bean (*Phaseolus vulgaris* L.) to nitrogen fertilizer source. *Annals of Agric Sci* Mashtohor **42**(1) 261-270.

Johnson LF and Curl AE 1972 *Method for the Research on Ecology of Soil Borne Plant Pathogens*. Burgess Publishing Company, Minneapolis pp 247.

Liu X, Zhang S, Shan X and Zhu YG 2005 Toxicity of arsenate and arsenite on germination, seedling growth and amylolytic activity of wheat. *Chemosphere* **61** (2) 293-301.

Lokanadhan S, Muthukrishnan P and Jeyaraman S 2012 Neem products and their agricultural applications. *J Biopest* **5** 72-76.

Mehdizadeh M, Darbandi EI, Naseri-Rad H and Tobeh A 2013 Growth and yield of tomato (*Lycopersicon esculentum*) as influenced by different organic fertilizers. *International Journal of Agronomy and Plant Production* **4**(4) 734-738.

Mohammadi K 2011 Effects of Different Fertilization Methods and on Soil Biological Parameters. *World Academy of Science, Engineering and Technology* **54** 407-410.

Olaniyi JO and Ajibola AT 2008 Effects of inorganic and organic fertilizers application on the growth, fruit yield and quality of tomato (*Lycopersicon lycopersicum*). *Journal of Applied Biosciences* **8** (1) 236 -242.

Steiner C, Teixeira WG, Lehmann J, Nehls T de Macêdo JLV, Blum WEH and Zech W 2007 Long term effects of manure, charcoal and mineral fertilization on crop production and fertility on a highly weathered Central Amazonian upland soil. *Plant Soil* **291** 275-290.

Toor RK, Savage GP and Heeb A 2006 Influence of different types of fertilizers on the major antioxidant components of tomatoes. *Journal of Food Composition and Analysis* **19** 20-27.

Troeh FR and Thompson LM 1993 *Soils and soil fertility*. Oxford University Press Inc., New York.

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