International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 2739-2742

Received: 09-05-2018
Accepted: 15-06-2018

Kiran Pilli
Department of Soil Science and Agricultural Chemistry, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

PK Samant
Department of Soil Science and Agricultural Chemistry, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

P Naresh
Central Horticultural Experiment Station, Aiginia, Bhubaneswar, Odisha, India

GC Acharya
Central Horticultural Experiment Station, Aiginia, Bhubaneswar, Odisha, India

Correspondence
Kiran Pilli
Department of Soil Science and Agricultural Chemistry, College of Agriculture, OUAT, Bhubaneswar, Odisha, India

Influence of INM on chemical properties of soil in grafted (Tomato and Brinjal), non-grafted and self-grafted tomato

Kiran Pilli, PK Samant, P Naresh and GC Acharya

Abstract
Grafting is an art and technique in which two living parts of different plants or same plant are joined together in a manner that they would unite together and subsequently grow into a composite plant. In addition to breeding of resistant cultivars, integrated pest management practices have been developed out of which grafting technique has been successfully used for controlling several soil-borne diseases and damage caused by root-knot nematodes in tomato production especially under intensive cultivation. The main purpose of employing grafting technology is to control soil borne diseases. A pot culture experiment was conducted at the Central Horticultural Experiment Station (CHES), Aiginia, Bhubaneswar, during winter 2017-18. Soil texture was sandy loam with low CEC and organic carbon content. Available N, P and K status was medium, low and medium respectively. Grafted Tomatoes (BT-10 grafted on brinjal var. Utkal Anushree), non-grafted and self-grafted tomatoes were evaluated with six treatments i.e. T_1 (Absolute Control), T_2 (100 % inorganic nitrogen), T_3 (75 % inorganic nitrogen + 25 % organic nitrogen), T_4 (50 % inorganic nitrogen + 50 % organic nitrogen), T_5 (25 % inorganic nitrogen + 75 % organic nitrogen), T_6 (100 % organic nitrogen). The experimental soil was acidic in reaction (pH 4.33) which was increased to 5.70 in T_6 in case, of T_2 it was 5.24 which indicated the importance of organic over inorganic. Which intern increase the organic content of soil and reduced the total soluble salts in post-harvest soil. Crop had removed more amount of nutrients from soil for growth and yield which led to depletion of nutrient status of post-harvest soil. The 100 % organic nitrogen treatment and organic-inorganic combination of treatments in post-harvest soil showed more available nutrient as compared to 100 % inorganic nitrogen treatment.

Keywords: Integrated nutrient management, grafting, non-grafted tomato, organic and inorganic nitrogen

Introduction

Tomato (*Solanum lycopersicon*) is one of the widely grown vegetable and most important food crops in India. It is rich in minerals, essential amino acids, sugars and dietary fibres. It also contains more vitamin B and C, iron, lycopene and phosphorus (Bagal *et al*., 1989) [3]. It is a rich source of minerals, vitamins and organic acids. It provides 3-4 per cent total sugar, 4-7 per cent total solids, 15-30 mg/100g ascorbic acid, 7.5-10 mg/100ml titratable acidity and 20-50 mg of lycopene per 100 g fruit.

The main purpose of employing grafting technology is to control soil borne diseases. However, the impact of grating includes not only a stronger resistance against pathogens but also a higher tolerance to abiotic stress conditions such as salinity, heavy metal, nutrient stress, thermal stress, water stress, organic pollutants, and alkalinity, and could improve fruit quality. (Crino *et al*., 2007; Lee *et al*., 2010; Rouphael *et al*., 2008b and Proietti *et al*., 2008) [7, 10, 16, 14].

Integrated nutrient management is an advanced acceptable concept of modern agriculture. Application of injurious and indiscriminate chemical fertilizers undoubtedly increases yield but at the same time soil properties are badly affected. Keeping in mind the bad impact of use of excess chemical fertilizers, the concept of integrated nutrient management came into effect to obtain a higher yield and quality. Organic fertilizers contain relatively low concentrations of nutrients as compared to chemical fertilizers, but they perform important functions which the chemical fertilizers do not do. The use of organic fertilizers and of course their appropriate management can reduce the need for chemical fertilizers thus allowing the small farmers to reduce cost of production and management of soil health. The release pattern of inorganic nutrients from fertilizer sources is higher as compared to organic source. As a result of which released nutrients are either used or lost rapidly by different means.

On the other hand, organic fertilizers are mineralized slowly and nutrients become available for a longer period of time as a result of which soil nutrient status is maintained till the harvest of the crop. Organic manures having humic substances not only improve soil fertility by modifying soil physical and chemical properties (Asik *et al*., 2009) [2], (Heitkamp *et al*., 2011) but also improves the moisture holding capacity of the soil, ultimately enhanced productivity and quality of crop produce.

Material Method

Poly pot preparation and treatments

The experiment was conducted in Central Horticultural Experiment Station (Aiginia), Bhubaneswar with Brinjal Grafted Tomato, Non-Grafted Tomato, Self-Grafted Tomato during 2017-18 in a Completely Randomized Design with six treatments and each treatment was replicated thrice. Each ploy bag was filled with 15 kg soil. Seed treatment was done with Bavistin @ 2 gm kg^{-1} of seed and Chlorodust was applied @ 1 g/pot against termite.

The experiment was laid out in a Completely Randomised Design comprising of six treatments with Grafting interaction. Grafted Tomatoes (BT-10 grafted on brinjal var. Utkal Anushree), non-grafted and self-grafted tomatoes were evaluated with six treatments i.e. T_1 (Absolute Control), T_2 (100 % inorganic nitrogen), T_3 (75 % inorganic nitrogen + 25 % organic nitrogen), T_4 (50 % inorganic nitrogen + 50 % organic nitrogen), T_5 (25 % inorganic nitrogen + 75 % organic nitrogen), T_6 (100 % organic nitrogen).

Nursery raising and grafting

Before grafting, scion and rootstock were exposed to sunshine for three days. Two crop varieties *viz*. Tomato- Utkal Kumari (BT-10) and Brinjal-Utkal Anushree were sown in the protrys. In Brinjal Grafted Tomato Utkal Kumari (BT-10) scion were grafted onto the Utkal Anushree rootstock using “side grafting” and in Self Grafted Tomato Utkal Kumari (BT-10) scion were grafted onto the Utkal Kumari (BT-10) rootstock using “side grafting”. Non-grafted seedlings were used as a check. Grafting was carried out at 2-3 leaf stage (20-25 days) of scion seedlings and 3-4 leaf stage (55-60 days) of root stock. Grafting was carried out in moist chambers. Grafting was made with similar thickness of scion and root stock which was cut at 45^0 and joined by using plastic clips.

The grafted plants were transplanted after thirty-five days. Then they were exposed to water stress before being taken to moisture chambers. This process was carried out to ensure high grafting success. The grafted seedlings were transferred to humidified chambers with a relative humidity of 85-95 per cent for five days to allow the graft union to heal, then intensity of light was gradually increased with decrease and relative humidity. Then the seedlings were transferred to the normal nursery where healing process was continued for two weeks before they were transplanted. Plants were grown under natural light conditions.

Collection and processing of soil and plant samples

Initial soil sample was collected before filling the poly bags. The post-harvest soil samples were also collected. The samples were dried under shade, ground with wooden hammer and sieved through 2 mm sieve. The samples were preserved in polythene bags with proper labels for analysis. The sand, silt and clay content of the soil samples were determined by Bouyoucos Hydrometer method as described by Piper (1950) [13]. Soil pH was determined in 1:2.5 soils: water suspension after equilibration for half an hour with intermittent shaking by pH meter as described by Jackson (1973). The lime requirement of the acid soil was determined by Woodruff Buffer method. The Organic carbon content of soil was determined by wet digestion procedure of Walkley and Black as outlined by Page *et al.*, 1982 [12]. Available nitrogen in soil was determined by alkaline $KMnO_4$ method (Subbiah and Asija, 1956). Available phosphorous in the soil was determined by Bray's 1 method (Bray and Kurtz, 1945) [4] as out lined by Page *et al*. (1982) [12]. Available potassium was determined by extracting the soil with neutral normal ammonium acetate solution and estimated by flame photometer (Page *et al*., 1982) [12]. Available Sulphur was determined by extracting the soil with 0.15 per cent $CaCl_2$ solution and measured calorimetrically by turbidimetric method using $BaCl_2$ (Chesin and Yien, 1951) [6]. Available Calcium and Magnesium were determined by extracting the soil with Neutral Normal Ammonium Acetate Solution after 30 minutes shaking. The Calcium & Magnesium were determined by using EDTA (Versenate) complexometric titration by using Colcon and Eriochrome black-T indicators respectively as outline by Hesse (1971).

Initial physico-chemical properties of soil

Initial physico-chemical properties of soil were analyzed before transplanting of tomato crop. The experimental soil was sandy loam texture (77.5 % sand + 11.0 % silt + 11.5 % clay), pHw (1:2.5)- 4.33, EC (dS m^{-1})- 0.04, Organic Carbon (g kg^{-1})- 3.4, Lime requirement ($CaCO_3$t ha^{-1})- 6.72, Cation exchange capacity -17.12 (c mol (p+) kg^{-1}), Available N (kg ha^{-1})-296 (medium), Available P (kg ha^{-1})-3.92 (low), Available k (kg ha^{-1})-157 (medium), Available S (kg ha^{-1})-2.9 (low), Calcium (c mol (p+) kg^{-1} soil)-2.3 (Adequate), Magnesium (c mol (p+) kg^{-1} soil)-1.8.

Statistical Analysis

The experimental data pertaining to chemical properties of soil were recorded, compiled in appropriate tables and analyzed statistically as per the procedure appropriate to the design (Panse and Sukhatme, 1978) and Gomez and Gomez (1976). All the data were statistically analyzed by two-factorial CRD ANOVA.

Results and Discussion

Influence of INM practices on Post-harvest soil properties

Soil reaction (pH)

The soil reaction before initiation of crop was 4.33 (pH). The soil was limed @ 0.2 LR before experimentation. It was expected to raised the soil pH. After harvest the soil pH decreased in inorganically fertilized packages than with organics or combinations of organics (Table-1). Types of grafting doesn’t show any role in change in soil pH rather it depends upon the substance that is applied as a source of organic or inorganic.

Soluble salts concentration (EC) (dS m^{-1})

The concentration of soluble salts in soil measured in terms of EC. Before transplanting of tomato crop it was 0.04 dS m^{-1}. Observations from Table-1 indicated that lowest EC (0.017 dS m^{-1}) was observed in 100 % organic nitrogen and highest in control (0.020 dS m^{-1}) decreased thereafter with decreased proportion of inorganic irrespective of grafting It.

Organic Carbon (g kg^{-1})

The organic carbon status at the beginning of crop was 3.4 g

kg^{-1}. The data in the Table-1 indicated that the organic carbon was under low status irrespective of the INM packages or types of grafts in the post-harvest soil. However, with increase in organic proportion through vermicompost the organic carbon in soil was increasing.

Available N in soil ($kg\ ha^{-1}$)

The available N status at the beginning of experiment was 296 $kg\ ha^{-1}$. It was observed that available N decreased by the harvest of the crop irrespective of INM packages and types of grafting practiced. However, INM package including use of organics maintained higher status of available N (Table-2). The treatment T_6 recorded highest available N (205) and lowest was control (124). The treatments T_6 (205) and T_5 (203) are at par which was due to application of vermicompost. T_3 (189) and T_4 (192) were also at par with each other but showed significant difference with other treatments. The available N was decreased with incremental proportion of inorganic Nitrogen in the package.

Vermicompost is rich in bacteria and microbes. The increase in available N occurs due to the enhanced multiplications of microbes by incorporation of crop residues which catalyse the conversion of organically bound N to inorganic form. Favourable soil conditions under crop residues might have helped in the mineralization of soil N leading to the build-up of higher available N. Studies of Kumar and Prasad (2008) [8], Prasad *et al.* (2010), Kumar and Singh (2010) [9] and Singh 2014.

Available P in soil ($kg\ ha^{-1}$)

The available P status at the beginning of experiment was 3.92 $kg\ ha^{-1}$ which decreased irrespective of the INM packages and grafting followed (Table-2). The treatment T_6 recorded highest available P (3.3) and lowest was control (1.1). The treatments are significantly differing with each other. The available P was decreased with incremental proportion of inorganic Nitrogen in the package.

Available K in soil ($kg\ ha^{-1}$)

The available K status at the beginning of experiment was 157 $kg\ ha^{-1}$ which decreased irrespective of grafting and INM packages followed (Table-2). The treatment T_6 recorded highest available K (131.1) and lowest was control (84.6). The treatments T_5 (130.2) and T_6 (131.1) are at par which was due to application of vermicompost. T_3 (109.2) and T_4 (111.8) were also at par with each other but showed significant difference with other treatments. The available K was decreased with incremental proportion of inorganic Nitrogen in the package.

Available Ca in soil (c mol (p+) kg^{-1} soil)

The available Ca status at the beginning of crop was 2.3 (c mol (p+) kg^{-1} soil). The status of calcium either decreased or maintained in the post-harvest soil irrespective of the INM packages and grafting method followed (Table-3). The treatment T_6 recorded highest available Ca (2.70) and lowest was control (2.14). All the treatments are significantly differing with each other. The available Ca was decreased with incremental proportion of inorganic Nitrogen in the package.

Available Mg in soil (c mol (p+) kg^{-1} soil)

The available Mg status at the beginning of experiment was 1.8 (c mol (p+) kg^{-1} soil). The magnesium status in post-harvest soil decreased irrespective of INM packages or grafting followed (Table-3). The treatment T_6 recorded highest available Mg (1.45) and lowest was control (0.9). The treatments T_2 (1.0) and T_3 (1.01) are at par which are almost inorganic treatments. All other the treatments are significantly differing with each other. The available Mg was decreased with incremental proportion of inorganic Nitrogen in the package.

Available S in soil ($kg\ ha^{-1}$)

The available S status at the beginning of experiment was 2.9 $kg\ ha^{-1}$. It was low in status. It decreased in post-harvest soil (Table-3). The treatment T_6 recorded highest available S (1.90) and lowest was control (1.0). All the treatments are significantly differing with each other. The available S was decreased with incremental proportion of inorganic Nitrogen in the package.

It was observed that available N, P, K, Ca, Mg and S However, INM package including use of vermicompost maintained higher status of available N, P, K, Ca, Mg and S.

Highest availability of nutrients in 100 % organic nitrogen (T_6) may be attributed to slow and steady release of nutrients by addition of vermicompost to the soil. However, the availability decreases with incremental proportion of inorganic nitrogen. Vermicompost addition can increase the availability of nutrients because rate of release of nutrients was slow and proved nutrients for longer period in soil.

Types of grafting doesn't show any role in change in soil reaction, total soluble salts and organic carbon status of soil, rather it depended upon the substance that was applied as a source of organic or inorganic. It was observed that the nutrient status of post-harvest soil was decreased as compared to initial status of soil. This was due to removal of nutrients by the crop. Similar results were found by Najar and Khan (2013) [11].

Table 1: Influence of INM practices of grafted tomato on post-harvest soil properties pH, EC ($dS\ m^{-1}$) and organic carbon ($g\ kg^{-1}$)

Treatment	pH				EC ($dS\ m^{-1}$)				Organic carbon ($g\ kg^{-1}$)			
	GT	NGT	SGT	Mean T	GT	NGT	SGT	Mean T	GT	NGT	SGT	Mean T
T_1 (control)	4.07	4.08	4.05	4.07	0.019	0.020	0.021	0.020	3.02	3.09	3.10	3.07
T_2 (100 % I.N)	5.12	4.88	4.92	4.80	0.014	0.026	0.018	0.019	3.13	3.28	3.28	3.23
T_3 (75 % I.N + 25 % O.N)	4.61	4.87	5.05	4.90	0.019	0.020	0.017	0.018	3.51	3.50	3.43	3.48
T_4(50 % I.N + 50 % O.N)	4.79	5.51	4.83	5.04	0.015	0.018	0.021	0.018	3.10	3.32	4.10	3.50
T_5 (25 % I.N + 75 % O.N)	4.65	6.15	4.92	5.24	0.014	0.018	0.021	0.018	3.56	4.48	3.54	3.86
T_6 (100 % O.N)	5.60	5.87	5.63	5.70	0.013	0.018	0.019	0.017	4.04	4.10	4.07	4.07
Mean B	4.97	5.39	5.03		0.015	0.018	0.018		3.39	3.61	3.61	
	T	B	T×B		T	B	T×B		T	B	T×B	
SE(m) (±)	0.010	0.007	0.017		0.000	0.000	0.000		0.015	0.011	0.027	
C. D. (0.05)	0.03	0.02	0.05		0.001	0.001	0.001		0.04	0.03	0.07	

Initial: pH-4.33, EC-0.04 $dS\ m^{-1}$and Organic Carbon-3.4 $g\ kg^{-1}$

Table 2: Influence of INM practices of grafted tomato on available status of N, P and K status of post-harvest soil

Treatment	Available N (kg ha^{-1})				Available P (kg ha^{-1})				Available K (kg ha^{-1})			
	GT	NGT	SGT	Mean T	GT	NGT	SGT	Mean T	GT	NGT	SGT	Mean T
T_1 (control)	121	121	129	124	1.1	1	1.1	1.1	79	94	81	84.6
T_2 (100 % I.N)	171	175	171	172	1.7	1.6	2.3	1.9	65	98	120	94.5
T_3 (75 % I.N + 25 % O.N)	200	196	171	189	1.6	1.8	3.1	2.2	106	113	108	109.2
T_4(50 % I.N + 50 % O.N)	196	204	175	192	3.1	1.5	2.3	2.3	96	116	124	111.8
T_5 (25 % I.N + 75 % O.N)	175	229	204	203	4.9	1.6	2.7	3.1	119	116	129	130.2
T_6 (100 % O.N)	217	200	200	205	2.0	3.3	4.7	3.3	99	120	142	131.1
Mean B	180	187	175		2.4	1.8	2.7		94	109	127	
	T	B	T×B		T	B	T×B		T	B	T×B	
SE(m) (±)	3.675	2.598	6.365		0.014	0.010	0.024		3.242	2.293	5.616	
C. D. (0.05)	10.60	7.50	18.33		0.04	0.03	0.07		9.34	6.60	16.17	

Initial: Available N-296 kg ha^{-1}, P-3.9 kg ha $^{-1}$, K- 157 kg ha^{-1}

Table 3: Influence of INM practices of grafted tomato on available Ca, Mg, S status of post-harvest soil

Treatment	Available Ca (c mol (p+) kg^{-1} soil)				Available Mg (c mol (p+) kg^{-1} soil)				Available S (kg ha^{-1})			
	GT	NGT	SGT	Mean T	GT	NGT	SGT	Mean T	GT	NGT	SGT	Mean T
T_1 (control)	2	2.3	2.2	2.14	0.74	1.04	0.93	0.9	0.97	1.00	1.00	1.0
T_2 (100 % I.N)	2.04	2.5	2.1	2.22	1.22	0.85	0.90	1.0	1.3	1.2	1.22	1.25
T_3 (75 % I.N + 25 % O.N)	1.9	2.6	2.2	2.24	1.13	1.09	0.82	1.01	1.3	1.4	1.4	1.40
T_4(50 % I.N + 50 % O.N)	1.7	2.5	2.7	2.30	1.6	0.74	0.82	1.05	1.91	1.61	1.72	1.75
T_5 (25 % I.N + 75 % O.N)	2.4	2.6	2.2	2.40	1.2	1.1	1.1	1.14	1.80	1.86	1.91	1.85
T_6 (100 % O.N)	2.7	2.64	2.7	2.70	1.22	1.7	1.4	1.45	2.06	1.81	1.78	1.90
Mean B	2.12	2.60	2.34		1.19	1.09	0.96		1.56	1.48	1.50	
	T	B	T×B		T	B	T×B		T	B	T×B	
SE(m) (±)	0.016	0.011	0.028		0.011	0.008	0.019		0.012	0.008	0.020	
C. D. (0.05)	0.046	0.032	0.079		0.032	0.022	0.055		0.033	0.023	0.057	

Initial: Available Ca-2.8 (c mol (p+) kg^{-1} soil), Mg-1.8 (c mol(p+) kg^{-1} soil) and S-2.94 kg ha^{-1}

Conclusion

The experimental soil was acidic in reaction (pH 4.33) which was increased to 5.70 in T_6 in case, of T_2 it was 5.24 which indicated the importance of organic over inorganic. Which intern increase the organic content of soil and reduced the total soluble salts in post-harvest soil. Crop had removed more amount of nutrients from soil for growth and yield which led to depletion of nutrient status of post-harvest soil. The 100 % organic nitrogen treatment and organic-inorganic combination of treatments in post-harvest soil showed more available nutrient as compared to 100 % inorganic nitrogen treatment.

References

1. AOAC. Official methods of Analysis. Association of Official Agricultural Chemists (10th edition) Washington D.C, 1960.
2. Asik BB, Turan MA, Celik H, Katkat AV. Effect of Humic Substances to Dry Weight and Mineral Nutrients Uptake of Wheat on Saline Soil Conditions. Asian Journal of Crop Science. 2009; 1(2):87-95.
3. Bagal SD, Sheikh GA, Adsule RN. Influence of different levels of P and K fertilizers on the yield and quality of tomato. Journal of Maharastra Agriculture University. 1989; 14:158-160.
4. Bray RA, Kurtz LT. Determination of total, organic and available forms of phosphorus in soil, Soil Science. 1945; 59(1):39-45.
5. Chapman HD. Methods of Soil Analysis, Part-II, American Society of Agronomy, Inc. Wisconsin, USA, 1965, 891-900.
6. Chesnin L, Yien CH. Turbidimetric determination of available sulphur. Soil Science Society of America Proceedings. 1951; 15:149-151.
7. Crinò P, Lo Bianco C, Rouphael Y, Colla G, Saccardo F, Paratore A. Evaluation of rootstocks resistance to fusarium wilt and gummy stem blight and effect on yield and quality of a grafted inodorusmelon. Horticultural Science. 2007; 42:521-525.
8. Kumar V, Prasad RK. integrated effect of mineral fertilizers and green manure crop on crop yield and nutrient availability under rice-wheat cropping system in Calciorthents. Journal of Indian Society of Soil Science. 2008; 56:209-214.
9. Kumar V, Singh AK. Long term effect of green manuring and farmyard manure on yield and soil fertility status in rice-wheat cropping systems. Journal of Indian Society of Soil Science. 2010; 58:409-412.
10. Lee JM, Kubota C, Tsao S, Bie Z, Echevarria PH, Morra L, Oda M. Current status of vegetable grafting, Diffusion, grafting techniques, automation, Scientia Horticulturae. 2010; 127(2):93-105.
11. Najar IA, Khan AB. Management of Fresh Water Weeds (Macrophytes) by Vermicomposting Using *Eisenia foetida*, Environmental Science and Pollution Research. 2013; 20(9):6406-6417.
12. Page AL, Miller RH, Keeney DR. Methods of soil analysis- part 2. Chemical and microbiological properties, 2nd (Ed) No. 9, Agronomy series ASA-SSSA publishers, Madison Wisconsin, USA, 1982.
13. Piper CS. Soil and plant analysis. Academi Press, New York, 1950.
14. Proietti S, Rouphael Y, Colla G, Cardarelli M, Agazio M, Zacchini M *et al*. Fruit quality of mini watermelon as affected by grafting and irrigation regimes. J Sci. Food Agri. 2008; 88:1107-1114.
15. Rivard CL, O'Connell S, Peet M, Louws F. Grafting tomato with inter specific rootstock to manage diseases caused by *Sclerotium rolfsii* and southern root-knot nematode, Plant Disease. 2010a; 94(8):1015-1021.
16. Rouphael Y, Cardarelli M, Colla G, Rea E. Yield, mineral composition, water relations, and water use efficiency of grafted mini-watermelon plants under deficit irrigation. Horticultural Science. 2008b; 43(3):730-736.