International Journal of Chemical Studies 2019; 7(2): 1648-1651

International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(2): 1648-1651

Received: 08-01-2019
Accepted: 12-02-2019

Supriya UL
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga Karnataka, India

Ganapathi
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga Karnataka, India

Dinesh Kumar M
Department of Agronomy, College of Agriculture, Shivamogga, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Correspondence
Supriya UL
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga, Karnataka, India

Study on influence of subsurface fertigation on depth wise distribution of total NPK and inorganic fractions of nitrogen under sugarcane crop cover

Supriya UL, Ganapathi and Dinesh Kumar M

Abstract
A study on the influence of subsurface fertigation on total NPK and inorganic fractions of nitrogen of soil under sugarcane crop cover in Arsapura and Yellebethuru villages of Davangere district, Karnataka was carried out during 2015-16. The total nitrogen, phosphorus and potassium under selected subsurface fertigated farms showed decreasing trend with depth. The nitrate nitrogen under selected sugarcane subsurface fertigated farms varied with depth and was higher at 45-60 cm and lower at 0-15 cm depth. The ammonical nitrogen showed variation in depth but higher at 0-15 cm and lower at 45-60 cm and 60-75 cm under selected subsurface fertigated farms.

Keywords: Fertigation, total NPK, sugarcane

Introduction
Fertigation management begins with knowledge of the nutrient status of the soil. A proper method of application of nutrient and water should be able to minimize the amount of nutrient moving below the root zone. Among the nutrient managements subsurface fertigation is one which manage the nutrients efficiently. The method of fertilizer application is very important in obtaining optimal use so that the amount of fertilizer used by the plant and reduce the amount lost by leaching, volatilization etc. Water and nutrients acquisition by plants, and the formation of a depleted zone in the immediate vicinity of the roots are the driving forces for solute movement towards the roots (Silber *et al.,* 2003) [25]. High water use application efficiencies are often possible with drip irrigation, since there is reduced surface evaporation, less surface runoff, as well as minimal deep percolation (Jiusheng *et al.* 2003) [10]. Subsurface fertigation is an advanced production technique using in sugarcane to increase yield. The supply of fertilizers nutrients along with irrigation water through the drippers are installed in subsurface soil depth (below 15 cm depth), to increase the nutrients and water use efficiency and ultimately achieve the higher production in sugarcane crops. Since there is lack of research data on the movement and distribution of nutrients through subsurface fertigation in sugarcane, the study was conducted on “Effect of subsurface fertigation on total NPK and inorganic fractions of nitrogen in soil under sugarcane crop cover” in selected villages of Davangere district, Karnataka

Material and Methods
The Six farmers who were practicing subsurface fertigation in sugarcane crop for more than 2 years from Arsapura and Yellebethuru villages in Davangere district were selected. Sugarcane was grown in paired row system with recommended spacing of 180 cm (row to row) and lateral to lateral 150cm with Tunga canal water. The farmers were using CO-323 and CO–265 varieties of sugarcane crop irrigating one hour per acre per day. The application of 50 kg of Urea, 45 kg of 17-17-17 NPK, 45 kg of Diammoinum phosphate (DAP) and 40 kg of Sulphate of potash (SOP) fertilizer for each acre were used in three split for sub surface fertigation. Additional quantity of 6 kg of fertilizers was given at 15 days interval in solution forms. Farms were. Soil samples were collected from 0-15, 15-30, 30-45, 45-60 and 60- 75 cm soil depth. In each farm depth wise three soil samples (total 15) in one acre area from 15 cm distance from lateral to row were collected from both the villages after harvest of sugarcane. Total ninty soil samples were collected. Collected soil samples were analysed using standard procedure. Total nitrogen in soil was determined by Kjeldahl’s method as out lined by Page *et al.* (1982) [21].

Inorganic forms (exchangeable NH4+-N and NO3--N) of nitrogen were extracted from soil using 2 NKCl at 1:10 soil to KCl ratio and shaking for one hour. To determine exchangeable NH4+-N, an aliquat of 20 ml of above extract was steam distilled with MgO and the distillate collected in 4 percent boric acid containing mixed indicator was titrated against standard H2SO4. Weighed sample in the distillation flask treated with 1ml of sulfamic acid solution and swirl the flask for a few second to destroy NO2-N and a pinch of Devardas alloy was added to distillation flask and the distillation was continued. The amount of NO3-N was determined as described in exchangeable NH4+-N.

Total phosphorus and total potassium in soils was determined by digesting the samples with hydrofluoric acid in a closed vessel (Lim and Jackson, 1982) [14]. The concentration of phosphorus in the digested soil samples was determined by chlorostannous reduced molybdophosphoric acid blue colour in HCl system using spectrometric method (Jackson, 1973) [9]. The concentration of potassium in the digested soil samples was determined by flame photometer (Jackson, 1973) [9].

Results and Discussion

Total nitrogen

The total nitrogen content (Table 1 and 2) was higher at surface soil depth and gradually decreases with depth might be due to the accumulation of the sugarcane biomass, more mineralization and microbial activity at the surface layer. Saha *et al.* (2000) [23] reported that contents of total, available, ammoniacal and nitrate forms of nitrogen in the soil profiles decrease with depth; the maximum NO3-N, NH4- N concentration was found in upper soil profile was due to Biological processes including mineralization of organic N from soil organic matter, nitrification, denitrification, and immobilization of inorganic N by soil microbes and plant roots at higher rates in the upper soil layers. Total soil N was highest in the top 15 cm of the soil profile and decreased by approximately half below this layer (Jackson and Bloom, 1990) [8]. The higher concentration of total nitrogen in the upper layer may be due to the presence of immobilised N on the soil surface (Barbosa and Fearnside, 1996) [3] which is prone to microbial decomposition in soil in the subsequent layers (Gupta and Malik 1996; Maharudrappa *et al.,* 2000) [6, 16]. The decline in the total nitrogen along the depth in profile was may be due to the mineralisation process, stimulating N mobilisation in the plant-available form. The total N content of soils showed a wide variation between the depths. The soils from surface 0-10 cm layer always showed dominance over the soils from 10-20 cm depth. This variation in total N content between the depths is mainly associated with the variation in organic matter content between the layers (Khan *et al.,* 2006) [11].

Total phosphorus

The total phosphorus content of soil (Table 1 and 2) was decreasing trend with increasing depth, higher concentration of total phosphorus was higher at surface soil (0-15 cm) and lower at subsurface soil (60-75 cm) might be due to the lesser mobility at surface layer and less leaching loss because of plant uptake. Phosphorus was accumulated in the top 0-20 cm soil depth due to application of single super phosphate and higher P level in this depth is attributed to the low P mobility (Koenig, *et al.,* 2000) [12]. Greater P accumulation occurred in the surface (0-15 cm) layer in trickle irrigated potato in agreement with the expected slow movement of P in the soil (Papadopoulos, 1992) [22]. Salas *et al.* (2003) [24] also document the contribution of plant residues to the P concentration in soil.

Total potassium

The total potassium content of soil status under sugaracane subsurface fertigated farms are presented in Table 1 and 2. In all farms of Arsapura and Yellebethuru village, the total potassium content was found higher at surface soil (0-15 cm) and lower at subsurface layer, might be due to fine texture, higher organic matter content and less leaching. Similar findings were observed by Tripti Nayak *et al.* (2014) [26] they reported that higher amount of all K fraction for top layer than at sub surface (15-30 cm) and with lower at 30-60 cm soil depth. Higher availability of K in surface soil was also reported by Naik, 2014. As distance from dripper increases from 0 to 30 cm, the concentration of K2O decreased significantly. It was observed that as the growth of crop advances the K2O concentration tends to increase in lower soil depth (Neelam Patel *et al.,* 2015) [20]. David *et al.* (1999) [4] reported that soil K content was significantly higher in the surface soil than in the subsoil, suggesting that the majority of applied K was held in the surface soil and that downward movement was slow. The decrease in K fraction with increasing soil depth may be ascertained to application of potassic fertilizers (Dhaliwal *et al.,* 2004) [5] more intensive weathering (Mandal *et al.,* 2011) [17].

Depth wise distribution of inorganic fractions (NO3- N and NH4-N) of nitrogen under subsurface Fertigated sugarcane growing soils

NO3-N

The data on NO3-N content of soil under under selected sugaracane subsurface fertigated farms are presented in Table 1and 2. In farms 1 and 4 of Arsapura and Yellebethuru village, the NO3-N is higher at 30-45 cm. In farm 2 of Arsapura village, the NO3-N was higher at 60-75cm. In farm 3, 5 and 6 of Arsapura and Yellebethuru village, the NO3-N was higher at 45-60 cm, might be due to the leaching loss and negatively charged ion. Similar results were observed by Badr *et al.* (2012) [2] might be due to the more mobile at subsurface layer. Nitrate is very mobile in the soil and has a tendency to move away from the dripper to the periphery of the wetting front (Li *et al.,* 2003). Lincoln Zotarelli *et al.* (2008) [15] reported that surface drip treatment which reduced water percolation due to limited quantity of water and consequently maintained fertilizer in the root zone, which was reflected in the relatively higher amounts of ammonium and nitrate being retained in the root zone. Myrold (1987) [18] reported that NO3 was low mineralizable nitrogen at lower depth and immobilization by microbes.

NH4 –N

The data on available nitrogen content of soil values under selected sugaracane subsurface fertigated farms are presented in Table 1 and 2. In farms 1 and 5 of Arsapura and Yellebethuru village, the NH4-N was higher at a depth of 15-30cm. In farm 2, 3, 4 and 6, the NH4-N was higher at a depth of 0-15cm, might be due to the less mobility. Similarly, Badr and Abou el-yazied (2007) [1] reported that ammonium distribution was restricted to a volume with a radius of 15-20 cm around the water source. Beyond this range, ammonium concentration remained at the initial values because of the relatively quick nitrification and slow transport due to adsorption. Among the N forms NH4 form is less mobile in soil. The increase in NH4- N concentration immediately in the vicinity of the emitter is a consequence of the hydrolysis of urea, NH4-N is adsorbed by the soil matrix and therefore the maximum concentration changes are confined to the top layer and around the emitter (Haynes, 1985) [7].

Table 1: Depth wise distribution of nitrogen fractions under subsurface fertigated sugarcane growing soils in Arsapura village

Depth (cm)	NH4-N	NO3-N	Total N	Total P	Total K
	Kg ha^{-1}				
Farm 1					
0-15	13.24	23.11	500	150	3660
15-30	18.32	24.45	490	130	3130
30-45	16.55	34.12	490	110	3530
45-60	17.05	29.26	480	110	2950
60-75	12.52	24.81	440	70	2670
Farm 2					
0-15	20.98	29.02	500	250	3000
15-30	18.20	21.44	490	180	2960
30-45	20.26	30.45	450	190	2680
45-60	16.89	27.79	440	150	2720
60-75	12.32	34.58	390	110	2670
Farm 3					
0-15	15.19	20.26	520	340	3670
15-30	12.59	21.30	500	260	3440
30-45	13.72	23.42	490	220	3440
45-60	12.69	27.49	460	190	3420
60-75	12.37	20.72	380	170	3370

Table 2: Depth wise distribution of nitrogen fractions under subsurface fertigated sugarcane growing soils in Yellebethuru village

Depth (cm)	NH4-N	NO3-N	Total N	Total P	Total K
	Kg ha^{-1}				
Farm 1					
0-15	17.76	23.11	490	290	3920
15-30	17.05	24.67	450	260	3870
30-45	13.82	29.52	460	260	3750
45-60	11.61	28.26	450	270	3700
60-75	13.24	26.03	380	190	3600
Farm 2					
0-15	15.50	16.25	510	390	4200
15-30	19.40	20.85	500	310	3750
30-45	17.78	28.65	490	300	3630
45-60	15.03	33.36	480	240	3680
60-75	11.83	25.96	460	200	3570
Farm 3					
0-15	22.00	26.13	520	500	4180
15-30	21.30	28.54	480	310	3750
30-45	18.05	27.20	470	200	3690
45-60	16.58	34.32	460	200	3630
60-75	13.99	34.03	420	160	3470

Conclusion

An investigation carried out to study the effect of subsurface fertigation on depth wise distribution of total NPK and inorganic fractions of nitrogen showed that the total NPK followed decreasing trend with depth while the nitrate nitrogen under selected sugarcane subsurface fertigated farm varied with depth and was higher at 45-60 cm. The ammonical nitrogen showed variation in depth but higher at 0-15 cm under selected subsurface fertigated farms.

References

1. Badr MA, Abou El-Yazied AA. Effect of fertigation frequency from subsurface drip irrigation on tomato yield grown on sandy soil. Aust. J Basic & Appl. Sci. 2007; 1(3):279-285.
2. Badr MA, Shaymaa I, Shedeed, Abou Hussein SD. Tomato fruit yield and nitrogen use efficiency as affected by drip irrigation method and rate of nitrogen in a hot dry climate. J Appli. Sci. Res. 2012; 8(8):4486-4495.
3. Barbosa RI, Fearnside PM. Carbon nutrient flow in amazonian forest fine litter production and composition at Apiau, Roraina, Brazil. Trop. Ecol. 1996; 37(1):115-125.
4. David, Patrick H, BROWN, Brent Holtz A. Effects of potassium fertilization on soil potassium distribution and balance in pistachio orchards. Better Crops and Plant food. 1999; 3:10-12.
5. Dhaliwal AK, Gupta RK, Singh Y, Sharma BD, Singh B. Distribution of different forms of potassium in benchmark soil series under rice-wheat cropping system in Punjab. J Potassium Res. 2004; 20:12-21.
6. Gupta SR, Malik V. Soil ecology and sustainability. Trop. Ecol. 1996; 37(1):43-55.
7. Haynes RJ. Principles of fertilizer use for trickle irrigated crops. Fert. Res. 1985; 6:235-255.
8. Jackson LE, Bloom AJ. Root distribution in relation to soil nitrogen availability in field grown tomatoes. Plant and Soil. 1990; 128:115-126.
9. Jackson ML. Soil Chemical Analysis. Prentice-Hall Inc., Englewood Cliffs, New Jersy. 1973, 498.
10. Jiusheng L, Jianjun Z, Ren L. Water and nitrogen distribution as affected by fertigation of ammonium nitrate from a point source. Irrig. Sci. 2003; 22:19-30.
11. Khan MS, Abedin Mian MJ, Afrin Akhter, Khosruzzaman M. Physico-chemical changes of paddy soils under long-term intensive fertilization. Asian J Plant Sci. 2006; 5:105-111.
12. Koenig RT, Barnhill JV, Hursta CJ. Sampling depth effects on sodium bicarbonate (NaHCO3) extractable phosphorus and potassium and fertilizer recommendations. *Commun*. Soil Sci. Plant Anal. 2000; 31:375-386.
13. LI J, Zhang J, Ren L. Water and nitrogen distribution as affected by fertigation of ammonium nitrate from a point source. Irrig. Sci. 2003; 22:19-30.
14. Lim CH, Jackson I. Dssolution for total elemental analysis In: Methods of Soil Analysis Part-II. Chemical and Microbiological Properties. Ed. Page, A. L. American Soc. Agron. Inc., Soil Sci. Soc. Am., Madison, Wilsconsin, USA, 1982
15. Lincoln Zotarelli, Michael D, Dukes, Johannes M, Scholbergb, Travis Hanselmanc *et al*. Nitrogen and water use efficiency of zucchini squash for a plasticmulch bed system on a sandy soil. Scientia Horticulturae. 2008; 116:1-8.
16. Maharudrappa A, Srinivasamurthy CA, Nagaraja MS, Siddaramappa R, Anand HS. Decompositon rates of litter and nutrient release pattern in a tropical soil. J Indian Soc. Soil Sci. 2000; 48(1):92-97.
17. Mandal D, Dey SK, Baruah TC. Forms of potassium and their distribution in rubber growing soils of Tripura. Ann. Pl. Soil Res. 2011; 13(2):75-79.
18. Myrold DD. Relationship between microbial biomass nitrogen and a nitrogen availability index. Soil Sci. Soc. Am. J. 1987; 51:1047-1049.
19. Naik SK. Distribution of nitrogen, phosphorus, potassium and zinc content in mango grown in acidic soils of Jharkand. The Ecoscan, 2014; 8(1):135-139.

20. Neelam Patel, Rajput TBS, Mukesh. Fertigation scheduling in tomato based on the hydraulics and nutrients under point source of water application. Asian J Sci. Tech. 2015; 6(2):1141-1145.
21. Page AL, Miller RH, Kenay DR. Methods of Soil Analysis, Part 2. Soil Sci. Soc. Am. Inc. Madison, USA. 1982.
22. Papadopoulos I. Phosphorus fertigation of trickle-irrigated potato. Nutr. Cycl. Agroecosyst. 1992; 31:9-13.
23. Saha AK, Saha N, Pal SK. Distribution of organic carbon and nitrogen in some tarai soils of west Bengal. Agropedology. 2000; 10:132-138.
24. Salas AM, Elliott ET, Westfall DG, Cole CV, SIX J. The role of organic matter in phosphorus cycling. Soil Sci. Soc. Am. J. 2003; 67:181-189.
25. Silber A, XU G, Levkovitch I, Soriano S, Bilu A, Wallach R. High fertigation frequency: The effects on uptake of nutrients, water and plant growth. Plant Soil. 2003; 253:467-477.
26. Tripti Nayak RK, Bajpal, Vinay Bachkaya. Vertical distribution of potassium under organic and inorganic nutrient management in a vertisol planted to rice. The Ecoscan. 2014; 8(3&4):257-361.