Journal of Crop and Weed, 13(2): 25-29 (2017)

Studies on soil properties as affected by integrated nutrient management practice in different cultivars of local scented rice (*Oryza sativa* L.)

P. CHETTRI, D. MAITI AND [1]B. RIZAL

Department of Agronomy, [1]Department of Agricultural Chemicals and Soil Science
Bidhan Chandra Krishi Viswavidyalaya Mohanpur-741252, Nadia, West Bengal

Received : 15-01-2017 ; Revised : 22-08-2017 ; Accepted : 25-08-2017

ABSTRACT

Studies on soil health as influenced by integrated nutrient management practice in different cultivars of local scented rice was conducted at the C Block Farm of BCKV, Kalyani, West Bengal during the Kharif season of 2011 and 2012. The experiment was carried out in split plot design taking three cultivars of scented rice viz. Gobindabhog (V_1), Kalonunia (V_2) and Dehradoon (V_3) in the main plots and six levels of nutrient management viz. 25% Recommended NPK as Chemical Fertilizer + 75% Recommended NPK as Vermicompost (T_1), 50% Recommended NPK as Chemical Fertilizer + 50% Recommended NPK as Vermicompost (T_2), 75% Recommended NPK as Chemical Fertilizer + 25% Recommended NPK as Vermicompost (T_3), 100% Recommended NPK as Chemical Fertilizer (T_4), 100% Recommended NPK as Vermicompost (T_5) and Control (T_6) in the sub plots in all possible combinations replicated thrice. The BD, EC and pH decreased with incorporation of organics while organic C %, total N%, available P increased. Only the available K content recorded higher values with 100 per cent recommended NPK as chemical fertilizer (T_4).

Keywords: Local scented rice varieties**,** nutrient management, physico-chemical properties

During the last quarter of the 20th century, the scenario of Indian agriculture had changed dramatically with the introduction of "Green Revolution" and increased application of chemical fertilizers. Our vision was then clouded by short term gains. Intensive cultivation, growing of exhaustive crops, use of unbalanced and inadequate fertilizers accompanied by the restricted use of organic manures and bio-fertilizers has made soil not only deficient in nutrient but also deteriorated soil health. Dawe *et al*. (2000), reported that the decline in yield was found to be related to soil properties affected by prolonged soil wetness or soil nutrient depletion. So it is essential that the chemical sources of nutrients should be either complemented or supplemented with the organic sources. It has also been seen that neither the organic manures nor the mineral nutrients alone could achieve yield sustainability at high level under modern intensive farming. In this perspective the prime and foremost demand is Integrated Nutrient Management (INM), which would not only maintain higher productivity but also provide sustained stability of crop production (Nambiar and Abrol, 1989).

Integrated nutrient supply/management (INM) aims at maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of benefit from all possible sources of plant nutrients in an integrated manner (Roy and Ange, 1991). One of the most important challenges facing humanity today is to conserve/sustain natural resources, including soil and water, for increasing food production while protecting the environment. Several studies have emphasized on the role of Integrated Nutrient Management practices in increasing the yield of crops and sustaining soil health in the long run (Gogoi et al., 2010, Basumatry and Talukdar, 1998 and Mankotia, 2007). Keeping in view the importance of Integrated Nutrient Management in present day agriculture this investigation was carried out to study the soil health as affected by various nutrient management practices in different cultivars of local scented rice (*Oryza sativa* L.) in the New Alluvial Zone of West Bengal.

MATERIALS AND METHODS

A field experiment was conducted at 'C' Block Farm, Kalyani, BCKV, Nadia, West Bengal during the *Kharif* seasons of 2011 and 2012, to study the soil health as affected by various nutrient management practices under local scented rice cultivation in the New Alluvial Zone of West Bengal. The farm is situated at 23^0 N latitude and 89^0 E longitudes with an average altitude of 9.75 m above MSL. A total of 54 plots, each of size 3.5 x 4.5 m were taken. The experiment was laid out in split plot design taking three cultivars of scented rice *viz*. Gobindabhog (V_1), Kalonunia (V_2) and Dehradoon (V_3) in the main plots and six levels of nutrient management *viz.* 25% Recommended NPK as Chemical Fertilizer + 75% Recommended NPK as Vermicompost (T_1), 50% Recommended NPK as Chemical Fertilizer + 50% Recommended NPK as Vermicompost (T_2), 75% Recommended NPK as Chemical Fertilizer + 25% Recommended NPK as Vermicompost (T_3), 100% Recommended NPK as Chemical Fertilizer (T_4), 100% Recommended NPK as Vermicompost (T_5) and Control

Email: pronitaz@yahoo.co.in

(T_6) in the sub plots in all possible combinations replicated thrice. The recommended dose of fertiliser was 60: 30: 30 Kg ha^{-1} of N, P_2O_5 and K_2O in the form of Urea, single super phosphate and muriate of potash respectively. The Vermicompost contained 1.7% N, 1.1% P_2O_5 and 1.2% K_2O. Pre germinated seeds @ 40 Kg Ha^{-1} of the different scented rice cultivars were used. The 28 days old seedlings were then transplanted into the experimental field maintaining a spacing of 20 x 10cm.

The bulk density was determined in undisturbed core from two soil layers (0-15cm and 15-30cm). The samples were analysed for soil pH and EC in 1 : 2.5 ratio of soil and water suspension by using glass rod electrode pH meter and the direct reading conductivity meter (Model: Systronics, 363) respectively as described by Jackson (1973). The organic carbon content was determined according to the volumetric wet combustion method of Walkley and Black (1934) as described by Jackson (1973). The Kjeldahl method as described by Jackson (1973) was used to analyse the soil sample for total nitrogen content. Available phosphate content was determined according to Olsen's method as described by Jackson (1973) while the flame photometer method of Muhr *et al*. (1965) was used to determine the available potash content in the soil sample. Statistical analysis and interpretation of results was done as described by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Physico-chemical properties of soil

The data as presented in table 1. revealed that the bulk density (0-15 and 15-30cm) was affected significantly by the variety and nutrient management practices in both the years and in pooled data. The bulk density of both the surface layers and sub-surface layers recorded a lower value in the second year of conducting experiment as compared to the first year. In the surface layer the variety Gobindabhog (V_1) and Kalonunia (V_2) were *at par* with each other while in the sub-surface layer the variety Gobindabhog (V_1) recorded the highest BD. Among the nutrient management practices the control treatment (T_6) wherein no nutrients were supplied recorded highest BD values for both years as well as pooled data which was in confirmation with Gogoi *et al*. (2015). The lowest value of bulk density was recorded with sole organic treatment (T_5) followed by T_1 (25% RDF+75% VC) and they differed significantly from each other. This may be attributed to the increase in the volume of soil as a result of increased porosity due to addition of organic manures. Similar conclusion was also reached by Santhy *et al*. (1999). It was seen that as the amount of nutrients being supplied inorganically increased the bulk density also went on increasing as also reported by Aziz *et al*. (2012). The same trend was followed in the sub-surface layer as well. The effect of varietal treatments, levels and sources of nutrient management on the electrical conductivity (EC) was found to be significant in 2010, 2011 and the pooled data (Table 1.). Except in 2010 where the varietal treatment Gobindabhog (V_1) recorded the highest value, all the varietal treatments recorded values that were statistically *at par* with each other. The sole organic treatment (T_5) recorded the lowest value of electrical conductivity in both the years and in pooled data. Similar decrease in EC was also reported by Walia *et al*. (2010), while the sole inorganic treatment (T_4) recorded the highest value of EC (Aziz *et al*., 2012). The pH of the soil was measured both before and after the experiment. The results presented in table-1 indicate that the pH of the soil remained almost same or reduced slightly after the experiment. The effect of varietal treatments was found to be non-significant on the soil reaction however the nutrient management treatments had a significant effect on the pH of the soil. The treatments supplying major portion of recommended NPK in organic form had lower pH compared to the inorganic treatments in both years of experiment and in pooled data. The highest value of pH was recorded with sole inorganic treatment (T_4). Zende (1968) and Gawai (2003), also reported decrease in pH with addition of organic manures which might be due to the release of organic acids during the decomposition of the organic manures.

Nutrient status of soil

The data pertaining to the effect of variety and nutrient management practices on the nutrient status of soil are presented in table 2. The effect of the different treatments on the organic carbon content in soil after the harvesting was found to be significant in the two years as well as in the pooled data. The variety Gobindabhog (V_1) recorded the highest OC%. The treatment receiving sole organic treatment (T_5) recorded the highest organic carbon content. It was noted that the organic carbon status of the soil improved as compared to the initial value in all the treatments except in the sole inorganic (T_4) and in control (T_6) which was in confirmation with Banswasi and Bajpai (2006) and Gogoi *et al*. (2015) . The increase in organic carbon with the addition of organic manures was attributed to the carbonaceous nature of organic manures and also the increase in microbial activity in the soil. The total nitrogen was affected significantly by the varietal treatments in the pooled data and in both the years and pooled data by the various nutrient management practices (Table 2.). All the varietal treatments were statistically *at par* with each other. It was noted that the treatments having sole organic or combination of organics and

Table 1: Effect of variety and nutrient management on the physico-chemical properties of soil

Treatment	BD(0-15cm) g cc^{-1}			BD(15-30cm) g cc^{-1}			pH			EC(dsm m^{-1})		
	Initial: 1.52			Initial: 1.61			Initial: 7.54			Initial: 0.174		
	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled
Variety(V)												
V_1: Gobindabhog	1.55	1.52	1.53	1.57	1.56	1.57	7.27	7.23	7.25	0.17	0.18	0.17
V_2: Kalonunia	1.55	1.52	1.53	1.56	1.54	1.55	7.28	7.24	7.26	0.16	0.18	0.17
V_3: Dehradoon	1.53	1.51	1.52	1.56	1.55	1.55	7.27	7.23	7.25	0.16	0.18	0.17
SEm(±)	**0.001**	**0.001**	**0.001**	**0.004**	**0.002**	**0.002**	**0.006**	**0.005**	**0.004**	**0.000**	**0.000**	**0.000**
LSD (0.05)	**0.005**	**0.003**	**0.002**	**NS**	**0.008**	**0.007**	**NS**	**NS**	**NS**	**0.001**	**0.001**	**0.001**
Nutrient management(t)												
T_1: 25% RDF+75% VC	1.52	1.48	1.50	1.54	1.53	1.53	7.16	7.13	7.14	0.16	0.17	0.17
T_2: 50% RDF+50%VC	1.54	1.51	1.53	1.55	1.54	1.55	7.22	7.17	7.19	0.17	0.18	0.17
T_3: 75% RDF+25%VC	1.56	1.52	1.54	1.58	1.56	1.57	7.39	7.36	7.37	0.17	0.19	0.18
T_4: 100% RDF	1.57	1.54	1.56	1.60	1.57	1.59	7.42	7.39	7.40	0.18	0.22	0.20
T_5: 100% VC	1.49	1.47	1.48	1.53	1.51	1.52	7.09	7.04	7.06	0.15	0.15	0.15
T_6: Control	1.58	1.57	1.58	1.60	1.59	1.59	7.36	7.30	7.33	0.16	0.16	0.16
SEm(±)	**0.003**	**0.003**	**0.002**	**0.003**	**0.003**	**0.002**	**0.006**	**0.004**	**0.003**	**0.000**	**0.000**	**0.000**
LSD (0.05)	**0.010**	**0.010**	**0.007**	**0.009**	**0.010**	**0.006**	**0.017**	**0.011**	**0.010**	**0.001**	**0.001**	**0.001**

Table 2: Effect of variety and nutrient management on the nutrient status of soil

Treatment	Total N (%)			Available P(kg ha^{-1})			Available K(kg ha^{-1})			Organic carbon(%)		
	Initial: 0.051			Initial: 13.1			Initial: 168.4			Initial: 0.49		
	1st Year	2nd Year	Pooled	1st year	2nd Year	Pooled	1st Year	2nd Year	Pooled	1st Year	2nd Year	Pooled
Variety(v)												
V_1: Gobindabhog	0.06	0.06	0.06	17.04	17.19	17.11	163.84	162.56	163.20	0.60	0.60	0.60
V_2: Kalonunia	0.06	0.06	0.06	16.75	16.88	16.81	162.39	161.19	161.79	0.58	0.58	0.58
V_3: Dehradoon	0.06	0.06	0.06	16.57	16.72	16.65	160.79	158.42	159.61	0.57	0.57	0.57
SEm(±)	**0.001**	**0.001**	**0.000**	**0.023**	**0.017**	**0.014**	**0.125**	**0.173**	**0.107**	**0.001**	**0.002**	**0.001**
LSD(0.05)	**NS**	**NS**	**0.002**	**0.091**	**0.068**	**0.047**	**0.492**	**0.677**	**0.348**	**0.006**	**0.008**	**0.004**
Nutrient management(t)												
T_1: 25% RDF+75% VC	0.06	0.06	0.06	17.35	17.67	17.51	164.12	163.09	163.61	0.70	0.71	0.70
T_2: 50% RDF+50%VC	0.07	0.07	0.07	18.19	18.34	18.26	165.73	164.80	165.27	0.67	0.66	0.66
T_3: 75% RDF+25%VC	0.06	0.06	0.06	17.55	17.67	17.61	166.70	164.67	165.68	0.51	0.49	0.50
T_4: 100% RDF	0.05	0.05	0.05	16.80	16.81	16.81	168.34	164.37	166.36	0.43	0.42	0.43
T_5: 100% VC	0.06	0.06	0.06	17.86	18.23	18.05	161.54	162.29	161.92	0.71	0.74	0.72
T_6: Control	0.05	0.05	0.05	12.96	12.85	12.91	147.59	145.12	146.36	0.48	0.47	0.48
SEm(±)	**0.001**	**0.001**	**0.000**	**0.025**	**0.032**	**0.020**	**0.116**	**0.170**	**0.103**	**0.003**	**0.004**	**0.003**
LSD(0.05)	**0.002**	**0.002**	**0.001**	**0.072**	**0.093**	**0.058**	**0.334**	**0.490**	**0.291**	**0.009**	**0.011**	**0.007**

inorganics had higher total nitrogen than the initial value as well as the sole inorganic treatment (T_4) and control (T_6). The findings were in confirmation with Islam et al. (2013) and Singh *et al*. (2001). The increase in the nitrogen content might be due to release of nitrogen after decomposition of organics and direct addition through vermicompost to the pool of soil. Moreover, it could also be attributed to the greater multiplication of soil microbes, which could convert organically bound nitrogen into inorganic form (Bhardwaj and Omanwar, 1994). It can be seen clearly from the data presented in table 2. that the available soil phosphorus after the harvest of rice was significantly influenced by the different treatments during the two years as well as in pooled data. The highest value of available soil phosphorus was recorded in the varietal treatment Gobindabhog (V_1) irrespective of the years as well as pooled data followed by Kalonunia (V_2). The sole inorganic nutrient management, T_4 had low available phosphorus which was higher than the control only (T_6) where no nutrient management was done. The highest value of available soil phosphorus was recorded with the treatment combining 50 per centorganic and 50 per cent inorganic nutrient management (T_2) followed by sole organic treatment (T_5) as also reported by Gogoi *et al*. (2015) and Gudadhe *et al*. (2015). The more build up in available N and P is attributed to the solubilization of nutrients from their native sources during the decomposition process and mineralization of organic manures (Sharma *et al*. 2001 and Swarup, 1993). It has been shown that organic material forms a cover on sesquioxide and thus reduces the phosphorus fixing capacity of soil. The available potassium in the soil after the harvest of rice was significantly affected by the various treatments implemented in the experiment (Table 2.). The highest available soil potassium was recorded in the varietal treatment Gobindabhog (V_1) followed by Kalonunia (V_2) in both the years and in the pooled data. The sole inorganic treatment (T_4) had the highest available potassium in the 1st year and in the pooled data and it differed significantly from the other treatments. However, in the 2nd year the sole inorganic treatment (T_4) was statistically at par with T_2 and T_3 treatments which combined organic and inorganic nutrient management practices. The lowest value of available potassium was recorded in the control treatment (T_6).

It may thus be concluded from the results obtained that the integration of organic manures (in this case vermicompost) with chemical fertilsers was preferred as it helped in maintaining as well as improving the soil health in terms of both the physico-chemical (BD, EC, pH) as well as the nutrient status (organic carbon status, total nitrogen and available phosphorus).

REFERENCES

Aziz, M.A., Amees,T., Aezum, Mahdi, Sheeraz S. and Ali, T. 2012. Effect of integrated nutrient management on soil physical properties using soybean (*Glycine max* (L.). Merill) as indicator crop under temperate conditions. *Int. J. Curr. Res.*, **4**: 203-07.

Banswai, R. and Bajpai, R. K. 2006. Influence of organic and inorganic fertilizer sources on soil fertility, yield and nutrient uptake by wheat crop in a rice-wheat cropping system. *J. Soils Crops*, **16**: 300-04.

Basumatry, A. and Talukdar, M. C. 1998. Long term effect of integrated nutrient supply system on soil properties in an *Inceptisol* of Assam. *Oryza*, **35**: 43-46.

Bhardwaj, V. and Omanwar, P. K. 1994. Long-term effect of continuous rotational cropping and fertilization on E.C, pH, organic matter and available nutrients of soils. *J. Indian Soc. Soil Sci*., **42**: 387-92.

Dawe, D., Daberman, A., Moya, P., Abdulrahaman, S., Singh, B., Lal, P., Li, S.L., Panaullah, G., Sariam, O., Singh, Y., Swarup, A., Tan, P.S. and Zhen, Q.X. 2000. How widespread are yield declines in long term rice experiment in Asia. *Field Crops Res*., **66**: 175-93.

Gawai, P. P., Effect of integrated nutrient management system in sorghum-chickpea cropping sequence. *Ph. D. Thesis* MPKV, Rahuri (M.S.) pp. 167.

Gogoi, B., Barua, N.G. and Baruah, T.C. 2010. Effect of integrated nutrient management on growth, yield of crops and availability of nutrients in inceptisol under rainfed rice (*Oryza sativa*)- niger (*Guizotia abyssinica*) sequence of Assam. *Indian J. Agric. Sci.*, **80**: 56-60 .

Gogoi, B., Kalita, B., Deori, B. and Paul, S.K. 2015. Soil properties under rainfed rice (*Oryza sativa*) crop as affected by integrated supply of nutrients. *Int. J Ag. Innovations Res.*, **3** (4).

Gudadhe, N., Dhonde, M.B. and Hirwe, N.A.2015.: Effect of integrated nutrient management on soil properties under cotton-chickpea cropping sequence in vertisols of Deccan plateau of India. *Indian J. Agric. Res*., **49**(3): 207-14 .

Islam, M.R., Chowdhury, M.A.H., Saha, B.K. and Hasan, M.M. 2013. Integrated nutrient on soil fertility, growth and yield of tomato. *J. Bangladesh Agril. Univ*., **11**(1): 33-40.

Jackson, M.L. 1973. *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd., New Delhi.

Mankotia, B.S. 2007. Effect of fertilizer application with farmyard manure and in-situ green manures in standing rice (*Oryza sativa*)- wheat (*Triticum* *aestivam*) cropping system. *Indian J. Agril. Sci.*, **77**: 512-15.

Muhr, G. R., and Dutta, N. P.1965. Sankar Subramoney, H., Laley, V.K. and Donahue, R.L. *Soil testing in India*. U.S.A. for International Development Mission to India. New Delhi, pp. 299-11.

Nambiar, K. K. M. and Abrol, I. P. 1989. Long term fertilizer experiments in India- an overview. *Fert. News*, **34**(4): 11-20.

Panse, V.G. and Sukhatme, P.V. 1978. *Statistical Methods for Agricultural Workers*, Indian Council of Agril. Res. India, **8** : 65.

Roy, R.N. and Ange, A.L. 1991. Integrated plant nutrient systems (IPNS) and sustainable agriculture. *Proc. FAI Ann. Sem.*, FAI, New Delhi, pp SV/1-1/1/1-12 .

Santhy, P., Velusamy, M.S., Murryappan, V. and Selvi D. 1999. Effect of inorganic fertilizers and fertilizer manure combination on soil physico-chemical properties and dynamics of microbial biomass in an inceptisol. *J. Indian Soc. of Soil Sci.*, **37**(3) : 379-82.

Sharma, M.P., Bali, S.V. and Gupta, D.K. 2001. Soil fertility and productivity of rice-wheat cropping system in an inceptisol as influenced by integrated nutrient management. *Indian J. of Agric. Sci.*, **71**: 82-86.

Singh, S.K., Verma, S. C. and Singh, R. P.2001. Effect of integrated nutrient management on yield, nutrient uptake and changes in soil fertility under rice (*Oryza sativa*)- lentil (*Lens culinaris*) cropping system. *Indian J. Agron*., **36**(2): 191-97.

Swarup, A. 1993. Integrated nutrient supply and management system for sustained crop production in alkali soils. *Fert. News.* **38**(9) : 27-34.

Walia, M.K., Walia, S.S. and Dhaliwal, S.S. 2010. Long term effect of integrated nutrient management of properties of Typic Ustochrept after 23 cycles of an irrigated rice-wheat system. *J. Sustainable Agric.*, **33:**723-33.

Walkley, A. and Black, C.A. 1934 : An examination of wet acid method for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Sci.* **37**: 29-38.

Zende, G.K. 1968. *Improvement of Saline and Alkali Soils in Maharashtra*. Res. Bull. 13. Department of Agriculture, Maharashtra.