International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 2709-2712

Received: 11-01-2018
Accepted: 14-02-2018

Nilotpal Hazarika
Department of Agronomy, Assam Agricultural University, Jorhat, Assam, India

Mohan Kumar Sarmah
Department of Agronomy, Assam Agricultural University, Jorhat, Assam, India

Anjali Basumatary
Department of Soil Science, Assam Agricultural University, Jorhat, Assam, India

Rituparna Saikia
Department of Soil Science, Assam Agricultural University, Jorhat, Assam, India

Correspondence
Nilotpal Hazarika
Department of Agronomy, Assam Agricultural University, Jorhat, Assam, India

Soil chemical properties as influenced by tillage and nutrient management practices after growing direct seeded sali rice

Nilotpal Hazarika, Mohan Kumar Sarmah, Anjali Basumatary and Rituparna Saikia

Abstract
A field experiment was carried out during 2016 at the Instructional-cum-Research (ICR) farm, Assam Agricultural University, Jorhat. The experiment was laid out in a split-plot design with three replications. The experiment included the possible combinations of three tillage practices in main plots viz., minimum tillage (T_1), zero tillage with non-selective herbicide (Glyphosate) (T_2) and conventional tillage (T_3) along with sources of nutrient - recommended doses of fertilizer (F_1) 60:20:40 N:P_2O_5:K_2O kg/ha, 50% N replacement through Vermicompost + 50% RDF of N and full RDF of P_2O_5 and K_2O (F_2) and 50% N replacement through Enriched compost + 50% RDF of N and full RDF of P_2O_5 and K_2O (F_3) in sub plots. The results revealed that the highest available N, P_2O_5 and K_2O in soil were found in zero tillage which was significant to minimum tillage and conventional tillage. Among the nutrient management practices, 50% N replacement through Enriched compost +50% RDF of N and full RDF of P_2O_5 and K_2O recorded significant effect of available N, P_2O_5 and K_2O content in soil.

Keywords: Direct seeded rice, conventional tillage, minimum tillage, zero tillage, enriched compost, vermicompost

Introduction
Nitrogen fertilization accounts for a large percentage of inputs for rice production. Nitrogen is dynamic in nature and it must be managed appropriately to provide the greatest economic return. Continuous use of chemical fertilizer alone creates various problems to environment. Hence integrated nutrient management is adapted to minimize deterioration of soil, water and ecosystem and improves the physical, chemical and biological functioning of soil. Integrated nutrient management is ecologically, socially and economically viable and environment friendly. Tillage systems influences physical, chemical and biological properties of soil and have a major impact on soil productivity and sustainability. Appropriate tillage practices avoids the degradation of soil properties but maintains crop yields as well as ecosystem stability. Conservation tillage provides the best opportunity for halting degradation and for restoring and improving soil productivity.

Materials and Methods
The experiment was carried out during kharif season of 2016 in the Instructional-cum Research (ICR) Farm of Assam Agricultural University, Jorhat. A well-drained medium land was selected for carrying out the experiment. The soil was sandy loam in texture, acidic in reaction. The experiment was laid out in split plot design with three replications. The experiment included the possible combinations of 3 tillage practices viz., Minimum tillage, Zero tillage with non-selective herbicide (Glyphosate) and Conventional tillage in the main plots and source of nutrients viz., recommended doses of fertilizer (RDF), 50% N replacement through Vermicompost + 50% RDF of N and full RDF of P_2O_5 and K_2O and 50% N replacement through Enriched compost + 50% RDF of N and full RDF of P_2O_5 and K_2O in the sub plots. Recommended doses of fertilizer 60:20:40 as N: P_2O_5: K_2O in kg/ha were applied in the form of Urea, SSP and MOP, respectively to the rice crop as per treatment. Vermicompost and Enriched compost were applied in the respective treatments. Required quantities of Nitrogen, Phosphorus and potassium through Urea (46% N), Single Super Phosphate (16% P_2O_5) and Muriate of Potash (60% K_2O) were applied as basal application in combination with

Vermicompost and Enriched compost. For RDF, Nitrogen was applied in 3 split doses i.e., ½ of N was applied in final land preparation, ¼ at active tillering stage and remaining ¼ at panicle initiation stage. All the phosphatic and potassic fertilizers were applied well ahead of sowing. The crop was harvested at maturity on 20 Oct, 2016. The physico-chemical characteristics of the experimental site is given in table 1:

Table 1: Physico-chemical characteristics of the experimental site

Soil properties	Value	Textural class/rating	Method adopted
A. Mechanical analysis			
Sand (%)	65.10	Sandy loam	International Pipette Method as described by Khana and Yadav (1979) [1]
Silt (%)	18.45		
Clay (%)	16.45		
B. Chemical analysis			
pH	5.3	Acidic	Glass Electrode Method as described by Jackson (1973) [2]
Available N (kg/ha)	302.36	Medium	Kjeldahl Method as described by Jackson (1973) [2]
Available P_2O_5 (kg/ha)	25.32	Medium	Bray's I Method as described by Jackson (1973) [2]
Available K_2O (kg/ha)	120.23	Low	Extraction with neutral normal ammonium acetate and flame photo-metric method as described by Jackson (1973) [2]

Results and Discussion

Nutrient uptakes by plant

Nutrient uptake by plant as influenced by different tillage practices were found to be significant. The total N, P, K uptake by rice in conventional tillage (T_3) treatment recorded the highest uptake of 137.33 kg ha^{-1}, 26.79 kg ha^{-1} and 111.25 kg ha^{-1} respectively which was significant to minimum tillage (T_1) and zero tillage (T_2). The lowest uptake of N, P, K were found on zero tillage (T_2) that recorded 85.27 kg/ha, 15.29 kg/ha and 70.55 kg/ha respectively. This might be due to the tillage operation which improves the physical condition by manipulating and pulverization of the soil that provides suitable environment to the germinating seeds and emerging seedlings, supplies free oxygen and availability of soil moisture and essential nutrients to plants. These results are in consistence with that of the findings of Arora *et al.* (1991) [3].

Significantly higher uptake of nutrients were recorded with the application of 50% N replacement through enriched compost + 50% RDF of N and full RDF of P_2O_5 and K_2O. This might be due to enriched compost that provide more available nutrient and favourable environment which also increased its absorption and improved the concentration of nutrient in plants. Application of fertilizers in combination with organic sources improved various physic-chemical properties resulting in enhanced nutrient absorption or uptake. Similar results were also reported by Pandey *et al*. (2007) [4].

Available N, P_2O_5 and K_2O content in soil after harvest

The effect of different tillage practices on available nutrient content in soil was found to be significant (Table 3). However, higher available N, P_2O_5 and K_2O were found in zero tillage treatment which were 274.11 kg/ha, 27.29 kg/ha and 134.16 kg/ha respectively and was statistically significant as compared to other tillage practices. This might be due to the less uptake of the nutrients by rice crop in zero tillage treatment which might have left a higher residual value compared to other tillage practices. Ali *et al.* (2006) [5] recorded the lowest value of soil N, P, K in conventional till plots and it could be due to the inversion of top soil during ploughing which shifts less fertile subsoil to the surface in addition to possible leaching.

Significant difference in available nitrogen content was observed due to different sources of nutrient. Higher available soil nitrogen (273.99 kg/ha) was recorded in 50% N replacement through enriched compost + 50% RDF of N and full RDF of P_2O_5 and K_2O which was significant to 50% N replacement through Vermicompost+50% RDF of N and full RDF of P_2O_5 and K_2O(271.93 kg/ha) and RDF (270.25 kg/ha). The availability of nitrogen in soil might be due to its direct addition and slow release of the nutrient through organic manures as observed by Kumari *et al*. (2010) [6].

Significant variation in available phosphate content was recorded due to application of different sources of nutrient. Application of 50% N replacement through enriched compost + 50% RDF of N and full RDF of P_2O_5 and K_2O recorded the highest P_2O_5 content in soil (26.85 kg/ha) which was significant to 50% N replacement through vermicompost + 50% RDF of N and full RDF of P_2O_5 and K_2O. The lowest P_2O_5 was observed in RDF. The increase in available phosphorus might be due to the organic acid, which were released during microbial decomposition of organic matter and help in solubility of native phosphates and as a result of increase in phosphorus was recorded. Addition of Azospirillum and PSB acted in combination to qualify enriched compost to the best for improving soil chemical properties. Similar results were also reported by Laxminarayan and Patiram (2006) [7].

Significant difference in available potassium was recorded due to different sources of nutrient. Application of 50% N replacement through enriched compost + 50% RDF of N and full RDF of P_2O_5 and K_2O recorded the highest K_2O content in soil (134.24 kg/ha) which was significant to 50% N replacement through Vermicompost + 50% RDF of N and full RDF of P_2O_5 and K_2O. The lowest K_2O was observed in RDF. The higher availability of potassium in soil may be due to beneficial effect of organic manures on the reduction of potassium fixation and release potassium due to interaction of organic with clay. Similar results were reported by Reddy and Reddy (1998) [8] and Das *et al*. (2004) [9].

Table 2: Effect of tillage (T) and sources of nutrient (F) on total uptake of N, P and K (kg/ha) of rice

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
Tillage (T)			
T_1	122.87	23.51	99.74
T_2	85.27	15.29	70.55
T_3	137.33	26.79	111.25

S.Ed(±)	2.03	0.72	1.63
CD(0.05)	5.79	2.07	4.66
Sources of nutrient (F)			
F_1	106.66	19.64	86.92
F_2	114.12	21.57	92.79
F_3	125.27	24.38	101.82
S.Ed(±)	3.09	1.01	3.01
CD (0.05)	6.80	2.22	6.63
Interaction	NS	NS	NS

NS= Non-significant

Table 3: Effect of tillage (T) and sources of nutrient (F) on available N, P_2O_5 and K_2O content in soil after harvest of rice

Treatments	Available N (kg/ha)	Available P_2O_5(kg/ha)	Available K_2O(kg/ha)
Tillage (T)			
T_1	272.04	26.73	132.47
T_2	274.11	27.29	134.16
T_3	270.02	25.64	131.23
S.Ed(±)	0.41	0.13	0.57
CD (0.05)	1.17	0.37	1.61
Sources of nutrient (F)			
F_1	270.25	26.35	130.62
F_2	271.93	26.47	132.99
F_3	273.99	26.85	134.24
S.Ed (±)	0.90	0.13	1.31
CD (0.05)	1.99	0.28	2.88
Interaction	NS	NS	NS

NS= Non-significant

Principal component analysis

The biplot (Fig 1) shows the position of the assayed variables and the treatments in the factorial space defined by two PCs. All the variables significantly contributed to PC1. PC1 and PC2 explain 100% variability of the dataset. PC1 clearly separated T_2 treatment from T_1 and T_3 treatment in the factorial space (Fig 1a). T_3 and T_1 treatment had greater effect on N, P and K uptake than T_2 treatment. But available N, P and K was higher under T_2 treatment. F_3 treatment was clearly separated by PC1 from F_1 and F_2 treatment in the factorial space (Fig 1b). All the variables are related to F_3 treatment than F_1 and F_2 treatments.

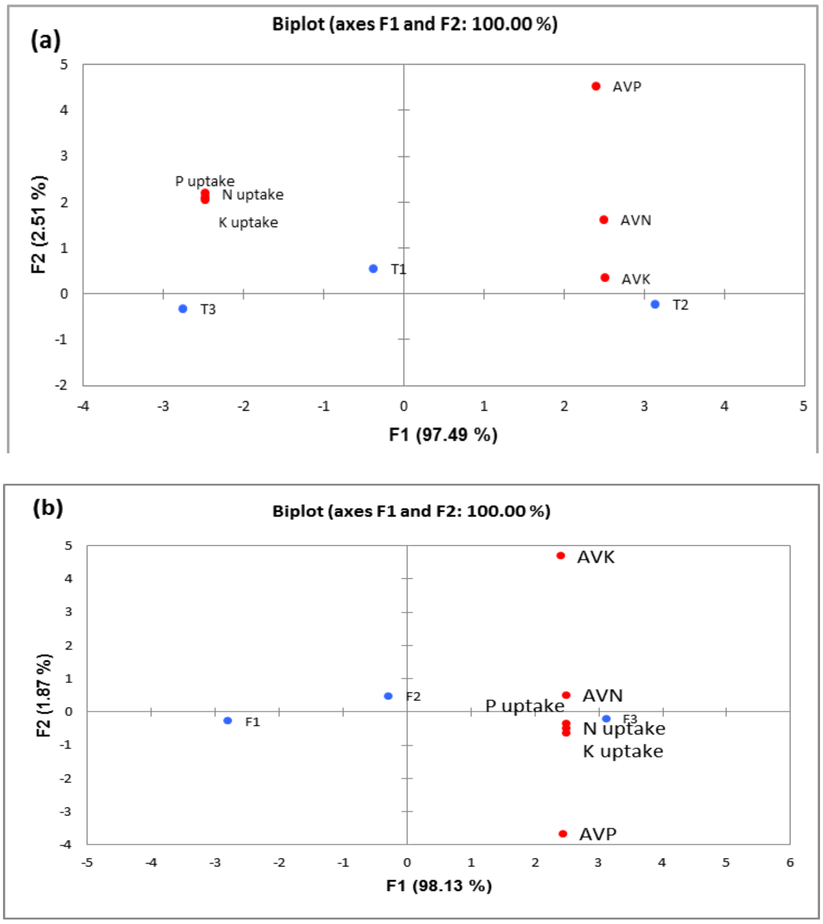

Fig 1: Principal component analysis of the assayed variables

Conclusions

From the present investigation it was observed that out of three tillage practices, zero tillage recorded the higher available N, P_2O_5 and K_2O as compared to conventional tillage and minimum tillage. Among the sources of nutrient F_3(50% N replacement through Enriched compost+ 50% RDF of N and full RDF of P_2O_5 and K_2O) was found to be the best suitable combination of organic and inorganic sources of nutrient in respect of available N, P_2O_5 and K_2O content in soil.

References

1. Khana SS, Yadav DV. Practical manual for introductory courses in soil. Pub. Director of Pub. HAV, Hisar, 1979.
2. Jackson ML. Soil chemical analysis. Pub. Prentice Hall of India Pvt. Ltd. New Delhi, 1973.
3. Arora VK, Gajra PR, Prihar SS. Tillage effect on corn in sandy soil in relation to water retentivity, nutrient and water management and seasonal evaporability. Soil Till. Res. 1991; 21:1-21.
4. Pandey N, Verma AK, Tripathi RS. Integrated nutrient management in transplanted hybrid rice (*Oryza sativa* L.). Indian J Agron. 2007; 52(1):40-42.
5. Ali A, Ayuba SA, Ojeniyi SO. Effect of tillage and fertilizer on soil chemical properties, leaf nutrient content and yield of soyabean in the Guinea savanna zone of Nigeria. Nigerian Journal of Soil Science. 2006; 16:126-130.
6. Kumari N, Singh A, Pal SK, Thakur R. Effect of organic nutrient management on yield, nutrient uptake and nutrient balance sheet in scented rice (*Oryza sativa* L.). Indian J Agron. 2010; 55(3):220-223.
7. Laxminarayan K, Patiram. Effect of integrated use of inorganic, biological and organic manures on rice productivity and soil fertility in Ultisols of Mizoram. J Indian Soc. Soil Sci. 2006; 54(2):213-22.
8. Reddy BG, Reddy MS. Effect of organic manures and nitrogen levels on soil available nutrient status in maize-soybean cropping system. J Indian Soc. Soil Sci. 1998; 46(3):474-476.
9. Das A, Prasad M, Gautam RC. Residual effect of organic and inorganic sources of nitrogen applied to cotton on succeeding wheat. Indian J Agron. 2004; 49(3):143-146.