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Effect of nutrients on soil properties under wheat-poplar based agroforestry system in tarai region of Uttarakhand

S. Das . M. Singh . Vineeta . G. Shukla

Agroforestry Section, Department of Agronomy, GBPUA&T, Pantnagar, Uttarakhand; Department of Forestry, UBKV, Cooch Behar, West Bengal

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ABSTRACT

A field experiment was conducted during rabi season of the year 2016-17 at Experimental site of Agroforestry Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand to study the effect of different nutrients based modules on soil properties (soil pH, soil EC, soil organic carbon, soil available nitrogen, phosphorus and potassium) after the harvesting the wheat crop under five years old poplar based agroforestry system. The study revealed that there was no effect of nutrient management modules on soil EC. Although the soil pH, soil available nitrogen, phosphorus, potassium and organic carbon was found to be non-significant before sowing of crop but a drastic reduction in soil pH after harvest was found out from treatment T7. After the harvesting of crop the available nitrogen, phosphorus and potassium found to be substantially different. After the harvesting of crop, available soil nitrogen was maximum (117.6 kg/ha) in T2 while it was maximum (217.77 kg/ha) in T6 before the sowing of crop. Maximum reduction of phosphorus was found in T6. The highest (14.38 kg/ha) phosphorus was remained after harvesting of crop in T2. Soil available potassium found less (68.87 kg/ha) in treatment T7and soil organic carbon after harvest found to be non-significant but a considerable increase observed in treatment T7 and T6.

1. Introduction

Mineral fertilizers have significant effects on food production in the world, and are an indispensable component of today's agriculture. It is an expensive commodity and estimates shows that a 50% increase in agricultural production is brought about through chemical fertilizers. Its nutrient input into the soil gets higher crop productivity, but over reliance on chemical fertilizers decreases some of the soil properties and crop yields over time. An integrated use of organic manures with inorganic fertilizers is a sustainable approach for efficient nutrient usage which enhances efficiency of the chemical fertilizers while reducing nutrient losses. Integrated Soil Fertility Management (ISFM) has been increasingly adopted by the research and development community as a framework for boosting crop productivity with minimal environmental impacts. Woody perennial based production systems has the great potential to combat the problem of nutrient deficiency in soil and the incorporation of trees and crops that are able to biologically fix nitrogen is fairly common in tropical agroforestry systems. Non N-fixing trees can also enhance soil physical, chemical and biological properties by adding a significant amount of above and belowground organic matter and releasing and recycling nutrients in agroforestry systems. Agroforestry systems not only arrest land degradation but also improve site productivity through interactions among trees, soil, crops, and livestock4-5. This is the most important way to practice agriculture without deteriorating agro-diseases and environmental degradation is highly appreciable. Ancient farmers used to rely on organic manures for crop production but swift economic development in whole the globe has led the farmers to use mineral fertilizers as they are more economical, affordable, easy to use and quick in response. However, their intensiveapplication is leading to land degradation, deteriorated soil health and leaching of nutrients into the underground water thereby posing environmental risks to human and animal health. So, there is a need to draw a mid-way between organic and inorganic extremities that may sustain crop yields without deteriorating soil fertility and/or productivity. Keeping all these aspects in consideration, the present study was therefore conducted to evaluate the effects of organic and inorganic manures on growth and yield of maize and to assess their residual impacts on soil properties. Present research work carried out to study the impact of different nutrient sources on primary soil nutrients and soil properties under the poplar based agroforestry system in terai region of Uttarakhand state.

2. Materials and methods

The field experiment was conducted at Agroforestry research center, G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand (29°00'N Latitude, 79° 30' E longitude and at an altitude of 243.84 masl) during 2016-2017. It lies in the foothills of the Shivalik range of the Himalayas in the narrow strip called 'terai'. The soils of terai region developed from calcareous, medium to moderately coarse textured materials under pre-dominant influence of tall vegetation and moderate to well drain conditions. The site had humid sub-tropical climate with cold and hot dry summers with 1400 mm mean annual rainfall, of which 80 to 90% is received between June and September. The remaining 10 to 20% rainfall is received during wheat- growing season (November to April). The plot comprised silty-clay-loam soil of pH raged between 7.30 to 7.34, nitrogen was ranged from 214.30 to 217.77 kg/ha, soil phosphorus was ranged from 17.42 to 17.93 kg ha-1, potassium was ranged from 153.63 to 155.60 kg ha-1 ad organic carbon was ranged from 1.04 to 1.06% respectively. The research work was carried out with 3 replications of 7 treatments in randomized block design (RBD). Wheat variety PBW-154 shown under the 5 years old poplar plantation established in March, 2012 at spacing of 7m X 3m.

T1 : Control
T2 : Recommended NPK (120:60:40)
T3 : 150% of N and recommended P, K
T4 : Recommended NPK + ZnSO4 @25 kg/ha
T5 : 150% of N and recommended P, K + ZnSO4 @25 kg/ha
T6 : Recommended NPK + ZnSO4 @25 kg/ha + FYM @10 t/ha
T7 : 150% of N and recommended P, K + ZnSO4 @25 kg/ha + FYM @10 t/ha

3. Results and Discussion

The soil pH before sowing was found more or less similar in all the treatments and the value ranged from 7.30 to 7.34 which were in the neutral range. However, the soil pH after the harvest of the crop was found to be significantly affected by the different treatments. The lowest value of soil pH had been recorded from T7. The tune of decrease in the pH in T7 was 7.2% lower than the pH value of the soil before the sowing. The effect of nutrient sources on soil pH is presented in Fig 1. The decrease in the pH of treatments might be resulted from the increase in acidity of the NPK fertilizers, ZnSO4 as well as the organic acids produced due to the application of FYM. Similarly, addition of FYM and inorganic fertilizer decreases the soil pH was reported by Liu7.

The soil electrical conductivity (EC) at before sowing and after harvest had almost similar and the effect of the nutrient sources found to be non-significant. This may be due to the fact that there was no persistent effect of fertilizer applied. The effect of nutrient sources on soil EC is presented in Fig 1.

The effect of nutrient management modules on soil available nitrogen is presented in Table 1. The data of soil available nitrogen before sowing was ranged from 214.30 to 217.77 kg/ha. But the analysis of soil after harvesting of the crop showed significant effect on soil available nitrogen. The maximum soil available nitrogen was found in T2 and the minimum soil available nitrogen was observed in treatment T4 which was significantly differed with T6 and T7. This drastic depletion in soil available nitrogen may be due to higher uptake of nitrogen by the crop which ultimately resulted in higher yield. The result was in conformity with Walsh8and results suggest that N applied at planting were used in flowering of wheat and more additional N supplied as additional were used in grain yield which leads in depletion of soil N status

The findings of soil available phosphorus before sowing was ranged from 17.42 to 17.93 kg ha-1 which indicates the availability of soil phosphorus was in medium range. The effect various fertilization treatments showed significant effect on soil available phosphorus after harvesting. The highest value of available phosphorus after harvest was found in treatment T2. The higher value in T6 and T7 was comparatively greater than the treatment T5 and T4 which is due to the fact that the FYM increased the availability of phosphorus in both the treatments T6 and T7 respectively. The lowest soil available phosphorus found in T5 and T4 may be due to the antagonistic effect between zinc and phosphorus in the soil. Similar results were also reported by Hua9.

The data of soil available potassium before sowing was ranged from 153.63 to 155.60 kg ha-1 which was in medium range. But the data after harvest showed a drastic reduction in soil available potassium and lowest value obtained from the treatment T7 followed by T6 which may be due to higher uptake of potassium by the crop which ultimately resulted in higher yield. The result was in accordance with Hossain10. The result indicates that there was more uptake of potassium (K) than to amount of potassium (K) added which resulted in depletion of K from the soil. The values of soil organic carbon before sowing were ranged from 1.04 to 1.06%. There was no significant change in the soil organic carbon values after harvesting of the crop. But analysis of soil after harvest showed that a little increase in soil organic carbon in T7 and T6 which may be due to incorporation of FYM in the respective treatments. Soil organic carbon increased significantly with long term application of FYM and fertilizers as compared to fertilizer alone11.

4. Conclusion

From the present study it can be concluded that the effect of different nutrient sources on soil properties in wheat crop under poplar plantation was influenced greatly by various nutrient management practices. There was considerable change due to the effect of various doses of fertilizer in soil pH, N, P and K. Although the soil pH, soil available nitrogen, phosphorus, potassium and organic carbon was found to be non-significant before sowing of crop but a drastic reduction in soil pH after harvest. Thus under agroforestry system the present study has eminent value, however, further research is required.

5. Acknowledgements

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Table 1: Effect of different nutrient management modules on soil available N, P, K under wheat-poplar based agroforestry system

Treatments	Before sowing (kg/ha)			After harvesting (kg/ha)		
	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
T1	215.33	17.85	153.63	114.1	11.2	118.11
T2	214.4	17.78	155.2	117.6	14.38	106.92
T3	216.8	17.42	155.33	107.1	9.8	84.45
T4	214.3	17.91	155.6	65.9	9.03	78
T5	216.07	17.93	155.4	80.3	8.27	73.6
T6	217.77	17.76	154.37	66.7	11.3	70.65
T7	216.93	17.77	155.3	71.5	10.8	68.87
SEm±	6.168	0.335	5.216	4.296	1.059	8.007
CD at 5%	NS	NS	NS	13.385	3.298	24.946

Fig 1: Effect of different nutrient management practices on soil pH ad EC under wheat-poplar based agroforestry system

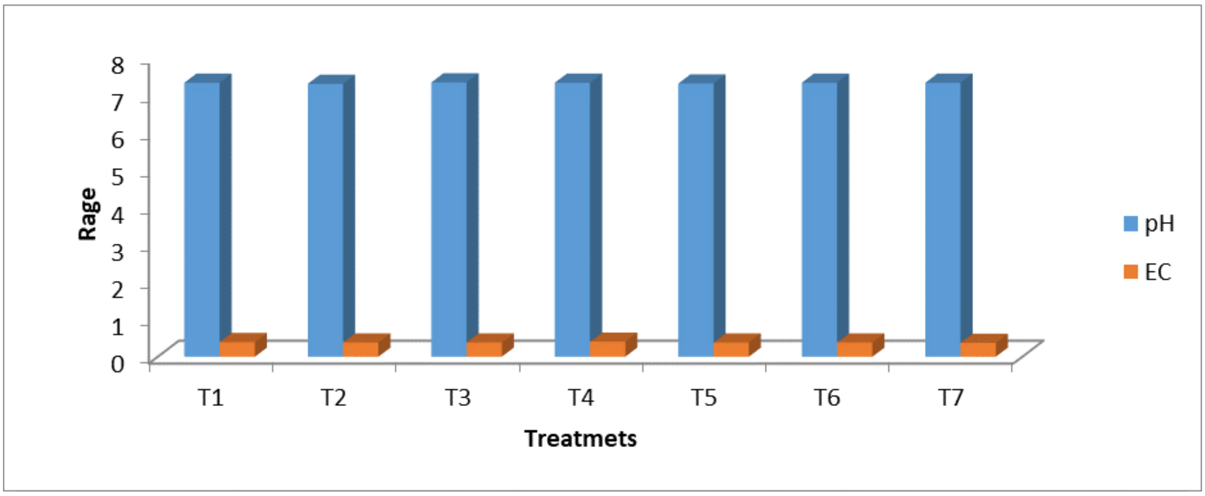

Fig. 2: Effect of different nutrient management practices on soil organic carbon under poplar based agroforestry system