Research Note

Indian Journal of Extension Education
Vol. 57, No. 4 (October–December), 2021, (147-149)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Impact of Soil Test Based Fertilizer Application on Yield, Soil Health and Economics in Rice

M. Jayalakshmi*, G. Prasadbabu, B. H. Chaithanya, R. Bindhupraveena and T. Srinivas

Krishi Vigyan Kendra, Banavasi, Acharya N.G. Ranga Agricultural University, Yemmiganur-518360, Kurnool (Dt.), Andhra Pradesh
*Corresponding author e-mail id: jayalakshmimitnala@gmail.com

ARTICLE INFO

Keywords: Rice, Soil test based fertilizer application, Technology gap, Extension gap, Technology index

http://doi.org/10.48165/IJEE.2021.57431

ABSTRACT

Frontline demonstrations were carried out to study the soil test-based fertilizer application on yield, soil health and economics in rice during the *kharif* seasons of 2017, 2018 & 2019 in farmers' fields of Kurnool district of Andhra Pradesh. The demonstrations conducted in ten locations revealed that application of nitrogen, phosphorus and potassium based on soil test values resulted in an average yield increase of 5.01 per cent over the farmer's practice. Demonstration plots recorded an average B: C ratio of 2.9 against farmers' practice of 2.4 and the technology index reduced from 3.84 to 1.53 per cent. The organic carbon content increased from 0.45 to 0.50 per cent due the application of farmyard manure based on soil test value. The soil test based fertilizer application resulted in higher yield, net returns, B:C ratio and organic carbon content and low technology index indicates the feasibility of technology to adopt at farmers' level.

INTRODUCTION

Rice is India's preeminent crop and plays a major role in global food security. Following the green revolution, intensive agriculture with the use of dwarf varieties that are highly responsive to fertilizers enhanced agriculture production. However, intensive agriculture led to heavy withdrawal of nutrients from the soil by the high yielding rice varieties created an imbalanced and discriminate use of chemical fertilizers that has resulted in deterioration of soil health (John et al., 2001). Fertilizers are one of the costliest inputs in agriculture and the use of the right amount of fertilizer at the right time is fundamental for farm profitability and environmental protection (Kimetu et al., 2004). Imbalanced use of fertilizers directly or indirectly causes adverse changes in soil properties and these changes are believed to have significant influences on the quality and productive capacity of the soil. For Indian soils, the most desirable nutrient use ratio of $N:P_2O_5:K_2O$ is 4:2:1 but the current ratio of 6.7:2.4:1 is far away from the mark. According to FAO (2005), there is a gap of about 10 million tonnes of N, P, K nutrients between the crop removal and replenishment through fertilizers. To narrow down this gap, balanced use of fertilizers is the most imperative aspect and fertilizer application based on soil testing is being advocated throughout the world. A large portion of the untapped potential farm yield could be exploited by using optimum inputs and by adopting appropriate production techniques without incurring additional cost (Singh et al., 2011). Through soil testing, nutrients status and their imbalances are known so that the required amount of the nutrients to overcome imbalances can be applied. Though awareness of the importance of soil health and soil testing is gaining momentum, many are not unaware of test results interpretation and use of soil test based fertilizer (STBF) application. The major constraints involved difficulty in understanding of soil testing, delay in getting the test reports, difficulty in following test based fertilizer recommendation, uncertainty in yield gain and lack of proper and scientific guidance (Patel et al., 2019). At this backdrop, Krishi Vigyan Kendra, Banavasi conducted front line demonstrations to create awareness and to impart knowledge on soil test based fertilizer application in cultivation of rice to reduce the indiscriminate and excessive use of fertilizers, reduction of cost of cultivation and to minimise the soil pollution.

Received 27-04-2021; Accepted 28-08-2021

METHODOLOGY

Krishi Vigyan Kendra, Banavasi, carried out ten frontline demonstrations in the farmers' fields during *kharif* season from 2017 to 2019 in the three mandals *viz.*, Yemmiganur, Adoni and Kodumuru of Kurnool District in Andhra Pradesh. The necessary steps for selection of site and layout of demonstrations etc. were followed as suggested by Choudhary (1999). Soil fertility of the selected plots was analyzed before and after the demonstrations. Samples were analyzed for organic carbon by Walkey and Black method (1934), available nitrogen by alkaline potassium permanganate method as proposed by Subbaiah and Asija (1956), available phosphorus by Olsen's method by Olsen et al., (1954) and available potassium by ammonium acetate method as described by Jackson (1973). The samples analyzed were found to be low in nitrogen content, high in phosphorus and medium in potassium content. Based on soil test values 300, 60 and 80 kg/ha of nitrogen, phosphorus and potassium were applied respectively in demonstration plots. The general trend of application fertilizers in farmers practice is 310 kg of nitrogen, 150 kg of phosphorus and 75 kg of potassium and 19.5 kg of sulphur. For each demonstration a plot of 0.8 ha was selected and divided into two parts of each 0.4 ha. Sub plots were allotted with T1 (plots receiving N, P, K fertilizers based on soil test values) and T2 (plots receiving fertilizers as per farmers practice). Rice variety BPT-5204 was sown in 2nd to 3rd week during July and transplanted during 2nd to 3rd week of August and harvested during 1st to 2nd week of December in all the years. The data were collected both from the demonstrations as well as check plots. The input and output prices of the commodities prevailing during the study were taken into an account for calculating the net returns and benefit-cost ratio. The extension gap, technology gap and technology index (Samui et al., 2000) were calculated using the following equation:

Technology gap = Potential yield – demonstration yield

Extension gap = Demonstration yield - farmers practice yield

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

The soil test data indicates that the organic carbon percentage in soil gradually increased from 0.45 to 0.5 per cent from 2017 to 2019 (Figure 1). This increase in organic carbon content which ultimately results in improvement of soil health might be due to application of 12.5 t ha^{-1} of farmyard manure based on soil test value and also acceleration of microbial activity with balanced use of chemical fertilizers instead of indiscriminate use. Combination of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining better soil fertility. Thus, the balanced use of fertilizer either alone or in combination with FYM is necessary for sustaining soil fertility and productivity of crop. Similar findings were reported in Chickpea by Singh et al., (2016).

Perusal of the data presented in Table 1 revealed that the average grain yields of paddy were higher with soil test based application fields with 6250, 6300 and 6500 kg ha^{-1} during 2017, 2018 and 2019 respectively than farmers practice yields of 5900, 6050 and 6200 kg ha^{-1} during 2017, 2018 and 2019 respectively. Percent increase in yield over farmers' practice was 5.93, 4.13 and 4.82 in 2017, 2018 and 2019 respectively. These higher yields might be due to balanced application of nitrogen, phosphorus and potassium in the demonstrations. In farmers practice due to application of phosphorus and sulphur by top dressing of complex fertilizers resulted in excessive buildup of phosphorus and sulphide injury in deep black soils of Kurnool. These results are also in accordance with Sujatamma & Nayak (2018). Higher net returns of Rs. 92,238 ha^{-1}, Rs. 88,650 ha^{-1} and Rs. 92,871 ha^{-1} were recorded during *kharif 2017*, 2018 and 2019 respectively with soil test based application as compared to Rs. 76,250 ha^{-1}, Rs. 75,553 ha^{-1} and Rs.78, 150 ha^{-1} during *kharif 2017*, 2018 and 2019 respectively in the farmers practice. The higher net returns in demonstration might be due to higher yields and reduced cost on fertilizers due to application of straight fertilizers for top dressing as against the farmers' practice where complex fertilizers were used for top dressing resulted in increased cost of cultivation. The benefit-cost ratio of rice cultivation with soil test based fertilizer application was 3.03, 2.87 and 2.85 during *kharif 2017*, 2018 and 2019, respectively compared to 2.42, 2.31 and 2.34 under farmers' practice. This might be due to higher returns and reduced cost of cultivation

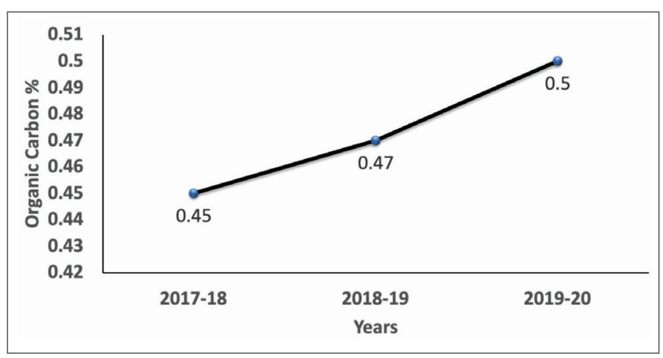

Figure 1. Effect of STBF on soil organic carbon

Table 1. Effect of on soil test based fertilizer application on yield and economics of rice

	Grain yield (kg/ha)		Percent increase in yield over	Cost of cultivation (Rs./ha)		Net Returns (Rs./ha)		B:C Ratio	
	STBF	F.P	farmers practice (FP)	STBF	F.P	STBF	F.P	STBF	F.P
2017-18	6250	5900	5.93	45262	53550	92238	76250	3.03	2.42
2018-19	6300	6050	4.13	49950	57567	88650	75533	2.77	2.31
2019-20	6500	6200	4.82	50129	58250	92871	78150	2.85	2.34
Average	6350.0	6050.0	5.01	48447.0	56455.7	91253.0	76644.3	2.9	2.4

in soil test based fertilizer application as compared to farmers practice. This finding was conformity with the findings of Singh et al., (2019) by a study conducted in wheat.

Extension gaps of 3.5, 1.5 and 2.0 q ha^{-1} was observed during *kharif* 2017, 2018 and 2019 respectively (Table 2). Extension gap emphasizes the need to bring awareness among the farmers for adoption of soil test based fertilizer application and to harvest the trend of wide extension gap. This extension gap may be due to difficulty in calculating the dosages of fertilizers according to soil test results. This results also in accordance with Ghaswa et al., (2019) by a study conducted in Ratlam district of M.P.

Table 2. Effect of Soil test based fertilizer application on Technology gap, Extension gap and Technology index

	Extension gap (q ha^{-1})	Technology gap (q ha^{-1})	Technology index (%)
2017-18	3.5	2.5	3.84
2018-19	1.5	2.0	3.07
2019-20	2.0	1.0	1.53

Results also indicated a technology gap between the soil test based fertilizer application and farmers practice in tune of 2.5, 2.0 and 1.0 q ha^{-1} during *kharif* 2017, 2018 and 2019 respectively. The technology gap observed may be attributed to differences in soil type and cultivation practices and may be overcome by adoption of soil test based fertilizer application along with best management practices. A similar finding was reported by Singh et al., (2019).

The technology index indicates the feasibility of the evolved technology at the farmers' fields. Lower the values of technology index more is the feasibility of the technology demonstrated (Chauhan, 2011). The technology index in the present study was 3.84, 3.07 and 1.53 per cent during *kharif* 2017, 2018 and 2019, respectively showing the efficacy of good performance of soil test based fertilizer application. The reduction in the technology index from 3.84 to 1.53 per cent during *kharif* 2017 to 2019 exhibits the feasibility of the soil test based fertilizer application.

CONCLUSION

The rice yield increased to a certain extent and cost of cultivation was reduced by conducting frontline demonstrations on soil test based fertilizer application. This substantially increased the net income of the farmers and improved the soil health due to balanced application of nutrients. Some of the constraints in adoption of soil test based fertilizer application of rice are lack of knowledge on the application of soil test results which are supplied by the Department of Agriculture and other institutions and lack of data on nutrient requirement of crops. If the farmers overcome these constraints by analyzing their soil for fertility status, understand the results given by the laboratories and application of nutrients based on soil test values, improves the yield of rice and increase internet income of rice farmers. This method gained a momentum in up scaling the net income from rice cultivation which created a positive impact on farming community.

REFERENCES

Chauhan, N. M. (2011). Impact and yield fissure inspection of gram through trainings and FLDs by KVK Tapi in Gujarat. *Indian Journal of Agricultural Research and Extension*, *4*, 12-15.

Choudhary, B. N. (1999). Krishi Vigyan Kendra-A guide for KVK managers. *Division of Agricultural Extension, ICAR*, pp 73-78.

Fertilizer use by crop in India. (2005). http://www.fao.org/3/a0257e/A0257E02.htm

Ghaswa, R., Tripaty, S., & Sharma, B. (2019). Knowledge, Adoption and Constraints of Soil Health Card based Fertilizer Application in Ratlam District, MP. *Indian Journal of Extension Education*, *55*(2), 94-96.

Jackson, M. L. (1973). *Soil chemical analysis* (pp 38–204). New Delhi, India: Prentice-Hall of India.

John, P. S., George, M., & Jacob, R. (2001). Nutrient mining in agro–climatic zones of Kerala. *Fertilizer News*, *46*, 45-57.

Kimetu, M., Mugendi, D. N., Palm, C. A., Mutuo, P. K., Gachengo, C. N., Nandwa, S., & Kungu, B. (2004). African network on soil biology and fertility. pp 207-224.

Olsen, S. R., Cole, C. V., Watanabe, F. S., & Dean, L. A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate (*USDA Circular ed., Vol. 939). U.S. Dept. of Agriculture.*

Patel, G. G., Lakum, Y. C., Mishra, A., & Bhatt, J. H. (2019). Correlates of knowledge regarding utility of soil testing and soil health card. *Indian Journal of Extension Education*, *55*(4), 31-35.

Samui, S. K., Mitra, S., Roy, D. K., Mandal, A. K., & Saha, D. (2000). Evaluation of frontline demonstration on groundnut. *Journal of the Indian Society of Coastal Agricultural Research*, *18*(2), 180-183.

Singh, D., Nain M. S., Hansra, B. S., & Raina, V. (2011) Trends in non-basmati rice productivity and factors of yield gap in Jammu region. *Journal of Community Mobilization and Sustainable Development*, *6*(1), 59-64.

Singh, S. K., Kumar, R., & Kushwah, R. S. (2019). economic effect of soil health card scheme on farmer's income: A case study of Gwalior, Madhya Pradesh. *Indian Journal of Extension Education*, *55*(3), 39-42.

Singh, Y. V., Dey, P., Meena, R., & Varma, S. K. (2016). Effect of soil test based fertilizer application on yield and economics of chickpea in inceptisols. *Annals of Plant and Soil Research*, *18*(4), 409-412.

Subbiah, B. V., & Asija, G. L. (1956). A rapid procedure for estimation of nitrogen in soils. *Current Science*, *25*, 259-260.

Sujathamma, P., & Nayak, S. B. (2018). Analysis of front line demonstrations conducted on soil test based fertilizer application in rice. *The Bioscan*, *13*(2), 625-627.

Walkley, A., & Black, C. A. (1934). An examination of the digestion method for determining soil organic matter and a proposed modification of the chromic and titration method. *Soil Science*, *37*, 29-38.