

## Studies on long-term effect of fertilizers on yield and economics of rice-wheat crop system

**S. K. Tripathi**

Department of Agricultural Chemistry, K.A.P.G. College, Allahabad, U.P.

### Abstract

The experiment was carried out during 2000-01 in a long term fertilizer experiment which was started in 1977-78 with a fixed rice-wheat system at Faizabad. The highest grain and straw yield of both the crops (rice and wheat) were recorded with  $N_{120} P_{80} K_{40}$  treatment. The grain yield of rice and wheat increased with increasing levels of NPK. Omission of phosphatic fertilizer resulted more decline in yield with higher rate in wheat in 24<sup>th</sup> years of cropping. The economic analysis of present investigation revealed that continuous application of Nitrogen fertilizer alone @ 80 and 120 kg N/ha returned only Rs.10, 701 and 13,374 against the cost of cultivation incurred Rs. 23,364 and Rs. 24,156 respectively during 24<sup>th</sup> crop cycle the maximum net return (22,047/ha) and return per rupee invested (Rs.1.78) were obtained by applying full dose of N P K fertilizers ( $N_{120} P_{80} K_{40}$ ).

**Keywords:** Long term fertilizers, rice-wheat, yield and economics

### Introduction

In India, rice-wheat rotation is a dominant cropping system across the Indo-Gangetic plains and in Himalayan foot-hills. The rice-wheat system is utmost important for the region's food security. Fertilizer consumption in India is grossly imbalanced, tilted towards more nitrogen followed by phosphorous. This has implications for the yield response to fertilizers and it decreases crop quality and adversely affects the soil fertility, productivity and increase the cost of production. Long term fertilizer experiments (LTFEs) are valuable for determining yield trends, estimating nutrient dynamics and balances understanding changes in yield, predicting soil carrying capacity and assessing system sustainability as a whole. Studies on crop productivity and soil fertility under long term cropping system have long been the subjects of immense importance. The data of many long term experiments have been analysed, but the analyses are mostly restricted to yield trends the analysis of some of these experiments have shown declining rice and wheat yields (Cassman *et al.* 1995, Nambiar 1994, Brar *et al.* 1998, Duxbury *et al.* 2000). The present study "Long term effect of fertilizers on yield and economics of rice wheat crop system" forms part of the

experimentation under All India Co-ordinated Agronomic Research Project, started in 1997 at CRS, Masodha, Faizabad. It aimed at evaluating the impact of more than two decades of fertilizer treatment on the productivity component of rice and wheat, soil fertility and economics parameter of this experiment located in a Inseptisol at the Crop Research Station, Masodha of N.D. University of Agriculture and Technology, Faizabad.

### Material and Methods

The present investigation was carried out during 2000-2001, in a long term fertilizer experiment which was started in 1977-1978 with a fixed rice-wheat system at Faizabad. The climate of the area is sub-humid, subtropical with an average annual rain fall of around 1100 mm. Nearly 85% of total precipitation is received from south-west monsoon during the month of July to September. The soil was Alluvial, silty loam in texture and belongs to the order Inseptisol. Initially, the soil had pH of 7.7, organic carbon 0.45%, available N, P, K 130, 10, 113 Kg ha<sup>-1</sup> and S content 11.4 mg kg<sup>-1</sup> soil. Nine fertility treatments i.e.  $N_0 P_0 K_0$  (control),  $N_{80}$ ,  $N_{120}$ ,  $N_{80} P_{40}$ ,  $N_{120} P_{40}$ ,  $N_{80} P_{80}$ ,  $N_{120} P_{80}$ ,  $N_{80} P_{40} K_{40}$  and  $N_{120} P_{80} K_{40}$  kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, respectively in

each crop with three replications were evaluated. The N, P and K were added through urea (46%), single super Phosphate (16% P<sub>2</sub>O<sub>5</sub>), and muriate of potash (60% K<sub>2</sub>O), respectively. Single super phosphate also provides 12% S in addition to P. Both the crops were grown under irrigated conditions with recommended agronomic practices. Each year rice was transplanted in July and harvested in October. Wheat was sown in November and harvested in April. Net income in rupee was worked out on one hectare basis common cost of cultivation as well as treatments wise costs of cultivation were worked out at the rates prevailed during 2000-2001. The net income was calculated by subtracting total cost of cultivation from gross income obtained from both grain and straw yield. Return per rupees investment was calculated by the following formula:

$$\text{Return per rupees investment} = \frac{\text{Gross income (Rs.)}}{\text{Total cost of cultivation (Rs.)}}$$

## Result and Discussion

The fertilizer treatments had significant effect on grain yield of rice and wheat the full dose of fertilizer treatment (N<sub>120</sub> P<sub>80</sub> K<sub>40</sub>) gave the

highest grain yield of rice and wheat which was significantly higher than under other imbalanced or suboptimal treatment (Table 1). Like grain yield, the fertilizer treatments were found to have significant effect on straw yield of rice and wheat. The maximum straw yield was obtained in N<sub>120</sub> P<sub>80</sub> K<sub>40</sub>, which was significantly higher than all other treatments. The yield data of wheat clearly showed that Nitrogen failed to response in the absence of phosphorous. Omitting of phosphatic fertilizers caused sharp decline in the grain yield of both the crops with higher rating wheat. The decline in response to applied Nitrogen may have been a result of changes in soil properties caused by repeatedly flooding and drying of rice-wheat field. These changes reduce the Nitrogen supplying capacity of soils by inhibiting the release of native soil N. (Olk *et al.* 1996 ) Application of P<sub>80</sub> over N<sub>120</sub> alone increased the yield of rice by 19 q/ha and of wheat by 30.3 q/ha during 23 years. With the increase in the availability of phosphorous under submergence condition needed for rice cultivation, the wheat crop responds more to applied P than rice (Hegde & Dwivedi 1992).

**Table 1 Effect of different long term fertilizer treatments on grain yield, straw yield of rice and wheat in rice-wheat cropping system.**

Treatments	Rice		Wheat	
	Grain yield (q/ha)	Straw yield (q/ha)	Grain yield (q/ha)	Straw yield (q/ha)
Control	7.68	13.06	4.64	6.50
N <sub>80</sub>	15.25	24.40	3.25	4.45
N <sub>120</sub>	18.67	30.60	4.41	5.51
N <sub>80</sub> P <sub>40</sub>	28.58	45.18	21.83	13.91
N <sub>120</sub> P <sub>40</sub>	32.75	53.54	29.50	42.87
N <sub>80</sub> P <sub>80</sub>	33.50	54.12	25.25	35.85
N <sub>120</sub> P <sub>80</sub>	37.67	59.92	34.67	50.00
N <sub>80</sub> P <sub>40</sub> K <sub>40</sub>	30.08	47.80	26.50	38.92
N <sub>120</sub> P <sub>80</sub> K <sub>40</sub>	40.67	61.45	38.75	55.60
S. Em. ±	0.67	1.43	0.9	1.30
C.D. at 5%	2.02	4.29	2.78	3.89

After N and P the K nutrient was found to be beneficial in rice –wheat cropping system. Thus, N P K combination gave higher yields of rice and wheat crops because of better fertility

status as a result of supply of these nutrients (Nambiar & Abrol 1989, Hagde & Dwivedi 1992). The economic analysis of present investigation revealed that continuous

application of Nitrogen fertilizer alone @ 80 and 120 kg N/ha returned only Rs.10,701 and 13,374 against the cost of cultivation incurred Rs. 23,364 and Rs. 24,156, respectively during 24<sup>th</sup> crop

cycle. The maximum net return (22,047/ha) and return per rupee invested (Rs.1.78) were obtained by applying full dose of N P K fertilizers (N<sub>120</sub> P<sub>80</sub> K<sub>40</sub>) (Table 2).

**Table 2 Long-term effect of fertilizer treatments on economics of rice-wheat cropping system**

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Return per rupee invested (Rs.)
Control	21,780	7,561	-14,219	0.35
N <sub>80</sub>	23,364	10,701	-12,663	0.46
N <sub>120</sub>	24,156	13,374	-10,782	0.55
N <sub>80</sub> P <sub>40</sub>	25,020	31,348	6,328	1.25
N <sub>120</sub> P <sub>40</sub>	25,812	39,291	13,479	1.52
N <sub>80</sub> P <sub>80</sub>	26,676	36,542	9,866	1.37
N <sub>120</sub> P <sub>80</sub>	27,468	45,645	18,177	1.66
N <sub>80</sub> P <sub>40</sub> K <sub>40</sub>	25,624	35,666	10,042	1.39
N <sub>120</sub> P <sub>80</sub> K <sub>40</sub>	28,072	50,119	22,047	1.78

## References

- Brar, B.S., Y. Singh, N.S. Dhillon & B. Singh 1980. Long-term effects of inorganic fertilizers, organic manure and crop residues on the productivity and sustainability of rice-wheat cropping system in northwest India. *In: Long-term soil fertility management through integrated plant nutrient supply* Edited by A. Swarup, D.D. Reddy & R.N. Prasad, *Indian institute of Soil Science, Bhopal, India*, Pp 335.
- Cassman, K.G., S.K. De Datta, D.C. Olk, J. Alcantra, M. Samson, J. Descalosta & M.A. Dizon 1995. Yield decline and nitrogen economy of long-term experiments on continuous, irrigated rice system in the tropics. *In: Soil management: Experimental basis for sustainability and environmental quality* Edited by R. Lal and B.A. Stewart, *Advance Soil Science CRC Press, Boca Raton, FL*, Pp 181-222.
- Duxbury, J.M., I.P. Abrol, R.K. Gupta and K.F. Bronson 2000. Analysis of long-term soil fertility experiments with rice-wheat rotations in south Asia *In: Long-term soil fertility experiments with rice-wheat rotations in south Asia* Edited by I.P. Abrol et al. *Rice-Wheat Consortium Paper Series No. 6, Rice-Wheat Consortium for the Indo-Gangetic Plains, New Delhi, India*, Pp. 7-22.
- Hegde, D.M. & B.S. Dwivedi 1992. Nutrient management in rice-wheat cropping system in India, *Fert. News*, **37(2)**: 27-41.
- Nambiar, K.K.M. 1994. Soil fertility and crop productivity under long-term fertilizer use in India. *Indian Council Agricultural Research, New Delhi, India*.
- Nambiar, K.K.M. & I.P. Abrol 1989. Long term fertilizers experiments in India (1971-82) *LTFE Res. Bull.* P. 101, *Indian Agric. Res. Inst. New Delhi*.
- Olk, D.C., K.G. Gassman, E.W. Randall, P. Kinches, L.J. Sangar & J.M. Anderson 1996. Changes in chemical properties of Soil organic matter with intensified rice cropping in troping lowland soils. *European J. Soil Sci.*, **47**: 293-303.