ADVANCE RESEARCH JOURNAL OF CROP IMPROVEMENT
Volume 2 Issue 2 (December, 2011) Page : 228-231

Received : September, 2011; ***Revised :*** October, 2011; ***Accepted :*** November, 2011

Research Paper

Effect of fertilizer nutrients and FYM on rice crop and soil fertility in long term rice based cropping system

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ABSTRACT

Field experiment was conducted at crop research centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal, India to find out the effect of fertilizer nutrients and FYM on rice crop and soil fertility in long term rice based crop system. 14 different treatment combinations were tested in randomized block design with 4 replications. The full nutrient treatments (NPK) had significant bearing on growth as well as on yield contributing characteristics. While the imbalanced fertilizer use *i.e.* N, NK, NP, PK reduced growth significantly as compared to balanced fertilizer treatments. The panicle number was adversely affected mainly due to lack of N, followed by P, whereas the total number of spikelets/panicle and grain weight/ panicle were adversely affected in the control where no fertilizer was used. The highest level of rice productivity (7.2 t/ha grain) was obtained with NPK +FYM treatment, whereas the lower yields were obtained with imbalanced use of fertilizer (e.g. N alone, PK, NK and NP etc). Even in the conventional recommended dose of NPK and NPK + Zn the yields were lower as compared to NPK + FYM or NPK + FYM + Zn. Application of individual nutrients (N, P and K) increased their concentration both in grain and straw. The uptake of these nutrients was increased with N application both in grain and straw. The treatments containing FYM had low values of soil pH. Productivity and fertility status were highest with balanced application of fertilizer along with FYM.

Karforma, Jyotirmay (2011). Effect of fertilizer nutrients and FYM on rice crop and soil fertility in long term rice based cropping system, *Adv. Res. J. Crop Improv.,* **2** (2) : 228-231.

KEY WORDS : Fertilizer nutrients, FYM, Rice, Rice wheat, Cropping system, Soil fertility

The fertility problem cannot be solved merely by supplying of plant nutrients but their efficient management also has to be given due consideration. Long term field experiments can be used for precise monitoring of changes in soil properties and soil productivity (Sheeba and Kumarasamy, 2001). Long term manorial experiments were conducted in India and in the world. These experiments showed a declining trend in crop productivity and soil fertility under modern intensive farming, particularly when rice based (cereal- cereal) cropping pattern was followed with imbalanced fertilizer use (Nambiar and Abrol, 1989). Long term fertility trial showed a decline in rice yield even after applying recommended dose of fertilizers. Such decline in yield was more apparent when wheat was grown after rice (Swarup and Ganeshamurthy, 1998). One of the reasons of this reported declining yield trend in rice-wheat system might be due to soil sickness, as both the crops were extensive feeder of nutrients. Keeping these in view, an attempt has been made to study the effect of fertilizer nutrients and FYM on rice crop and soil fertility in long term rice based cropping system.

RESEARCH PROCEDURE

The experiment was conducted at the crop research centre of the G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal during *Kharif* season of 2000 to study the effect of fertilizer nutrients and FYM on rice crop (Variety Pant Dhan 4) and soil fertility in long term rice based cropping system. This was a part of long term fertility experiment being conducted since 1984. The experiment was laid out in a Randomized Block Design (RBD) having fourteen (14) treatment combinations and four (4) replications. At initial period the soil of the experimental site was silty loam in texture and neutral to slightly alkaline in reaction (pH = 7.9) having higher organic carbon (1.2%). The rice variety (Pant Dhan 4) was transplanted maintaining a spacing of 20 cm x 15 cm. Fertilizer doses per hectare were N means 120 kg/ha, P and K mean 40 kg P_2O_5 /ha and 40 kg K_2O/ha,

respectively. Other doses were mentioned in the treatment like 150 kg N, 180 kg N and 80 kg P_2O_5 /ha and FYM @ 5 t/ha (dry weight basis). Half of the recommended dose of N in the form of urea and full doses of P_2O_5 as single super phosphate and K_2O as muriate of potash were applied as basal during final land preparation as per treatment. The remaining half of the recommended dose of fertilizer N was applied in two equal splits at active tillering and panicle initiation stage. Zinc was applied through application of 2 per cent $ZnSO_4$. Diammonium phosphate (DAP) was also used as a source of N and P_2O_5 and was applied as basal. The necessary protection measures were taken as and when required. The rice crop was harvested at maturity and the grain and straw yields were recorded.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been summarized under following heads:

Yield attributes and yield:

The full nutrient treatments (NPK) had significant bearing on yield attributing characteristics and yield of rice. The panicle number was adversely affected mainly due to the lack of N, followed by P, whereas the total number of spikelets/ panicle, filled spikelets/ panicle and unfilled spikelets (%) were adversely affected in the control where no fertilizer was used. However, these parameters were significantly higher in NPK treatments. The highest level of rice productivity (7.16 t/ha grain) was obtained with NPK + FYM treatment (Table 1), whereas, the lower yields were obtained with imbalanced use of fertilizer (e.g. N alone, PK, NK and NP etc). Even in the conventional recommended dose of NPK and NPK + Zn the yields were lower as compared to NPK + FYM or NPK + FYM + Zn. Higher dose of N and P treatment ($N_{180}P_{80}$ + Zn) could not increase yield. Addition of P along with N increased grain yield significantly, (NP over N). Similarly, addition of K along with N increased grain yield significantly (NK over N).

Uptake of nutrients by rice crop:

The uptake of individual nutrients (N, P or K) was increased with N application, both in grain and straw. In the highest nutrient treatment, *i.e.*, $N_{180}P_{80}K$ + Zn + FYM, the total uptake by rice grain + straw of N, P and K were about 134, 32.8 and 154 kg/ha, respectively, whereas, in conventionally recommended fertilizer schedule (NPK) the uptake was about 118, 23.9 and 109 kg/ha of N, P and K, respectively (Table 2).

Soil fertility status:

The high soil pH obtained with control plots and in imbalanced fertilizer treatments like N alone and PK. The treatment containing FYM had low values of pH. The available P in soil was highest (19.6 kg/ha) in full fertilizer treatment like $N_{180}P_{80}K$ + Zn + FYM. Organic matter (2.21%) content was highest in $N_{180}P_{80}K$ + Zn + FYM and available K (217 kg/ha) was highest in NPK + FYM treatment. In imbalanced fertilizer used, N alone treatment, the status of organic matter, available P and K was low

Table 1 : Yield attributing characters and yield of rice as influenced by different fertilizer treatments in long term rice-wheat cropping system

Treatments	Panicles /m^2	Spikelets			1000 grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
		Total No ('000/m^2)	Filled/Panicle	Unfilled (%)			
Control	133	11.3	57	34	28.7	3.36	3.40
N	182	18.8	67	35	30.2	4.57	5.65
NP	226	25.4	79	31	32.4	5.96	4.84
PK	168	19.5	82	30	30.4	5.40	4.56
NK	192	21.1	65	42	31.8	5.35	6.71
NPK	224	25.9	83	29	31.9	6.58	5.89
NPK+ Zn	229	26.8	80	32	32.0	6.82	5.90
NPK+FYM	263	30.8	86	30	31.9	7.16	6.60
NPK+ Zn+ FYM	254	30.0	82	30	32.8	6.94	6.19
N_{180} P_{60}+Zn	258	29.0	69	39	30.0	5.86	6.32
N_{180} P_{60}K+Zn+ FYM	258	31.0	81	32	32.2	7.01	6.78
N_{150}PK	253	27.9	79	29	32.6	6.89	5.76
N_{150} P_{60}K+Zn	244	33.4	81	40	31.8	6.29	6.92
NPK (DAP)	222	27.5	86	31	32.4	6.47	6.18
S.E. (±)	8.3	1.3	4.2	2.4	0.49	0.24	0.56
C.D. (P=0.05)	23.7	3.7	12.0	7.0	1.39	0.68	1.59

Table 2: Effect of different fertilizer treatments on nutrient (NPK) uptake (kg/ha) by rice

Treatments	N uptake (kg/ha)			P uptake (kg/ha)			K uptake (kg/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Control	36.9	15.8	52.7	6.3	2.2	8.5	8.9	33.8	42.7
N	50.7	23.9	74.6	8.9	3.7	12.6	12.7	72.4	85.1
NP	61.5	26.3	87.8	14.0	4.5	18.5	18.3	66.6	84.9
PK	51.3	19.6	70.9	18.9	3.8	22.7	18.1	68.5	86.6
NK	56.0	35.7	91.7	10.9	3.9	14.8	18.7	100.6	119.3
NPK	88.3	29.2	117.5	19.1	4.8	23.9	22.7	85.8	108.5
NPK+ Zn	70.3	29.5	99.8	21.4	4.7	26.1	23.5	87.0	110.5
NPK+FYM	82.9	30.2	113.1	25.1	7.0	32.1	27.2	100.1	127.3
NPK+ Zn+ FYM	73.9	29.8	103.7	22.4	5.8	28.2	26.4	95.3	121.7
N_{180} P_{60}+Zn	67.7	33.6	101.3	19.1	7.0	26.1	15.8	81.0	96.8
N_{180} P_{60}K+Zn+ FYM	93.1	40.6	133.7	24.3	8.5	32.8	27.6	125.9	153.5
N_{150} PK	78.7	28.6	107.3	21.0	4.2	25.2	23.8	75.3	99.1
N_{150} P_{60}K+Zn	66.8	36.7	103.5	20.4	8.1	28.5	21.2	97.9	119.1
NPK (DAP)	68.8	31.6	100.4	18.5	4.6	23.1	18.6	82.3	100.9
S.E. (±)	4.1	3.3	5.8	1.1	0.7	1.3	1.7	11.0	11.8
C.D. (P=0.05)	11.7	9.5	16.5	3.1	2.0	3.8	4.8	31.6	33.6

Table 3 : Effect of different fertilizer treatments on soil pH, organic matter (%), available P (kg/ha) and available K (kg/ha) of soil

Treatments	pH	Organic matter (%)	Available P (kg/ha)	Available K (kg/ha)
Control	8.58	1.76	10.4	191
N	8.31	1.63	12.3	196
NP	8.25	2.19	15.1	198
PK	8.43	1.85	14.3	208
NK	8.26	1.81	12.3	204
NPK	8.21	2.00	12.9	211
NPK+ Zn	8.29	2.07	14.0	208
NPK+FYM	8.24	2.15	18.5	217
NPK+ Zn+ FYM	8.26	1.91	17.9	216
N_{180} P_{60}+Zn	8.28	2.17	15.7	200
N_{180} P_{60}K+Zn+ FYM	8.23	2.21	19.6	216
N_{150} PK	8.29	1.65	14.6	213
N_{150} P_{60}K+Zn	8.27	2.09	15.7	214
NPK (DAP)	8.29	1.77	12.3	213
S.E. (±)	0.05	0.09	1.8	1.4
C.D. (P=0.05)	0.13	0.26	5.4	4.0
Initial soil test value	7.90	1.20	20.0	222

being 1.63%, 12.3 an 196 kg/ha, respectively (Table 3). Productivity and fertility status were highest with balanced application of fertilizer along with FYM.

On the basis of present study and result obtained, it could be conclude that the conventional fertilizer application (120 kg N, 40 kg P_2O_5 and 40 kg K_2O + Zn) is not adequate for obtaining higher yield in intensive cropping. Incorporation of organic manure like FYM with chemical fertilizer gave the best result in respect to yield, nutrient use efficiency and soil fertility status. So, combined use of organic manure an inorganic fertilizer is beneficial to sustain soil fertility and grain yield in rice wheat cropping

system.

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