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Feasibility of customized fertilizers for sustainable productivity of rice

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Abstract
A field experiment was conducted to study the feasibility of customized fertilizers for sustainable productivity of rice at Agronomy Research Farm at Narendra Deva University of Agriculture and Technology, Faizabad during *Kharif* 2014 and 2015. The treatment 3; application of Soil Test Based Recommendation (N-140:P2O5-60: K2O-30: S-30: Zn-5:B-2 kg ha^{-1}) was found maximum plant height (cm), number of tillers m^{-}2, number of effective tillers m^{-2} which was at par with (Indo Gulf) and (Tata Chemical Limited) and significantly superior over control, RDF and Farmer's' practices. The highest grain and straw yield and nutrients uptake of nitrogen, phosphorus, potassium, sulphur, zinc and boron of rice was recorded with T_3 (Soil test based recommendation) was significantly superior over the control (18.31 q ha^{-1}), RDF (43.42 q ha^{-1}) and Farmers' practices (28.36 q ha^{-1}) and statically at par with Vardan (Indo gulf) (48.33 q ha^{-1}) and Paras (TCL) (47.50 q ha^{-1}). The highest net return (Rs.32204 and Rs.34968 ha^{-1}) and B:C (0.74 and 0.84) during 2014 and 2015, respectively were also obtained due to application of soil test based recommendation which was followed by application of Indo Gulf- Customized Fertilizers- Vardan and TCL- Customized fertilizers-Paras.

Keywords: Nutrients, TCL, indo-gulf, growth, yields, nutrients uptake

Introduction
Rice is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planet's human population with ever increasing population; demand for rice continues to increase. India need to raise its food grains targets at a rate of more than 4 million tonnes per annum and to maintain self-sufficiency, annual production needs to increase by two million tonnes every year. The annual consumption of fertilizers, in nutrient terms (N, P & K), has increased from 0.07 million MT in 1951-52 to more than 28 million MT in 2010-11 and per hectare consumption, has increased from less than 1kg in 1951-52 to the level of 135 kg 2010-11(DOF, 2012) [6]. The crop is generally fertilized by farmers with nitrogen, phosphorus and potassium only, though micronutrients are also equally important. Micronutrients are elements which are essential for plant growth, but are required in much smaller amounts than those of the primary nutrients, nitrogen, phosphorus and potassium. The imbalanced fertilization and continuous nutrient mining from native soil led to secondary and micronutrient deficiency, declining productivity and deterioration of soil health. Balanced fertilization maintains a dynamic equilibrium between nutrient application and nutrient uptake by crops and thereby aims to harness benefits for farmers, consumer and for the nation. Customized fertilizer is the implication of the fertilizers best management practices and is generally assumed to maximize crop yields while, minimizing unwanted impacts on the environment & human health. Application of customized fertilizer is compatible with existing farmers system can be comfortably accepted by the farmers. Customized fertilizer satisfies crop's nutritional demand, specific to area, soil, and growth stage of plant. As the micronutrients are also added with the granulated NPK fertilizer the plants can absorb the micronutrient along with macronutrient which prevents nutrient deficiency in plant.
Customized fertilizer is a balanced distribution of plant nutrients in the field and provides the best nutritional package for premium quality plant growth and yield Shivey, 2011 [15]. They are multi nutrient carrier designed to contain macro and/or micro nutrient forms, both from inorganic and/or organic sources, manufactured through a systematic process of granulation, satisfying the crop's nutritional needs, specific to its site, soil and stage, validated by scientific crop model capability developed by an accredited fertilizer manufacturing/marketing company Goel *et al*., 2011 [8]. Such fertilizers also include water soluble specialty fertilizer as customized combination products. The Nutrient requirement of the crop in a particular area is

Mixed physically and steam granulated by technology known as fusion blending Yadav, 2012. The farmers get all the required nutrients in terms of NPK with secondary and micro-nutrients in balanced proportion. A large number of customized fertilizer grades proposed by a number of companies have been included in fertilizer control order which is multi-nutrient carriers designed to contain primary, secondary and micro nutrients. These products are manufactured through a systematic process of granulation providing uniform quality. The products have been validated by a scientific crop model, by a fertilizer manufacturing company and can meet crop nutritional needs which is specific to site, soil and stage of crop. Depending on the soil test results, climate, water requirement and crop chosen, a particular type of grade of fertilizer (customized fertilizers) is prescribed to get the best yield and maintain soil health.

Materials and Methods

A field experiment was conducted during *kharif* seasons of 2014 and 2015 at Agronomy Research Farm, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. (Uttar Pradesh) India. Geographically, the experimental site falls under sub-tropical climate and is located at 26. 47° N latitude and 82.12° E longitudes and at an altitude 113 m above the mean sea level in the Indo-Gangetic alluvial soil belt of Eastern Uttar Pradesh. The area falls under sub-tropical zone which in characterized by hot and dry summer with cold winters. Rain is more often confined to the period from July to September with occasional winter and summer rain. The experimental field was well levelled having good irrigation and drainage facilities. The mean annual rainfall is 1021.8mm. The soil of the experimental field was silty loam having slight alkaline (pH 8.1), EC 0.41 dSm^{-1}, poor in organic carbon (3.70 g kg^{-1}), available nitrogen (160.76 kg) medium in available phosphorus (15.40 kg), potassium (280.70 kg), sulphur (8.2 ppm), Zn (0.50 ppm) and B (0.39 ppm).

Experimental design and treatments

The experiment was laid out in randomized block design with four replications. The treatment consisted of T1 (control), T2 (RDF), T3 (Soil test-based recommendation), T4 (Indo-Gulf Customized Fertilizer), T5 (TCL Customized Fertilizer) and T6 (Farmer's Practice). The recommended dose of N, P_2O_5, K_2O and $ZnSO_4^-$ *i.e.*, @ 150, 60, 60 and 25 kg ha^{-1}, respectively was applied. 150 kg N, 60 kg P_2O_5, 60 kg K_2O was considered as 100% RDF; 140 kg N, 60 kg P_2O_5, 30 kg K_2O, 30 kg S, 5 kg Zn and 2 kg B ware considered as STR recommended dose of fertilizer; 250 kg Indo Gulf-Customized Fertilizers- Vardan on Basal as well as @125 kg N as urea in two splits top dressing at tillering and panicle initiation stage and 250 kg TCL-Customized fertilizers- Paras on Basal as well as @125 kg N as urea in two splits top dressing at tillering and panicle initiation stage was considered as Basal recommended dose of fertilizer. In treatment T3 (STR) sulphur, zinc and boron were applied through gypsum, zinc sulphate and borax, respectively.

The rice variety NDR-359 during both the years transplanting seedlings in experimental field was done by using 25 days old nursery. Two seedlings per hill were transplanted at about 3 cm depth in spacing row to row 20 cm and plant to plant10 cm. The crop was harvested at 92 days after transplanting of seedling and yield was recorded. The chemical analysed is of the plant sample was carried out by wet digesting with HNO_3:$HClO_4$ (4:1) di-acid mixture as per the procedure outlined by Jackson (1973) [9] and to determine concentrations of N, P, K, S and Zn at harvest using procedure described by Jackson, (1973) [9]. The analysis of variance was carried out using the randomized block design (Snedecor and Cochran, 1967) [7].

Results and Discussion

Plant height (cm)

Plant height at harvest stage was influenced significantly by various treatments (Table-1). the maximum plant height (90.40 and 92.2 cm) were recorded with the application of STR, which was significantly superior over the Control, RDF and Farmer's practices and statistically at par with Indo Gulf-Customized Fertilizers-Vardan and TCL-Customized fertilizers- Paras during both the years of investigation. Plant height is not a yield component especially in grain crops but it indicates the influence of various nutrients on plant metabolism. The highest plant height was measured in the treatment having T_3-STR during both the years of investigation. Increase in plant height may be attributed to the fact that the fulfilment of required by plants which causes beneficial effects such as accelerated rate of photosynthesis, assimilation, cell division and vegetative growth. It might have resulted from increased production of photosynthesis by prolonged availability of fertiliser (Bhardwaj *et al.*, 2010) [2].

Number of tillers m^{-2}

Significantly higher number of tillers m^{-2} were recorded under T_3-STR which was significantly higher than T_1-control, T_2-RDF and T_6-Farmers' practice while statistically at par with T_4- Indo Gulf-Customized Fertilizers- Vardan and T_5- TCL-Customized fertilizers- Paras during both the years of investigation (Table-1). Similar results were also reported by Lin and Lin (1985) [10] and Rao *et al* (1996) [12]. The highest numbers of effective tillers m-2, length of panicles, are the most important yield contributing characters. The treatments were found significantly superior over treatment T_1-(Control), T_2-(RDF) and T_6-(Farmers' Practices).

Number of effective tiller m^{-2}

The maximum increase in number of effective tillers m^{-2} (430.0 and 447.2) and panicle length (24.80 and 25.30 cm) were observed in T_3-STR followed by T_4-Indo Gulf-Customized Fertilizers- Vardan and T_5-TCL-Customized fertilizers- Paras during both the years(Table-1). The superiority of the treatment is explained on as applied nutrients Ahmad and Irshad (2011) [1].

Table 1: Effect of treatments on Plant height, Number of tillers m^{-2} and Panicles length of rice crop

Treatments	Plant height (cm)		No. of tillers m^{-2}		No. of effective tillers m^{-2}		Panicles length (cm)	
	2014	2015	2014	2015	2014	2015	2014	2015
T_1 –Control (No fertilizer application)	60.20	61.40	193.4	201.2	180.0	187.2	18.6	18.9
T_2 –Recommended dose of fertilizer (RDF) (N-150: P_2O_5-60: K_2O -60:$ZnSO_4$-25 kg/ha)	82.20	83.80	415.2	432.6	380.0	395.2	22.5	22.9
T_3 –Soil Test Based on Recommendation (STR) (N-140:P_2O_5-60:K_2O-30:S-30:Zn-5:B-2 kg ha^{-1})	90.40	92.20	471.9	589.6	430.0	447.2	24.8	25.3
T_4 - Indo Gulf Customized fertilizer (Vardan) @ 250 kg ha + N-115 kg	88.60	90.40	462.1	480.9	422.0	438.9	24.2	24.7
T_5 - Tata Chemical Limited customized fertilizer (Paras) 250 kg/ha+ N-115 kg	87.20	88.90	455.3	472.2	415.0	431.6	23.8	24.3
T_6 Farmers' practices (N-100, P_2O_5-40, K-0, $ZnSO_4$-:10 kg/ha)	65.60	66.90	283.1	293.4	260.0	270.4	20.0	20.4
SEm±	2.34	2.72	15.33	15.99	12.76	13.27	0.65	0.66
C.D. at 5%	7.06	8.19	46.22	48.06	38.47	40.01	1.96	2.00

Panicles length (cm)

The maximum length of panicles (24.80 and 25.30 cm) recorded (Table-1) with the application of T_3-STR was significantly superior over the T_1- Control, T_2-RDF and T_6 - Farmer's practices and statistically at par with T_4- Indo Gulf-Customized Fertilizers-Vardan and T_5-TCL-Customized fertilizers-Paras during both the years of investigation. The minimum number of length of panicles (18.60 and 18.90 cm) was recorded under control during 2014 and 2015, respectively.

Grain and straw yield

Maximum grain (45.11 q ha^{-1} and 52.50 q ha^{-1}) and straw yield (70.82 q ha^{-1} and 79.8 q ha^{-1}) of rice were recorded with T_3-Soil Test based Recommendation (STR-where most of the required nutrients i.e. N, P, K, S, Zn and B supplied in balanced amount) which was significantly higher over all the treatments (Table-2). However, at par with Indo-Gulf (T_4) in grain (44.78 q ha^{-1} and 51.81 q ha^{-1}) straw (68.0 q ha^{-1} and 79.88 q ha^{-1}) and TCL-customized fertilizers (T_5) having 44.02 and 50.98 q ha^{-1} grain and 67.15 and 78.0 q ha^{-1} straw yield of rice respectively during 2014 and 2015. The application of nutrients according to Soil Test base Recommendation (T_3), the grain yield of rice was increased 62.60%, 10.46%, 0.73%, 2.41% and 42.58% over T_1 (Control), T_2 (RDF), T_4 (Indo-Gulf-CF), T_5(TCL-CF) and T_6 (Farmers' Practice) respectively during 2014 and 62.36%, 11.52%, 1.2%, 2.98% and 21.68% over T_1 (Control), T_2 (RDF), T_4 (Indo-Gulf-CF), T_5(TCL-CF) and T_6 (Farmers' Practice) respectively during 2015. The yield difference under both the customized fertilizers was not up to the level of significant. Application of RDF, the grain yield of rice was increased 58.23 % and 35.07% in 2004 and 57.45 and 33.64 % in 2015 over Control and Farmers' practices respectively. Similar trend was also observed in straw yield. higher grain yield may be owing to the application of sufficient nutrients in combination which resulted to greater availability of essential nutrients to plants, improvement of soil environment which facilitate in better root proliferation leading to higher absorption of water and nutrients and ultimately resulting in higher yield, Dwivedi, *et al*, 2014 [7]. Shekhon *et al*. (2012) [14] also reported that application of higher dose of customized fertilizer produced additional grain and straw yields.

Table 2: Effect of treatments on of grain, straw yield in rice crop

Treatments	Grain Yield (q ha^{-1})		Straw Yield (q ha^{-1})	
	2014	2015	2014	2015
T_1 –Control (No fertilizer application)	16.87	19.76	27.85	31.62
T_2 –Recommended dose of fertilizer (RDF) (N-150: P_2O_5-60: K_2O -60:$ZnSO_4$-25 kg/ha)	40.39	46.45	60.62	77.46
T_3 –Soil Test Based on Recommendation (STR) (N-140:P_2O_5-60 :K_2O-30:S-30:Zn-5:B-2 kg ha^{-1})	45.11	52.50	70.82	79.8
T_4 - Indo Gulf Customized fertilizer (Vardan) @ 250 kg ha + N-115 kg	44.78	51.87	68.0	79.88
T_5 - Tata Chemical Limited customized fertilizer (Paras) 250 kg/ha+ N-115 kg	44.02	50.98	67.15	78.00
T_6 Farmers' practices (N-100, P_2O_5-40, K-0, $ZnSO_4$-:10 kg/ha)	25.90	30.82	41.18	47.96
SEm±	0.813	0.946	1.547	1.846
C.D. at 5%	2.451	2.850	4.664	5.563

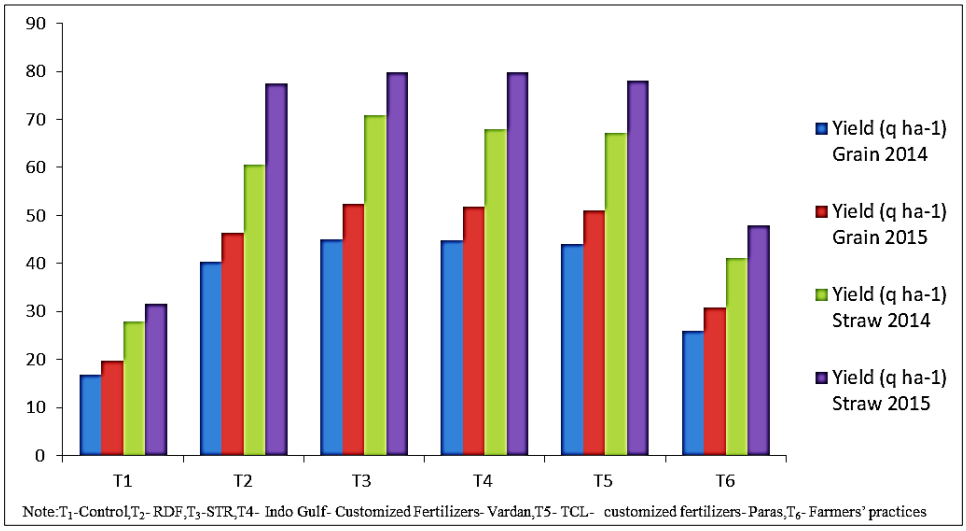

Fig 1: Effect of treatments on of grain and straw yield

Nutrients uptake by crop

The maximum uptake (Table-3) of N (98.85 and 115.08 kg ha^{-1}), P (21.91 and 25.82 kg ha^{-1}), K (113.92 and 136.12 kg ha^{-1}), S (15.46 and 18.05 ppm) Zn (202.17 and 231.73 ppm) and B (158.90 and 161.60 ppm) recorded with the application of T3-STR during 2014 and 2015, respectively was statistically at par with T4- Indo Gulf- Customized Fertilizers-Vardan and T5- TCL-Customized fertilizers- Paras and significantly superior over rest of the treatments during both the years. The higher nutrient uptake was mainly due to higher grain and straw yield. The similar findings have been also reported by Pandey *et al.* (2007) [11]. Application of customized fertilizer helps to provide essential nutrient to get the targeted yield. This shows that N, P, K, S, Zn, B) combination is useful for rice growth and yield. Similar findings have been also reported for N, P, K and Zn by Singh (2006) [16] and Das *et al*. (2003) [5].

Economic feasibility of various treatments

The economic study of different doses of customized fertilizer showed (Table 3) that the highest net return (Rs. 32204.0 and 34968.0 ha^{-1}) were computed under the treatment T_3-STR followed by T_4-Indo Gulf-Customized Fertilizers-Vardan and T_5- TCL-Customized fertilizers- Paras and minimum net return (Rs. -6241.0 and -5418.0 ha^{-1}) was calculated with in the treatment T_1-control. While, maximum B: C ratio (0.74 and 0.84) was computed under the treatment T_3 STR followed by T_4-Indo Gulf-Customized Fertilizers-Vardan and T_5-TCL-Customized fertilizers-Paras during both the years, respectively. The similar findings have been also reported by Shekhon *et al.*, (2012) [14]. The variation in nutrition might be due to increased cost of cultivation. This trend in economic return is mainly due to the treatment effect on the grain and straw yield of rice reported by Chaudhary *et al.* (2008) [4] and Bhaskaran and Subramanyam (2011) [3].

Conclusion

Based upon the experimental results, it concluded that the growth parameter, nutrient uptake and economic yield of rice was recorded maximum in Soil Test based treatment (T3) that significantly higher over all the treatments except customized fertilizers. These soil test based fertilizer application can be adjudged to the best treatment in terms of yield and B: C ratio and it helps to minimize the cost of fertilizer application.

Table 3: Effect of customised fertilizer on nutrient N, P, K, S, Zn and B uptake by rice crop

Treatment	N (kg ha^{-1})		P (kg ha^{-1})		K(kg ha^{-1})		S (g ha^{-1})		Zn (g ha^{-1})		B (g ha^{-1})	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1 –Control (No fertilizer application)	30.36	36.53	6.18	7.74	37.51	44.70	4.82	5.66	71.08	81.76	92.92	97.85
T_2 –Recommended dose of fertilizer (RDF) (N-150: P_2O_5-60: K_2O - 60:$ZnSO_4$-25 kg/ha)	79.48	105.80	18.24	22.84	106.49	126.87	12.80	15.94	178.41	217.71	118.53	122.13
T_3 –Soil Test Based on Recommendation (STR) (N-140:P_2O_5-60 :K_2O-30:S-30:Zn-5:B-2 kg ha^{-1})	98.85	115.08	21.91	25.82	113.92	136.12	15.46	18.05	202.17	231.73	158.90	161.60
T_4 - Indo Gulf Customized fertilizer (Vardan) @ 250 kg ha + N-115 kg	94.90	112.71	21.52	25.76	111.72	132.73	14.91	17.55	195.86	223.06	149.33	152.23
T_5 - Tata Chemical Limited customized fertilizer (Paras) 250 kg/ha+ N-115 kg	93.05	109.10	21.19	25.22	111.14	131.83	13.15	15.50	189.47	220.25	152.41	155.54
T_6 Farmers' practices (N-100, P_2O_5-40, K-0, $ZnSO_4$-:10 kg/ha)	51.55	61.66	11.01	13.46	58.99	72.56	8.055	9.66	109.84	129.43	102.43	104.84
SEm±	1.56	1.91	0.27	0.25	2.19	2.63	0.21	0.22	2.89	3.74	3.3	3.39
C.D. at 5%	4.70	5.76	0.82	0.76	6.62	7.92	0.63	0.68	8.73	11.28	9.97	10.23

Table 4: Economics of various treatment combinations

Treatments	Total cost of cultivation (Rs. ha^{-1})		Gross return (Rs. ha^{-1})		Net return (Rs. ha^{-1})		Benefit : cost ratio	
	2014	2015	2014	2015	2014	2015	2014	2015
T_1 -Control (No fertilizer application)	33443	34070	27202	28652	6241	418	0.19	0.16
T_2 –Recommended dose of fertilizer (RDF) (N-150: P_2O_5-60: K_2O -60:$ZnSO_4$-25 kg/ha)	46712	47365	64229	67352	17491	19960	0.37	0.42
T_3 -Soil Test Based on Recommendation (STR) (N-140:P_2O_5-60 :K_2O-30:S-30:Zn-5:B-2 kg ha^{-1})	40843	41157	71047	76125	32204	34968	0.74	0.84
T_4 - Indo Gulf Customized fertilizer (Vardan) @ 250 kg ha + N-115 kg	41256	44370	70863	75211	29607	30841	0.72	0.69
T_5 - Tata Chemical Limited customized fertilizer (Paras) 250 kg/ha+ N-115 kg	41256	44870	69992	73921	28736	29051	0.70	0.65
T_6 Farmers' practices (N-100, P_2O_5-40, K-0, $ZnSO_4$-:10 kg/ha)	39253	37843	41569	44689	2316	6846	0.06	0.18

Reference

1. Ahmad R, Irshad M. Effect of boron application time on yield of wheat, rice and cotton crop in Pakistan. Fauji Fertilizer Company Limited, Lahore, Pakistan Soil Environ. 2011; 30(1):50-57.
2. Bharadwaj V, Yadav V, Chauhan, BS. Effect of nitrogen application timing and varieties on growth and yield of wheat grown on raised beds. Arch Agron. Soil Sci. 2010; 56:211-222.
3. Bhaskaran MN, Subrahmanyam, SVS. Marketing strategy for customized and innovative specially fertilizers. Indian J of ferti. 2011; 7(9):70-76.
4. Chaudhary SK, Rao PVR, Jha, PK. Productivity and nutrient uptake of rice varieties as affected by nitrogen levels under rainfed lowland ecosystem. Indian J Agric. Sci. 2008; 78(5):463-465.
5. Das K, Medhi DN, Guha B. Application of crop residues in combination with chemical fertilizers for sustainable productivity in rice (Oryza sativa) wheat (Triticum aestivum) system. Indian J Agronomy. 2003; 48(1):8-11.
6. DoF. Report of the working group on fertilizer industry for the twelfth plan (2012-17). Government of India, Ministry of Chemical & Fertilizers, Department of Fertilizers, 2012, 3.
7. Dwivedi SK, Meshram MR, Pandey N. Response of customized fertilizer on wheat (Triticum aestivum) under chhattisgarh condition, The Bioscane, 2014; 9(4):1509-1512.
8. Goel MC, Singh KJB, Bhende SN. Response of application of customized fertiliser grade (CFG) on yield and quality of pomegranate. Acta horticulturae. 2011; (890):333.
9. Jackson ML. Soil chemical analysis, prentice Hall of India, Pvt. Ltd, New Delhi, 1973.
10. Lin JL, Lin TL. Tiller number and leaf area index of rice community as influenced by planting density and nitrogen fertilizer. J Agril. Assoc. of China. 1985; 12(9):14-34.
11. Pandey N, Verma AK, Anurag, Tripathi RS. Integrated nutrient management in transplanted hybrid rice (*Oryza sativa*). Indian J. Agronomy. 2007; 52(l):40-42.
12. Rao KS, Moorthy BTS, Padaria CR. Efficient nitrogen management for sustained productivity in low land rice (*Oryza sativa* L.). Indian Journal of Agronomy. 1996; 41(2):215-220.
13. Rashid A, Yaseen M, Ashraf M, Mann RA. Boron deficiency in calcareous soils reduces rice yield and impairs grain quality. Inter Rice Res Notes, 2004; 29:58-60.
14. Shekhon BS, Kaur S, Singh P. Evaluation of a customized fertilizer on wheat. Indian J Ecol. 2012; 239(1):71-75.
15. Shivey YS. Customized fertilizers: increased crop productivity and nutrient use efficiency. Proc. International Conference on Issues for Climate Change, Land Use Diversification and Biotechnological Tools for Livelihood Security, Hi-Tech Horticultural Society, Meerut, 2011, 128-133.
16. Singh SK, Dwivedi SP, Singh DP, Singh PN, Singh SK. Effect of different levels of phosphorus and zinc on growth and yield of rice (*Oryza sativa* L.) grown on saline alkali soils under late sown condition. Plant Archives, 2006; 6(1):333-336.
17. Snedecor GW, Cochran WG. Statistical method 6th Ed. Oxford and IBH Publishing Corp, Calcutta, 1967.
18. Yadav DS. Fertilizer marketing in changing environment. Indian Journal of Fertilizers. 2012; 8:60-77.