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Evaluation of different nutrient management practice in yield and growth in rice in Morang district

Abstract

A field experiment was therefore conducted on farmer's field at two sites of Morang district viz. Itahara and Babiyabirta using Nutrient Expert® Rice model from 4thweek of June to 2ndweek of October. The experiment was conducted in Randomized Completely Block Design replicated among twelve farmers. Three treatments were NE (Nutrient Expert recommendation), GR (Government recommendation), and FP (Farmer practices). The result revealed significant difference in terms of panicle length, plant height, no. of effective tiller/m2 filled grain/panicle, unfilled grain/panicle, sterility %, total grain/panicle, and yield at 15.5% moisture, test weight, straw weight, harvesting index and biomass. The highest yield (5.46ton ha-1) was obtained from NE followed by GR (4.79ton ha-1) and FP (4.43ton ha-1). NE based practices produced significantly higher yield and in comparison with GR. The yield estimated by Nutrient Expert® (NE) proved to be attainable at farmer's field, thus validating the NE model and can be recommended at field level for better yield.

Keywords: nutrient expert, government recommendation, farmer fertilizer practice, yield

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Introduction

Rice, the major cereal crop which used as a source of main food for more than 85% population in world and 90% in Asia but lacking, imbalanced, inappropriate or excessive use of nutrients in agricultural systems is a major cause for low crop yields in parts of developing country. Nutrients such as nitrogen (N) and phosphorus (P) often move beyond the bounds of the agricultural field because the management practices used fail to achieve good congruence between nutrient supply and crop nutrient demand (SSNM). If left unchecked, such losses may bear significant costs to society. Increasing nutrient use efficiency continues to be a major challenge for world agriculture. In Nepal, it is grown in all types of ecological regions and district (except Manang and Mustang).The area and production of paddy at 1,425,346ha. and 4,788,612mt. respectively with an average yield 3.171t/ha.[1,2] The area, production and yield of paddy at Morang is 83525ha, 332100mt, 3976kg/ha.[3] Rice contributes nearly 20% to the agricultural gross domestic product (AGDP), more than 50% in food grains and more than 50% of the total calories requirement of the Nepalese people.[4] About 90% of the rice grown in the world is produced and consumed in Asian region. About 59% of the world's population living in Asia consumes about 90% of the global rice production.

The yield of Rice is low in Nepal compare to other country like china produces 6.59 tons per hectare and other developed countries.[2] There are many factor behind it, of them, depletion of organic matter, imbalance use of fertilizer, intensive cropping without inclusion of legumes crops in rotation, use of modern varieties, nutrient leaching with monsoon rain, lack of knowledge of new inputs and techniques etc. In context of Nepal, rice is mainly grown in swampy areas, which are very limited and as such cannot meet rice demand of increasing population. Beside this, less attention is still being given to upland rice production in Nepal. There are large gaps between crop yield potential and farmers' yields. Fertilizer being the most crucial input for increasing crop production in the shortest possible time plays a vital role to mitigate the food demand of the country. In Nepal, fertilizer utilization is still below the optimum level to achieve the potential yield for satisfying the countries food requirement.[5]

Government of Nepal provides the regional based fertilizer recommendation which address the average fertility status of the soil of very region. So, recommendation of the fertilizer doesn't addressed the soil of farmers field and it's seems impractical to use due to insufficient dissemination of the developed approach. Thus, there is the requirement of the site specific nutrient management technique (SSNM). SSNM is an approach for "feeding" crops with nutrients as and when needs and thus can improve NUE, crop yield and farmers' income.[6] It advocates the optimal use of existing indigenous nutrient sources and timely application of fertilizers at optimal rates. Based on SSNM principles, Nutrient Expert–Rice was developed. It helps to enable the Rice growing farmer to implement SSNM for their individual which utilizes the information given by local expert to suggest meaningful yield for that location and formulate a fertilizer management strategy.[7] NE is a simple computer based decision support system (DSS) or delivery tool that can rapidly provide nutrient recommendations for N, P and K for crops for individual farmer's fields in presence or absence of soil testing results. This research helps in identifying the best ways of managing the rice nutrition and water management for sustained higher rice production in the rainfed rice ecosystem in the mid hills and terai region of Nepal.

Materials and methodology

The modeling research was conducted in Morang district of eastern Nepal in an amalgamation with FORWARD (Nepal), NRNA-NCC (Australia) and IPNI(Delhi) project "Transfer, Evaluation and Dissemination of an Improved Nutrient Management Tool (Nutrient Expert®) for Increasing Crop Yields and Farmers' Income for Eastern Nepal". Two site of Morang namely Itahara and Babiyabirta Municipality was selected since it was a major summer rice growing area. Keen interested farmers were gathered in group meeting and

training was given about the NE modeling importance and how to practice this modeling. Preliminary survey was done in these sites with the Nutrient Expert Rice questionnaire. The information was collected from the farmers and simulated attainable yield for each farmer field was obtained by using the Nutrient Expert® Rice model software.

Randomized Complete Block Design with 3 treatments and 12 replications was set up. Treatments were NE (Nutrient Expert recommendation), GR (Government recommendation), and FFP (Farmer fertilizer practices). Gross plot size of 100m^2 for each treatment and net plot size of 1m^2 (from where all yield attributing data was taken. Similarly the actual yield was taken from 10m^2. Sambha Mansuli sub 1 rice variety was sown from 4th week of June in farmer field according to the treatment set-up. Harvesting was done from 2nd week of October. Observation of No. of effective tiller per hill, Length and weight of panicle, Number and weight of grains per panicle , Test weight, straw yield and grain yield after 4 days sundry, filled and unfilled grain per panicle, total grain, Harvest index and biomass was taken. Data entry and analysis was done by using: Microsoft word for data processing, MS excel for data input, table, charts, graphs & simple statistical analysis, IBM SPSS Statistics 16, Genstat 2003 for statistical analysis. ANOVA was done at 0.05% level of significance.

**=Highly significant, *=Significant and NS=Non- Significant

Result and discussion

Panicle length

Significant difference between different treatments was found in case of panicle length. The longest panicle length was obtained in field of NE is 23.21cm.which was followed by treatment GR and FFP (22.98cm). The result obtained from GR is 22.79cm and NE is 23.21cm was statistically at par and FFP was statically at par with GR.

Plant height

Plant height of Sambha Mansuli sub 1rice was significantly affected by selected treatments. The height of plant varied from 91.66cm in FPP treatment (T3) to 96.67cm in NE treatment (T1). The highest plant height was found in NE treatment which was followed by GR treatment (93.8cm) and FPP. Table 1 showed that plant height increased with balanced fertilizer used that required by the site field. Salam MA et al.[8] Haq et al.[9] reported that highest plant height was found in high and balanced NPK fertilizer.

Effective tillers

The tiller number was highly significant with all the treatment. The number of effective tillers due to different treatment varied from 270 to 353. The highest tillers number were found in NE treatment (353) and followed by T2 treatment (311) and T3 treatment (270). Haq MT et al.[9] and uddin et al.,[10] reported that balanced and optimum use of fertilizer application increased the number of effective tiller. Similar, result was showed by Mirza et al., 2010.

Filled grain per panicle

Number of filled grain per panicle was significantly influenced by the different nutrient management. The highest filled grain per panicle was found highest in NE (119) followed by GR (114) and the lowest filled grain per panicle was found in FFP (113). The result obtained from GR and NE was statistically at par from each other. The result obtained from GR (114) and FFP (114) was statistically at par from each other.

Unfilled grain per panicle

Number of unfilled grain per panicle was highly significantly influenced by the different nutrient management. The highest unfilled grain per panicle was found in NE, i.e (19) followed by GR, i.e (17) and the lowest filled grain per panicle was found in FFP, i.e (16).

Total grain per panicle

The total number of grain per panicle was highly significantly influenced by the different nutrient management. The total grain per panicle was found highest in NE, i.e. (135) followed by GR, i.e. (128) and the lowest total grain per panicle were found in FFP, i.e. (125). The more number of grain per panicle in higher nitrogen rate were probably due to better nitrogen status of plant during panicle growth period that was applied during second spilt dose of urea of NE recommendation.

Sterility

Significant difference between different treatments was found in case of sterility %. Highest sterility was obtained in field of NE i.e. 14.73% which was followed by treatment GR and FFP. The result obtained from GR, i.e. (13.657%) and FFP, i.e. (12.90%) was statistically at par from each other.

Test weight

Test wt. was found significant difference between treatments. The highest test weight was found in the NE, i.e. (16.42g) followed by GR (15.23g) and FFP, i.e. (14.32g). It was found that test weight was higher (24.96g) if 175kg Nitrogen applied due to increase in chlorophyll content in leaves which lead to higher photosynthesis rate and ultimately plenty of photosynthesis available during grain development.

Rice Yield

Result shows that the yield was found highly significant effect in different nutrient management practices. The yield found to be highest was 5.46t/ha in NE nutrient management practice than those of farmer practices was 4.430t/ha. The yield in government practice (4.786t/ha) and farmer practice had almost similar result. The yield in the Nutrients expert management is 1t/ha more than the farmer practice. The increased % in Yield over FFP of NE was 23.25% and GR was 8.12% (Table 2). The NE-based fertilizer recommendation for rice improved the grain yield as compared to FFP across multiple sites in West Bengal. The highest yields achieved using the NE recommendation and FFP were 7,250kg/ha and 6,200kg/ha, respectively. The yield variability across sites was higher in the farmers' practices as compared to the NE treatment due to variable management of farmers. Rice yields were far more stable and varied within a short range as the NE recommendation for each individual farmer was designed to achieve the maximum attainable yield of HYV rice in the kharif season.

Other studies using NE for maize and wheat also showed significant yield advantage from the tool-based fertilizer recommendation as compared to existing practices.[7] Dubermann *et al.*,[6] also reported the same result that NE or SSNM practice showed the highest yield than the farmer practice.

Citation: Gupta G, shrestha A, shrestha A, et al. Evaluation of different nutrient management practice in yield and growth in rice in Morang district. *Adv Plants Agric Res.* 2016;3(6):187–191. DOI: 10.15406/apar.2016.03.00119

Table 1 Effect of improved nutrient management on panicle length, Panicle weight, Plant height, tiller per m^2, filled grain, unfilled grain, sterility, total grain and test wt. of Sambha Mansuli sub 1rice

Treatment	panicle length (cm)	Panicle weight (g)	Plant height (cm)	Tiller per M^2	Filled grain/ panicle	Unfilled grain/ panicle	Sterility (%)	Total grain	Test Wt. (g)
NE	23.21a	2.208	96.672a	353a	119a	19a	14.730a	135a	16.42a
GR	22.79ab	2.013	93.80ab	311b	114b	17b	13.657b	128b	15.23b
FFP	21.98b	2.223	91.655b	270c	113b	16c	12.90b	125b	14.32C
SEM(+-)	0.249	0.2794	3.5	20.64	3.236	0.914	0.814	2.73	0.73
LSD(0.05)	0.731*	0.0953NS	1.193*	7.04**	1.103*	0.312**	0.277*	0.931**	0.249*
CV (%)	3.5	6.8	5.7	14.6	5.1	19.3	17.9	6.5	4.1

Table 2 Effect of improved nutrient management on yield, straw weight and harvest index of Sambha Mansuli sub-1 rice

Treatment	yield (T/Ha)	Yield difference over FPP(T/Ha)	Increased % in yield over FFP	straw Wt.(T/ Ha)	Straw Wt, difference over FPP	Increased % straw over FFP	Biomass	HI (%)
NE	5.46	1.03	23.25%	10.32	1.06	11.44%	15.78	34.71
GR	4.79	0.36	8.12%	9.55	0.29	3.13%	14.34	33.52
FR	4.43	0		9.26	0		13.69	32.37
SEM(+-)	0.066			0.202			0.291	0.584
LSD	0.195**			0.594*			0.603**	1.714*
CV (%)	10			10.8			9.7	5.8

**=Highly significant, *= Significant and NS= Non- Significant.

Straw weight

All the treatment of nutrient management showed significant result. In the NE recommendation, the straw wt. was found to be highest (10.322t/ha) and followed by government recommendation (9.548t/ha) and Farmer practices (9.257t/ha). The result obtained from GR and FFP was statistically at par.[11–16] The straw weight difference over FPP was found 1 times more in NE. The increased % in straw weight over FFP of NE was 11.44% and GR was 3.13 % (Table 2). Straw yield is a function of vegetative growth. Balanced and optimum used of fertilizer increased plant higher, green leaves/hill, tillers/hill and dry matter production which finally resulted in higher straw yield. Similar results were reported by Mirza et al. (2010).

Harvesting Index (HI)

All the treatment of nutrient management showed significant result. In the NE recommendation, the HI was found to be highest (34.71%) and followed by government recommendation (33.519%) and Farmer Fertilizer practice (32.371%) (Table 2). The result obtained from GR was found statistically at par from NE and FFP.

Biomass

Biomass was found highly significantly by the different nutrient management. In the NE recommendation, the biomass was found to be highest (15.78%) followed by government recommendation (14.34%) and Farmer Fertilizer practice (13.69%) (Table 2) (Figure 1-4).

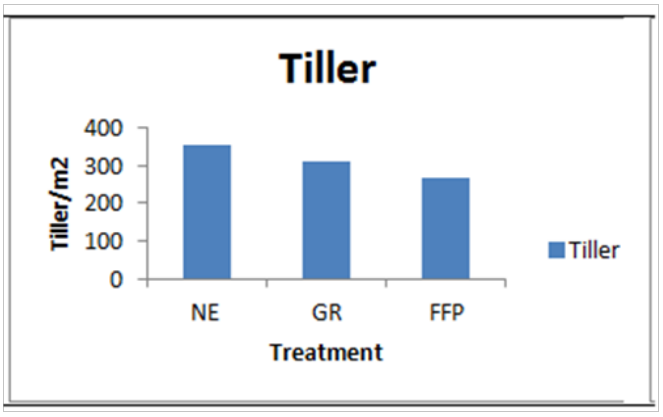

Figure 1 Effect of improved nutrient management in tiller.

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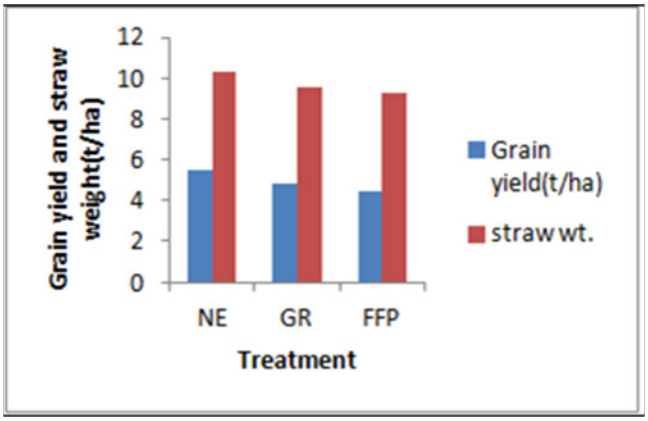

Figure 2 Relationship between grain yield and straw weight.

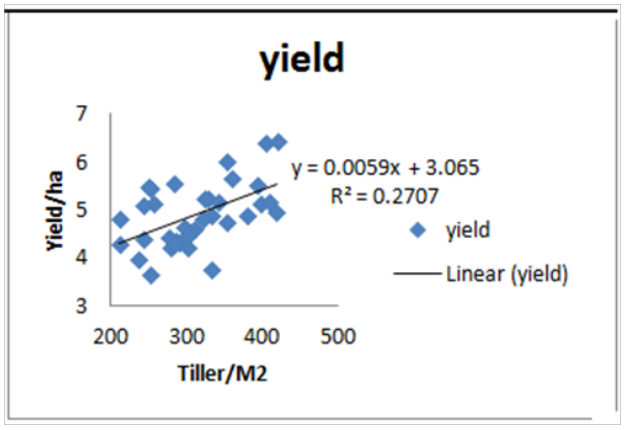

Figure 3 Relationship between yield wt. and tiller.

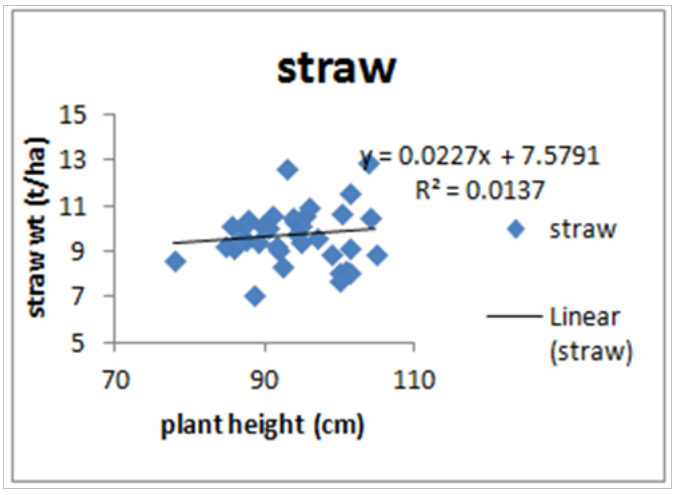

Figure 4 Relationship between straw wt and plant height.

Conclusion

From the trail, we got the highest yield in the NE treatment whereas least yield in farmer practices. The highest yield helps to increase the income and profitability. Comparison of Nutrient Expert® (NE) estimated attainable rice yield versus actual rice yield in farmer field trail, NE-based fertilizer recommendations proved to be successful in reaching the yield targets estimated by the software. The actual rice yields recorded in farmer fields were higher than the NE estimated attainable yields. Thus, NE recommendation was found better over GR and FP. Higher yield from rice was obtained from NE based recommendation as it make use of the right source of fertilizer, at right time, in right amount and in right place and fulfilled the growing demand for rice for food and feed. Hence, NE is the best tools to increase the productivity of Rice in Nepal as well as in grainary area called Terai region.

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None.

Conflict of interest

The author declares no conflict of interest.

References

1. Yogendra Kumar Karki. Ministry of Agricultural Development (MoAD). Nepal Portfolio Performance Review; 2015.
2. Agriculture in Nepal. Wikipedia; 2016.
3. Statistical Information on Nepalese Agriculture; 2014/15.
4. FAO Statistical Yearbook (FAOSTAT); 2013.
5. Nepal Crop Production index. Index mundi, India; 2012.
6. Witt C, Dobermann A, Abdulrachman S, et al. Internal nutrient efficiencies of irrigated lowland rice in tropical and subtropical Asia. *Field Crops Res*. 1999;63(2):113–138.
7. Satyanarayana T, Majumdar K, Pampolino M, et al. A tool to optimize nutrient use and improve productivity of maize. *Better Crops*. 2012;97(1):21–24.
8. Salam MA, Fouzia Lucy, Kabir MH, et al. Effect of different doses of fertilizers on yield and yield components of two varieties of *boro* rice. *J Agro for Environ*. 2011;5(2):53–56.
9. Haq MT, Sattar MA, Hossain MM, et al. Effects of fertilizers and pesticides on growth and yield of rice. *Online journal of Biological Sciences*. 2002;2(2):84–88.
10. Uddin MS, Sattarand MA, Salam MA. Effect of organophosphorus pesticides on ecology of Rice production in soils. *Bangladesh J Environ Sci*. 1998;4:169–178.
11. Mirasol F Pampolino, Christian Witt, Julie mae pasuquin, adrian johnston, myles j fisher. Development approach and evaluation of the Nutrient Expert software for nutrient management in cereal crops. *Computers and Electronics in Agriculture*. 2012;88:103–110.
12. Mirasol Pampolino, Kaushik Majumdar, Jat ML, et al. Development and evaluation of nutrient expert for wheat in South Asia. *Better Crops*. 2012;96(3):29–31.
13. Roland J Buresh. *Nutrient best management practices for rice, maize, and wheat in Asia*. Metro Manila, Philippines: International Rice Research Institute; 2009.

14. Krupnik TJ, Yasmin S, Pandit D, et al. Yield performance and agronomic n efficiency of a maize–rice rotation under strip and conventional tillage in contrasting environments in Bangladesh. International Maize and wheat improvement center.

15. Neelima TL, Bhanu Murthy VB. Growth and yield attributes of rice as influenced by fertilizer and differential incorporation of sunhemp green manure. *Journal of Rice Research*. 2018;2(1):45–50.

16. Vijay Singh Meena, Maurya BR, Verma R, et al. Effect of concentrate manure and inorganic fertilizers on soil electro–chemical properties and productivity of rice (*Oryza sativa* L.) under Inceptisol of Varanasi. *Annals of Biology*. 2013;29(3):358–363.

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