**SHORT COMMUNICATION**

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# Integrated nutrient management in hybrid rice under terai zone of West Bengal

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## ABSTRACT

*A field experiment was conducted during the dry seasons of 2010 and 2011 to study the response of hybrid rice to graded levels of NPK supplied through integrated nutrient management. Experimental results revealed that application of FYM (10 t ha$^{-1}$) in combination with $N_{100}P_{22}K_{41.6}$ or $N_{140}P_{31}K_{58}$ produced significantly higher number of matured panicles and resulting in higher yield. Application of inorganic fertilizer level of $N_{100}P_{22}K_{41.6}$+ FYM+ Zn produced the highest grain yield (9.13 t ha$^{-1}$) which was at par with $N_{100}P_{22}K_{41.6}$+ FYM at 10 t ha$^{-1}$ and $N_{140}P_{31}K_{58}$. The split application of potassium resulted in higher yield than its application only once. The higher net return (₹ 55226.00 ha$^{-1}$) was recorded with application of $N_{100}P_{22}K_{41.6}$+FYM (10t ha$^{-1}$)+$ZnSO_4$ at 25 kg ha$^{-1}$. The application of NPK in higher level with FYM gave the highest nutritional uptake.*

**Key words:** *hybrid rice, grain yield, nutrient management, economics*

Hybrid rice technology is one of the options to augment rice productivity. In *terai* zone of West Bengal the productivity of rice is very poor (1.63 t ha$^{-1}$) against the state average (2.53 t ha$^{-1}$) though 5.46 lakh ha of land is under rice cultivation during 2008-09 (Anonymous, 2010). For boosting up the existing productivity level, use of hybrid rice may be a good option. Hybrid rice has the potential to produce 15-20% higher yield than existing varieties (Mahadevappa, 1996). However, hybrid rice requires heavy input of nutrients as it removes a substantial amount of nutrients from the soil. The price of inputs, mainly chemical fertilizers, is increasing day by day. Therefore, emphasis has to be given in maximizing nutrient use efficiency and minimizing the cost of production. The efficiency of nutrients may be increased by combined use of organic and inorganic fertilizers, supplying nutrients in peak period of demand or application of nitrogen in slow-release form. Hence a field experiment was conducted to study the response of hybrid rice to graded levels of NPK supplied through integrated nutrient management in *Terai* region of West Bengal.

The experiment was carried out during the dry season of 2010 and 2011 in Coochbehar, West Bengal in sandy loam soil with mineralizable N (135.50 kg ha$^{-1}$), available P (22.70 kg ha$^{-1}$) and available K (129.60 kg ha$^{-1}$) and pH 5.9. The experiment was laid out in randomized complete block design with twelve treatments replicated thrice. The treatments comprised of combinations of biofertilizer, organic and inorganic nutrients, viz., $N_{100}P_{22}K_{41.6}$;$N_{140}P_{31}K_{58}$; $N_{100}P_{22}K_{41.6}$ (2/3$^{rd}$ K as basal + 1/3$^{rd}$ K at PI); $N_{140}P_{31}K_{58}$ (2/3$^{rd}$ K as basal + 1/3$^{rd}$ K at PI); $N_{100}P_{22}K_{41.6}$+ FYM at10 t ha$^{-1}$; $N_{140}P_{31}K_{58}$ + FYM at 10 t ha$^{-1}$; $N_{100}P_{22}K_{41.6}$+ $ZnSO_4$ at 25 kg ha$^{-1}$; $N_{140}P_{31}K_{58}$ + $ZnSO_4$ at 25 kg ha$^{-1}$; $N_{100}P_{22}K_{41.6}$+ 25% extra plant population; $N_{100}P_{22}K_{41.6}$+ N in slow-release form; $N_{100}P_{22}K_{41.6}$+ FYM at 10 t ha$^{-1}$ + $ZnSO_4$ at 25 kg ha$^{-1}$; $N_{100}P_{22}K_{41.6}$+ AZO-PSB. The total amount of phosphorus, potassium and zinc sulphate were applied as basal except in treatment $N_{100}P_{22}K_{41.6}$ (2/3$^{rd}$ K as basal + 1/3$^{rd}$ K at PI) and $N_{140}P_{31}K_{58}$ (2/3$^{rd}$ K as basal + 1/3$^{rd}$ K at PI) where potassium was applied in splits. Nitrogen was applied in three equal splits at final land preparation, active tillering and at panicle initiation stage. To make nitrogen in slow-release form, urea was treated with neem-extract powder and kept in shade for 48 hours before application. FYM and biofertilizers(AZO-PSB) were applied 15 days before transplanting the seedlings. The rice hybrid RH 664 was planted with single seedling of 21 days old at a spacing of 20 cm x 15 cm. Yield attributes and yield data were taken from sample plots accordingly. Oven-dried grain and straw samples were digested and plant analysis was done following standard methods and nutrient uptake was calculated accordingly.

The highest number of panicles $m^{-2}$ (398) was recorded with application of inorganic fertilizer $N_{100}P_{22}K_{41.6}$+ FYM+Zn. Among different nutrient management practices, application of FYM at $N_{100}P_{22}K_{41.6}$ or at $N_{140}P_{31}K_{58}$, being at par, produced significantly higher number of matured panicles $m^{-2}$ (Table 1). It could be due to slow rate of release of nutrients from FYM after decomposition. This slow release over a longer period favoured better plant growth and yield components of hybrid rice. Parihar (2004) reported similar effect of FYM on rice. The same nutrient management practices significantly increased number of filled grains $panicle^{-1}$. Application of K in splits (2/3rd as basal + 1/3rd at panicle initiation stage) produced higher number of matured grains $panicle^{-1}$, number of filled grains panicle-1 in comparison to the single application as basal. The split application of K might have a favourable effect in nutrient mobilization, increased enzymatic activities as well as increased translocation of photosynthates; which favoured the yield components. This was in line of conformity with the findings of Pandey *et al.* (2007). Slow release of nitrogen checked the nitrogen loss and thereby increased the yield components than untreated nitrogen.

Application of inorganic fertilizer at $N_{100}P_{22}K_{41.6}$+ FYM+ Zn produced the highest grain yield (9.13 t $ha^{-1}$) which was at par with $N_{100}P_{22}K_{41.6}$+ FYM and $N_{140}P_{31}K_{58}$. Application of FYM with inorganic fertilizer might have supplied several primary nutrient element as well as micronutrients. Pandey and Tripathy (1993) also reported that application of 10 t $ha^{-1}$ of FYM resulting in saving of 50 kg N, 6.9 kg P and 16.6 kg K with addition of several micronutrients. Among the inorganic fertilizer $N_{140}P_{31}K_{58}$ produced significantly higher yield (7.23 t $ha^{-1}$) over $N_{100}P_{22}K_{41.6}$(5.83 t $ha^{-1}$) and yield increment was recorded to be 20% (Table 1). These results are in conformity with the findings of Pandey *et al.* (2007). The split application of potassium was associated with efficient soil-absorption and transportation (Pandey *et al.*, 1993) and resulting in higher yield than application once. Majumder and Ghosh (1980) reported that inherent limitation associated with full K-application as basal were efficiently circumvented by split application. Less denitrification in anaerobic layer with neem-coated

**Table 1.** Yield attributes, grain and straw yield and economics of hybrid rice as influenced by integrated sources of nutrient .

| Treatments | No. of matured panicle $m^{-2}$ | No. of filled grains $panicle^{-1}$ | Test wt.(g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) | Net return* (₹ $ha^{-1}$ ) | B-C ratio |
|---|---|---|---|---|---|---|---|
| $N_{100}P_{22}K_{41.6}$ | 351 | 171 | 22.7 | 6.02 | 6.59 | 31452.00 | 2.46 |
| $N_{140}P_{31}K_{58}$ | 377 | 199 | 22.9 | 7.23 | 7.66 | 40556.00 | 2.75 |
| $N_{100}P_{22}K_{41.6}$ (2/3rd K as basal + 1/3rd K at PI) | 364 | 196 | 22.5 | 6.95 | 7.43 | 39524.00 | 2.82 |
| $N_{140}P_{31}K_{58}$ (2/3rd K as basal + 1/3rd K at PI) | 381 | 205 | 23.0 | 7.38 | 7.89 | 42764.00 | 2.93 |
| $N_{100}P_{22}K_{41.6}$+ FYM at10 t $ha^{-1}$ | 389 | 209 | 23.1 | 8.23 | 8.84 | 49988.00 | 3.20 |
| $N_{140}P_{31}K_{58}$ + FYM at 10 t $ha^{-1}$ | 394 | 12 | 22.8 | 8.43 | 9.06 | 50316.00 | 3.10 |
| $N_{100}P_{22}K_{41.6}$+ $ZnSO_4$ at 25 kg $ha^{-1}$ | 356 | 182 | 23.1 | 6.51 | 6.99 | 35514.00 | 2.63 |
| $N_{140}P_{31}K_{58}$ + $ZnSO_4$ at 25 kg $ha^{-1}$ | 366 | 193 | 23.1 | 6.85 | 7.39 | 36962.00 | 2.59 |
| $N_{100}P_{22}K_{41.6}$+ 25% extra plant population | 349 | 178 | 22.7 | 6.33 | 6.84 | 33740.00 | 2.54 |
| $N_{100}P_{22}K_{41.6}$+ N in slow-release form | 360 | 184 | 22.8 | 6.74 | 7.34 | 38564.00 | 2.85 |
| $N_{100}P_{22}K_{41.6}$+ FYM at 10 t $ha^{-1}$+ $ZnSO_4$ at 25 kg $ha^{-1}$ | 398 | 221 | 23.7 | 9.13 | 9.62 | 55226.00 | 3.20 |
| $N_{100}P_{22}K_{41.6}$+ AZO-PSB | 362 | 189 | 22.9 | 6.85 | 7.53 | 39012.00 | 2.83 |
| CD (P=0.05) | 39 | 13.7 | NS | 0.38 | 0.43 | | |

N.B.(*) Cost of cultivation were ₹. 21524 , 23068, 21636, 22180, 22436, 23868, 21774, 23318, 21964, 20748, 25118 and 21274 for Treatments, respectively

**Table 2.** Effect of integrated sources of nutrients on NPK uptake of hybrid rice (mean of 2 years)

| | Nutrient Uptake (Kg $ha^{-1}$) | | |
|---|---|---|---|
| Treatments | N | P | K |
| $N_{100}P_{22}K_{41.6}$ | 99.6 | 23.3 | 159.3 |
| $N_{140}P_{31}K_{58}$ | 131.2 | 32.3 | 198.4 |
| $N_{100}P_{22}K_{41.6}$ (2/3rd K as basal+1/3rd K at PI) | 117.3 | 26.4 | 188.2 |
| $N_{140}P_{31}K_{58}$ (2/3rd K as basal+1/3rd K at PI) | 148.2 | 37.5 | 224.7 |
| $N_{100}P_{22}K_{41.6}$+ FYM at10 t $ha^{-1}$ | 157.2 | 42.9 | 261.3 |
| $N_{140}P_{31}K_{58}$ + FYM at 10 t $ha^{-1}$ | 155.3 | 44.7 | 257.2 |
| $N_{100}P_{22}K_{41.6}$+ $ZnSO_4$ at 25 kg $ha^{-1}$ | 137.5 | 40.4 | 168.7 |
| $N_{140}P_{31}K_{58}$ + $ZnSO_4$ at 25 kg $ha^{-1}$ | 134.3 | 37.3 | 172.5 |
| $N_{100}P_{22}K_{41.6}$+ 25% extra plant population | 139.3 | 38.5 | 165.7 |
| $N_{100}P_{22}K_{41.6}$+ N in slow-release form | 133.8 | 36.9 | 166.2 |
| $N_{100}P_{22}K_{41.6}$+ FYM at 10 t $ha^{-1}$+ $ZnSO_4$ at 25 kg $ha^{-1}$ | 163.5 | 44.3 | 252.5 |
| $N_{100}P_{22}K_{41.6}$+ AZO-PSB | 136.5 | 37.2 | 165.3 |
| CD (P=0.05) | 11.2 | 3.7 | 19.4 |

urea helped in efficient utilization of nitrogen resulting in higher yield (6.74 t $ha^{-1}$) than untreated form (6.02 t $ha^{-1}$). Application of zinc with $N_{100}P_{22}K_{41.6}$ or $N_{140}P_{31}K_{58}$ brought about an increase in yield; when zinc was applied with FYM that resulted in maximum yield. Increase in plant population unable to make any significant improvement in grain yield. The trend was similar in case of straw yield too. The findings are similar with the findings of Pandey *et al.*(2007).

The cost of cultivation was lowest with lower inorganic level ($N_{100}P_{22}K_{41.6}$) only, whereas it was the highest when inorganic level was combined with FYM and zinc. The highest net return (₹ 55226.00 $ha^{-1}$) was recorded with application of inorganic $N_{100}P_{22}K_{41.6}$+ FYM+Zn (Table 1). Slight increase in cost of cultivation in inorganic+inorganic treatment resulted in huge boosting in yield of hybrid rice leading to higher profit and benefit-cost ratios. Beneficial effects of conjunctive use of organic and inorganic nutrients in hybrid rice were also reported by Bhowmik and Nayak(2000) and Pandey *et al.* (2007).

The application of NPK in higher level with FYM and Zn($N_{100}P_{22}K_{41.6}$+ FYM at 10 t $ha^{-1}$+ $ZnSO_4$ at 25 kg $ha^{-1}$) gave the highest nutritional uptake than other management practices (Table 2). Realization of higher yield might be the cause for this increased uptake. Split application led to significantly higher K uptake than its single application as basal at both the levels. This might be due to efficient absorption and utilization by plants. These findings were in close conformity with the findings of Yadav *et al.* (2005). Application of FYM might have modified the physical condition of the soil and helped in translocation of nutrients from soil.

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