Nutrient-response model and economic nutrient level for rice
(Oryza sativa) – Indian mustard (Brassica juncea) sequence

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Rao and Singh (1987) and Balasubramaniyan (1989) reported that phosphorus in rice (Oryza sativa L.) not only influences its yield but also remains available to the succeeding crops. Nutrient levels are to be chosen primarily for the economic benefit of farmers, elimination of soil-nutrient deficiency and the maximization of production by maintaining soil fertility through application of nutrients. Hence an experiment was conducted to develop production function for the effect of nitrogen and phosphorus on rice yield and their residual effect on Indian mustard [Brassica juncea (L.) Czernj. & Cosson], and economic analysis was carried out to find out the most profitable level of nutrients.

The experiment was conducted during the rainy and winter seasons of 1989–90 at Raipur. The treatments were: T1, N40P0 (N 40 kg/ha + P 0 kg/ha); T2, N40P17.2; T3, N40P34.4; T4, N80P0; T5, N80P17.2; T6, N80P34.4; T7, N120P0; T8, N120P17.2; and T9, N120P34.4. Nutrient in all the combinations were applied to 'Kranti' rice in rainy season and a common dose of 80 kg N/ha to 'Varuna' Indian mustard in winter season. The trial was laid out in factorial partially confounded design. Rice was transplanted on 17 July 1989 and Indian mustard was sown on 27 November 1989. The soil of the experimental field was low in N (286 kg/ha), medium in P (11.2 kg/ha) and high in K (291.5 kg/ha) and organic carbon 0.32%, and was neutral in reaction (6.9 pH).

For quantitative effect of nutrient levels on yield, calculation of optimal levels and analysis of variance of data require the representation of yield as a function of applied nutrient level (France and Thornley 1984). Hence polynomial-type mathematical model was chosen:

\[ Y = a + bN + cP + dN^2 + eNP + fP^2 \]

where a, b – f, constants; N and P, the variables representing levels of nitrogen and phosphorus nutrients respectively. For economic analysis, standard procedure of taking first-order partial derivative of the model and equating it to unit cost of fertilizers, including cost of application per unit cost of produce, was used.

Total economic yield of rice significantly increased with increase in levels of N and P from 40 to 120 kg N/ha and 0 to 34.4 kg P/ha. However, at 120 kg N/ha the response to P was significant, though the maximum yield of rice was observed with P34.4, which was at par with P0 (Table 1). Similarly, yield of Indian mustard increased with increase in levels of N and P applied to rice. It indicates the residual effect of P to succeeding Indian mustard. N
and P also increased the total production of rice and Indian mustard.

Profitable level of nutrient for rice is **N₄₀P₀** that gives Rs 37.66 per rupee investment. In Indian mustard the best result was obtained under **N₁₂₀P₃₄.₄** applied to rice and **N₉₀** applied to Indian mustard. However, for rice-Indian mustard sequence the best profit: investment ratio (21.97) was received with **N₄₀** to rice and **N₉₀** to Indian mustard, with no phosphorus application at all, because of the presence of medium to high initial P in the soil.

The analysis of polynomial-type nutrient-response model indicates that most profitable levels of N and P were 17.43 kg/ha and 42.99 kg/ha respectively for obtaining economic yield of rice (3.82 tonnes/ha), and 108.33 kg N/ha and 27.4 kg P/ha for Indian mustard (928 kg/ha). However, the economic nutrient dose in winter-season Indian mustard was 90.90 kg N/ha (without P).

On the basis of yield data of rainy-season rice and winter-season Indian mustard obtained at various levels of N and P, polynomial-type nutrient-response model was found the best fit by adopting regression technique. For rainy-season rice crop the most economic nutrient levels were 17.4 kg N/ha with 42.99 kg P/ha, giving a yield of 3.82 tonnes/ha. Subsequently, an application of 90.9 kg N/ha (without P) to winter-season Indian mustard gave most economical yield of 928 kg/ha.

**REFERENCES**

