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Efficient nutrient management for late *rabi* rice

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Abstract : Field experiments were conducted during late *rabi* season of 1997-'98 and 1998-'99 at A.C&R.I., Madurai, to study the nutrient management practices under late transplanted condition of *rabi* rice. Application of recommended N and K (150 and 50 kg ha^{-1} each) in four splits + nutrient foliar spray + *Sesbania rostrata as* intercrop + SSB registered significantly higher yield attributes and grain (6388 and 6534 kg ha^{-1}), straw yields (8281 and 8276 kg ha^{-1}) during 1997-'98 and 1998-'99 respectively. *(Key words: Rice, Late rabi, N & K, Split application, Nutrients, Foliar spray, Sesbania rostrata, SSB, Yield).*

Rice occupies a pivotal position in the food security system of India and contributes to 41.5 per cent of the total food grain production. In future, the food security of India depends on the capacity to achieve sustained improvement in the productivity and profitability of rice farming.

In Periyar Vaigai Command (PVC), rice is cultivated as a major crop both in the *kharif* and *rabi* seasons. About 18,440 ha is under double cropped rice in PV Command. In the event of delayed onset of SWM, there is inadequate storage position of water in the reservoir. As a result, the release of water is delayed even upto the month of August and consequently the transplanting of *kharif* rice gets delayed. This will ultimately result in the delayed transplanting of *rabi* rice. Under such condition the uptake and mobility of the nutrients got reduced due to malevolent weather (Sreedharan and Vamadevan, 1981). Hence, a study was undertaken to develop efficient nutrient management practices for late *rabi* rice.

Materials and Methods

Field experiments were conducted during late *rabi* seasons of 1997-'98 and 1998-'99 at AC&RI, Madurai. The soil was sandy clay loam in texture with pH 7.2, low in available N (162.4 kg ha^{-1}), medium in available P_2O_5 (13.4 kg ha^{-1}) and high in available K_2O(290 kg ha^{-1}). The treatments consisted of

- N_1 - Recommended N & K in three splits i.e. 50% basal, 25% at AT and 25% at PI (control)
- N_2 - Recommended N & K in four splits i.e. 16.7% at 7 DAT (establishment), 33.3% at 21 DAT (active tillering), 33.3% at 55 DAT (panicle initiation), 16.7% at 65 DAT (flowering)
- N_3 - N_2+ foliar spraying of nutrients (0.5% $ZnSO_4$ + 0.2% $CuSO_4$ + 1% MOP + 1% DAP) at T, AT and PI.
- N_4 - N_3+ intercropping of *Sesbania rostrata* and incorporated at 45 DAT
- N_5 - N_4+ Silica Solubilising Bacteria (SSB) @ 2 kg ha^{-1}

Note : T - tillering, AT - active tillering and PI - panicle initiation

The experiment was laid out in randomised block design with four replications. The medium duration rice Cv. ADT 39 was transplanted at spacing of 15 x 10 cm during second week of November in both the years. The recommended dose of fertilizers (150:50:50 kg ha^{-1} of N, P_2O_5 and K_2O respectively) were applied as per the treatment schedule. Twenty five days old seedlings of *S.rostrata* were transplanted in the rogue spacings at 1.5 m interval along with paddy seedlings and incorporated at 45 DAT. The silica solubilizing bacteria *(Bacillus sp.)* @ 2 kg ha^{-1} as basal as per the treatments.

The silica solubilizing bacteria (SSB) @ 2 kg ha^{-1} along with 25 kg of FYM was mixed and broadcasted over the field prior to planting of rice.

One gram of DAP in 100 ml of water was prepared separately by overnight soaking and this was mixed with the nutrient combination of 0.5 g $ZnSO_4$, 0.2 g $CuSO_4$ and 1.0 g of muriate of potash each dissolved in 100 ml of water just before spraying the crop. The spraying of nutrient mixture was done immediately.

The pooled mean of the two years data are presented in the tables.

Table 1. Effect of nutrient management practices on the growth parameters of late *rabi* rice (pooled mean)

Treatments	Plant height at harvest (cm)	Number of tillers at flowering	LAI at flowering	Dry matter production at harvest (kg ha^{-1})
N_1	80.1	9.9	5.2	12256
N_2	83.8	10.5	5.4	12637
N_3	93.6	10.8	6.1	14139
N_4	96.5	12.0	6.3	14349
N_5	100.1	13.6	6.5	14735
SEd	1.5	0.4	0.2	107
CD (P=0.05)	3.8	0.8	0.4	210

Table 2. Effect of nutrient management practices on yield attributes, yield and economics of late *rabi* rice (pooled mean)

Treatments	No. of panicles m^{-2}	No. of filled grains $panicle^{-1}$	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Net return per rupee invested
N_1	344	75	19.8	5193	7045	2.21
N_2	358	78	20.3	5435	7201	2.33
N_3	372	79	20.7	6080	8059	2.41
N_4	384	83	21.0	6256	8088	2.32
N_5	203	85	21.2	6461	8279	2.43
SEd	8	2	0.2	57	77	-
CD (P=0.05)	16	3	0.3	114	156	-

Table 3. Effect of nutrient management practices on nutrient uptake (harvest stage) of late *rabi* rice (pooled mean)

Treatments	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
N_1	102.2	21.7	83.4
N_2	106.4	23.1	87.1
N_3	117.9	26.0	98.3
N_4	121.1	26.7	100.3
N_5	125.2	28.1	103.7
SEd	2.0	0.8	1.6
CD (P=0.05)	4.2	1.6	3.3

Results and Discussion

Growth parameters

The nutrient management practices significantly influenced the growth parameters *viz.*, plant height, number of tillers, LAI and dry matter production. Application of N & K in four splits + foliar spraying of nutrient mixture + intercropping of *S.rostrata* with SSB (N_5) recorded significantly higher values for growth characters (Table 1). The reason that could be attributed was enhanced nutrient uptake (Table 3). Intercrop *S.rostrata* when incorporated, under decomposition might have solubilised the soil native P apart from contribution from its green biomass which led to the balanced nutrition availability and hence taller plants, more number of tillers, higher LAI and dry matter production were obtained (Diack, 1986).

Yield Attributes and Yield

The yield attributes of rice *viz.* number of panicles, filled grains per panicle, test weight and grain and straw yields were significantly influenced by various nutrient management practices during both the years of study (Table 2). Application of N and K in four splits + foliar spraying of nutrient mixture + intercropping of *S. rostrata* along with SSB (N_5)produced significantly higher values followed by N_4(Table 2).

Application of N and K in four splits till flowering (N_2) but skipping the basal registered a higher rice grain yield of 4.5 per cent over the existing practice of three splits (N_1). It was due to the priming effect of late application of fertilizer N which resulted in the release of organic source of N even beyond the stage of flowering (Selvi, 1998).

Along with four splits of N and K (N_2), if the nutrients were sprayed (N_3) the increase in rice grain yield was 10.6 per cent. The role of all nutrients in increasing the rice grain yield through their activities on photosynthesis, respiration, carbohydrate / nitrogen balance, carbon-di-oxide utilisation, P metabolism and chlorophyll formation is clearly illustrated under growth parameters.

The positive role of adding a green manure along with four splits of N and K and nutrients spray (N_4) was well exposed through the increase in the grain yields by 2.8 per cent over four splits + nutrient spray (N_3) and as high as 17.0 per cent over three splits (N_1). Addition of green manure benefited the rice crop through increased N availability in the soil as seen from the higher uptake by rice crop was reported by Srividya (1991) and efficient utilisation of mineralised N from the incorporated *Sesbania rostrata* (Solaiappan and Veerabadran, 1997).

The contribution of SSB towards the increase in grain yield of late *rabi* rice was significantly substantiated. The basal addition of SSB @ 2 Kg ha^{-1} along with four splits of N and K, foliar spraying of nutrient mixture and addition of *S. rostrata* (N_5) increased the rice grain yield by 3.2 per cent over N_4. The reasons for the SSB increasing the late *rabi* rice grain yield might be due to erectness of leaves, efficient photorespiration, carbon assimilation and promotion of new root growth (Gaussman, 1962), improvement in oxygen supply to roots by increasing the volume and rigidity of the gas channels (Ponnamperuma, 1964), better translocation of P from source to sink (Cheng *et al.* 1973). Moreover, the yield increase after silica application was largely attributed to the advantage gained in grain filling and grain weight (Murali Kannan, 1996).

Based on the results of the study, application of N and K in four splits (skipping basal) + foliar spraying of nutrient mixture + intercropping of *S.rostrata* + SSB was found to be the best nutrient management practice for obtaining maximum yields of late *rabi* rice.

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Soil fertility management in fodder cultivated area through sewage water irrigation

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Abstract : Field experiments were conducted at AC & RI, Madurai to study the effect of sewage effluent on nutrient availability in soils besides improving the fodder yield and quality of bajra napier hybrid grass (BN 2) . Field experiments were conducted in a spilt plot design with two irrigation sources *viz.*, ordinary water (I_1) and sewage effluent (I_2) as main plots and four N leves *viz.*, 0, 50, 75 and 100 kg N ha^{-1} as sub plot treatments with three replications. BN 2 grass was grown as a test crop. The analyses of sewage effluent collected at periodic intervals showed that the sewage effluent was alkaline in reaction (pH : 8.3), non-saline (EC: 1.1-1.5 dSm^{-1}). The total N, P, K, Ca and Mg contents ranged from 220-700 ppm, 3-14 ppm, 16-268 ppm, 18-292 ppm and 19-134 ppm, respectively. The micronutrients like Zn, Cu, Mn and Fe ranged from traces - 0.18, traces- 0.06, 0.03- 0.21 and traces-12.84 ppm respectively. The heavy metals like selenium and cadmium were absent whereas lead, chromium and nickel were present in trace amounts. The bacterial, fungi and actinomycetes population in sewage water were $3.55 \times 10^7 ml^{-1}$, $2.68 \times 10^3 ml^{-1}$ and $5.55 \times 10^3 ml^{-1}$, respectively. Periodic soil samples were taken after 2nd, 4th and 8th cuts during first year and after 4th and 8th cuts during second year. Addition of increased levels of N increased the available N content in soil. Irrigation with sewage effluent increased the organic carbon content (0.96%) compared to ordinary water (0.65%). A built up in soil available N, K and organic carbon content was observed due to sewage effluent irrigation. *(Key words : Bajra Napier Hybrid Grass, Sewage effluent, Nutrient availability, Organic carbon, Micro nutrients)*

Growing fodder crops using waste water and effluents is gaining commercial importance. The commercial fodder production invariably invites heavy applications of nitrogenous fertilizers to enhance productivity. In addition to large amount of certain plant nutrients, organic matter and heavy loads of microorganisms, such waste waters may also contain appreciable amounts of micronutrients (Fe, Mn, Cu and Zn) and heavy metals (Ni, Cr, Cd, Pb, Se etc...) depending on their source. Their possible potential pollution hazards on soil, environment and fodder require evaluation for long term monitoring purposes. Keeping this in view, the present investigation was carried out to assess the fertility built up in fodder cultivated area through sewage water irrigation.

Materials and Methods

Field experiments were conducted during 1992-93 to study the effect of sewage effluent