RESPONSE OF IRRIGATED DRY AND WET SEEDED RICE TO NITROGEN LEVELS AND TIME OF BASAL APPLICATION

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ABSTRACT

A field investigation was made to study the level and time of initial fertilizer N application to irrigated dry and wet seeded rice to maximise N use efficiency and yield. Two experiments were conducted during kuruwai (June to September) and samba seasons (September - January) on dry seeded rice and one experiment in theledi season (October to February) on wet seeded rice. Nitrogen application caused a general increase in the yield of rice, however, the response was at a decreasing rate. The economic dose of N was found to be 55.8, 122.5 and 123.3 kg ha\(^{-1}\) to get a grain yield of 51.8, 34.5 and 25.2 t ha\(^{-1}\) in kuruwai, theledi and samba seasons respectively. The initial dose of 50 per cent of total N could be applied 20 days after sowing (DAS) to kuruwai and samba crops when dry seeding was done and 10 DAS to theledi crop when sprouted seeds were sown on paddy field, to maximise the grain yield and N use efficiency.

KEY WORDS: Direct seeded rice, N dose and timing, production function

Transplanting of rice in puddled field is the ruling rice culture in Tamil Nadu. Now-a-days, the receipt of irrigation water from the monsoon-dependent river projects is delayed to take up transplantation of rice in the right season, leading to yield reduction. In order to make best use of the pre-monsoon rains, underground water and canal water on its receipt, direct seeding of rice either in dry soil in dry season or wet seeding on paddy during monsoon season could be an alternate rice culture system. Management of applied fertilizer N in direct seeded rice is different from that of transplanted rice. One way to achieve better use of applied N is to apply the nutrient at the rate and time to best meet at the demand of the rice plant (Greenwood, 1982). Varying responses have been reported to graded levels of N application.

For direct seeded rice, Maurya and Vaish (1984) recommended reducing basal application of N to a minimum, as the seedlings take some time to establish and start absorbing the applied nutrients and the nutrients in the seeds are sufficient to sustain 15 days of seedling growth. Recent studies on time of N application to direct seeded lowland rice indicated the advantages of delaying first dose of N up to first weeding or maximum tillering stage of 30-40 DAS (Mahapatra et al. 1986). In order to optimise the dose and time of initial dose of N application to direct seeded rice to maximise the N use efficiency and yield, the present study was made.

MATERIALS AND METHODS

A field experiment was conducted at Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu, on a clay loam soil. The soil had pH 7.3 and 0.42 per cent organic carbon and clay loam in texture, classified as low in available N (199 kg ha\(^{-1}\)) and medium in available P (75 kg ha\(^{-1}\)) and K (248 kg ha\(^{-1}\)). Four N levels at 0, 40, 80 and 120 kg ha\(^{-1}\) in kuruwai and 0, 50, 100 and 150 kg ha\(^{-1}\) in theledi (October-February) and samba (September-January) seasons, and the initial dose (50% of total) of the N applied at four different times in kuruwai (at 10, 20, 30 days after sowing (DAS) and at active tillering) and at five different times in theledi and samba (at sowing, 10, 20, 30 DAS and at active tillering). The remaining 50 per cent of N was applied in two equal doses at active tillering and panicle initiation stages except in treatment where the initial dose itself was applied at active tillering. In this treatment N was applied in two splits, half at active tillering and half at panicle initiation. The experiments were laid out in a factorial randomised block design with three replications. Short duration TKM 9, medium duration IR 20, and long duration CR 1009 were sown on kuruwai, theledi and samba seasons respectively. Dry seeds were broadcasted on dry
soil during Kuruvai and Samba and sprouted seeds broadcast on puddled soil in Thaladi.

RESULTS AND DISCUSSION

Grain yield

N levels profoundly influenced the grain yield in dry and wet seeded rice. In Kuruvai, the first level of 40 kg N ha$^{-1}$ increased the rough rice yield by about 17.5 q ha$^{-1}$ over control, while, the second increment (40 to 80 kg) boosted it further by 7.4 q ha$^{-1}$. The response at this stage tended to be quadratic (Table 1). In Thaladi and Samba seasons, there were significant responses to applied N up to the highest N level tried (150 kg ha$^{-1}$). The increase in grain yield at 50, 100 and 150 kg N ha$^{-1}$ over control was 11.5, 16.5 and 18.6 q ha$^{-1}$ respectively in Thaladi season, and it was 12.9, 18.2 and 20.6 q ha$^{-1}$ respectively for the above levels in Samba season. Here again, though, the grain yield showed significant increase for each increment in N level, it is evident from above figures that the response exhibited a declining trend. The yield increase obtained by N fertilizers is mostly interpreted as N being a substrate for the synthesis of organic N compounds which are the constituents of protoplasm and chloroplasts as well as its stimulation of meristematic growth and cytokinin biosynthesis (Beringer, 1980).

Regarding time of first dose of N application in Kuruvai and Samba seasons, this dose applied at 10 DAS enhanced the grain yield (54.2 q ha$^{-1}$ and 54.9 q ha$^{-1}$ respectively) significantly over other times of application. Yield reduction to the tune of 9.9 and 9.1 q ha$^{-1}$ was observed when N application was delayed to active tillering stage in the above seasons. In Thaladi season, the highest grain yield of 34.6 q ha$^{-1}$ was obtained when the first dose of N was applied on 10 DAS. In this season, early application was required because of the fact that sprouted seeds sown on puddled soil had early seedling establishment and foraging capacity roots.

Production function

N application caused a general increase in rice yields up to the highest level of N tried. The responses to N application fitted quadratic function.

Kuruvai: \( Y = 25.5 + 0.52 N - 0.003N^2 \)
Thaladi: \( Y = 16.4 + 0.26 N - 0.001 N^2 \)
Samba: \( Y = 30.5 + 0.29 N - 0.001 N^2 \)

From the production function, the economic levels of N at the existing price levels were found to be 95.8, 122.5 and 123.3 kg N ha$^{-1}$ with an estimated grain yield of 51.8, 34.5 and 52.5 q ha$^{-1}$ for Kuruvai, Thaladi and Samba seasons respectively.
Apparent N recovery

N application increased its uptake, but the apparent recovery decreased at higher levels of N. The recovery was generally low in wet season than in dry season like kuruvai, because of greater leaching losses of applied N in wet season. In line with grain yield response, in kuruvai and sanba seasons, N recovery was more when initial N was applied 20 DAS, while in thaladi, the same benefit was obtained with initial application at 10 DAS.

The results indicated that a N dose of about 100 kg ha\(^{-1}\) in kuruvai and 125 kg ha\(^{-1}\) in thaladi and sanba seasons would be economical and first dose of N (50% of the total) could be applied 20 DAS in kuruvai and sanba seasons when dry seeding was done and 10 DAS in thaladi when sprouted seeds were sown in puddled field, for getting higher yields in direct seeded rice culture.

REFERENCES


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APPROPRIATE VARIETIES AND MANAGEMENT TECHNIQUES FOR DIRECT SOWN RICE UNDER PUDDLED CONDITION

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ABSTRACT

Field experiments were conducted during kuruvai seasons (June-Sept) of 1994 and 1995 to identify appropriate techniques and suitable rice varieties for direct seeding under puddled condition at Tamil Nadu Rice Research Institute, Aduthurai. Five rice varieties viz., Vikes, IET 9978, IET 9994, IET 9221 and ADT 36 were included during kuruvai 1994 and during 1995, the variety IET 9221 was replaced by IET 10402 and ASD 16. Four management practices viz., transplanting, wet seeding, weed control and split application of fertilizer were included in the experiments. Grain yield obtained under direct seeding is comparable with transplanted rice. Rice varieties, ADT 36, ASD 16 and IET 9978 are found to perform well under direct sown situation with improved management practices viz., herbicide application followed by one hand weeding and application of recommended dose of N, P, K (125:50:50 kg/ha) and ZnS04 (2.5 kg/ha).

KEY WORDS : Direct seeding, puddled soil, wet seeding, appropriate varieties, technology.

Rice is the most important cereal crop grown in Cauvery delta zone of Tamil Nadu. In recent years, increased irrigated areas, the availability of short duration modern rice varieties and cost-effective herbicides and high labour cost motivated the farmers towards direct seeding in puddled soil (De Datta and Nantasomsaran, 1990). The practice of direct seeding of sprouted seed is possible in areas where land is levelled with good water and weed control. It can help to reduce the labour requirement and duration of crop to some extent and provide comparable grain yields. Rachel Sophia Alexander and James Martin (1995) reported that wet seeded rice cultivation could be a better alternative for transplanted rice. Direct sowing of rice is practiced in Tamil Nadu under conditions of delayed receipt of canal water or due to uncertain monsoon and scarcity for farm labour. Economic use of all inputs is essential, particularly under direct seeded condition. Under direct sown condition, higher dose of 150:75:75 kg N, P2O5 and K2O/ha, registered higher grain and straw yields as well as net return/rupee invested in both navarai and sanba seasons with variety ADT 37