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SEEDING METHODS AND NITROGEN MANAGEMENT PRACTICES FOR IRRIGATED LOWLAND RICE IN CAUVERY DELTA ZONE OF TAMIL NADU

P. SANTHI, K. PONNUSWAMY and N. KEMPU CHETTY

Tamil Nadu Rice Research Institute, Aduthurai - 612 101

Investigation was carried out at Tamil Nadu Rice Research Institute, Aduthurai from June 1995 to February 1997 to evaluate the efficient N management practices for direct seeded rice raised under irrigated lowland condition. The experiments were carried out both in *Kuruvai* and *thaladi* seasons of 1995-'96 and 1996-'97. The experiment I consisted of three methods of sowing *viz*., transplanting, sowing sprouted seeds in lines manually and using seed drum as main plot treatments and eight N management practices in the sub plots. The experiment II consisted of the same main plot treatments with modified N management practices based on the results of the first experiment. Eventhough the seeding methods had no significant differences among them, the drum seeding recorded numerically higher grain yield and net return than manual sowing and transplanting leading to reduction in crop duration by one week. Application of neem cake blended urea and placement of urea solution at 100 percent recommended N level favourably influenced the growth and yield components. These treatments recorded significantly higher grain and straw yields than conventional split application. Application of 75 per cent recommended N as placement of urea solution and as gypsum and neem cake blended urea gave comparable effect with improved split application of 100 per cent recommended N and integrated application of green manure and urea each supplying 50 percent recommended N in respect of grain yields of rice. These treatments also showed increased net return and return per rupee invested compared to conventional split application of prilled urea.

KEY WORDS : Seeding methods, Drum seeder, Liquid urea applicator, Gypsum, Neem cake, Green manure.

In Tamil Nadu rice is cultivated over an area of 2.7 million ha with a production of 7.16 million tonnes. During 2000 AD the estimated production will be 8.9 million tonnes with 4.5 percent growth rate (Pillai, 1996). Cauvery delta zone is the potential area of traditional rice cultivation in Tamil Nadu due to the canal irrigation system of Cauvery river. This zone accounts for about 22.3 percent of the rice area and 25.3 per cent of rice production of the state. Hence it is named as "The Rice Bowl of Tamil Nadu".

In this zone, rice is cultivated in three distinct seasons viz., *Kuruvai* followed by thaladi (in double crop wetlands) and samba (in single crop wetlands). *Kuruvai* rice solely depends on the Cauvery river water from Mettur dam, whereas *thalodi* and *samba* rice utilises heavy monsoon

rains at the beginning of the season besides supplemental irrigation by canal water.

Hence, time of release of Mettur dam water for irrigation decides the *kuruvai, thaladi* and *samba* rice production. When the water is released late ie., beyond the scheduled date of June 12th,the harvest of late *kuruvai* and planting of *thaladi/ samba* crops overlap, leading to labour shortage in this zone. This necessiates the farmers to switch over to direct seeding practice, since this practice has certain advantages like elimination of nursery preparation and maintanance, pulling out seedlings, transportation and planting, in addition to shorter crop cycle because of the absence of transplanting shock (Dingtuhn *et al.*, 1987). Nitrogen use efficiency (NUE) in flooded rice is low and N recovery rarely exceeds 30-40 per cent under lowland conditions (Schnier *et al.*, 1988). Likewise legume green manuring and recycling of crop residues are becoming increasingly important in making today's agriculture sustainable and more efficient. keeping this in view, the present study was made.

MATERIALS AND METHODS

The experiments were carried out at Tamil Nadu Rice Research Institute, Aduthurai both in *kuruvai* and *thaladi* seasons of 1995-'96 (experiment I) and 1996 -'97 (experiment II)in the wetlands. The experiment I consisted of methods of sowing *viz.*, transplanting, sowing sprouted seeds in lines manually and using seed drum as main plot treatments and N management practices of conventional split application at 100 and 50 per cent recommended N level, placement of urea solution by applicator at 100 and 50 per cent recommended N level, application of neem cake blended urea at 100 and 50 per cent recommended N level, integrated application of green manure and prilled urea each supplying 50 per cent recommended N and control (no N) in the sub plots. The experiment II consisted of the same main plot treatments with modified N management practices *viz.*, conventional and improved split application of 100 per cent recommended N, placement of urea solution at 100 and 75 percent recommended N by applicator, neem cake blended urea at 100 percent recommended N, gypsum and neem cake blended urea at 75 per cent recommended N, integrated application of green manure and urea each supplying 50 percent recommended N and control (no N) in the sub plots. The experiments were laid out in split plot design and replicated thrice. The varieties ADT 42 (110-115 days duration) and ADT 38 (130-135 days duration) were used in *kuruvai* and *thaladi* seasons respectively in both the experiments.

Table 1. Effect of seeding methods and N management practices on growth and yield of rice Kuruvai '95

Treatments	LAI	Days to 50% flrg	DMP (t/ha)	No.of pani/^{2}	Grain yield (t/ha)	Straw yield (t/ha)	Net ret (Rs.ha)	Return per Reinvested
S_1	5.05	85.8	12.965	555.5	5.523	6.618	16165	2.32
S_2	5.05	78.6	12.951	557.4	5.463	6.728	16561	2.47
S_3	4.92	78.9	12.923	561.4	5.630	6.785	17836	2.65
CD(P=0.05)	NS	0.62	NS	NS	NS	NS	NS	0.204
N1	5.43	81.5	14.041	651.2	6.064	8.769	19943	2.76
N2	4.15	81.4	10.706	467.3	4.472	5.037	11559	2.06
N3	6.46	81.2	15.459	676.4	6.986	9.082	24282	3.11
N4	4.57	81.0	12.657	500.2	5.129	5.251	14462	2.31
N5	6.64	81.2	15.532	678.1	7.010	8.967	23768	2.97
N6	4.22	80.7	12.648	506.0	5.072	4.624	14199	2.26
N7	6.06	80.6	15.184	650.9	6.038	8.344	19554	2 68
N8	2.50	81.3	7.343	334.7	3.529	3.607	7065	1 68
CD(P=0.05)	0.121	NS	0.1230	24.42	0.5024	0.8570	2149.8	0.192
S at N	NS	NS	NS	NS	NS	NS	NS	NS
N at S	NS	NS	NS	NS	NS	NS	NS	NS

The experimental field are moderately drained deep clay soil.

Odorthenric chromusterts alluvial clay low in available N, medium in available P and K with neutral reaction.

The drum seeder which was developed by the Department of Agricultural Engineering, Tamil Nadu Agricultural University, Coimbatore for row seeding of per-germinated paddy seeds on puddled, soils was used for direct seeding purpose. The sprouted seeds were used for sowing and the row spacing was adjusted according to the season i.e. 15 cm for *kuruvai* and 20 cm for *thaladi*.

Biometric observations like leaf area index at flowering, drymatter production at harvest, days to 50 per cent flowering, number of panicles/m2, thousand grain weight, grain and straw yields were recorded. Gross and net returns per hectare and return per rupee invested was also worked out.

RESULTS AND DISCUSSION

Leaf Area Index at flowering

The seeding methods didn't have any significant influence on leaf area index (LAI) at flowering in both *Kuruvai* and *thaladi* seasons in both experiments.

Application of 100 per cent recommended N as neem cake blended urea (N_5) and placement of urea solution (N_1) in *kuruvai* season and placement of urea solution (N_3), conventional split application of 100 percent recommended N as prilled urea (N_1), integrated application of 50 per cent N as green manure and 50 percent N as prilled urea (N_2) and as neem cake blended urea (N_4) in *thaladi* season produced greater LAI than other treatments. In experiment II, application of 100 per cent recommended N as neem cake blended urea (N_5), as placement of urea solution (N_3) and application of 75 per cent N as urea blended with gypsum and neem cake (N_6) produced greater LAI than other treatments in *Kuruvai*, whereas in *thaladi* season there was no marked difference among the N management practices. The interaction effects between the seeding methods and N management practices were not significant with regard to LAI at flowering stage in both the kuruvai and thaladi seasons. Higher availability and reduced losses of N in these treatments led to improved growth and yield components ultimately resulting in higher yield. The beneficial effect of increased NH_4+I-N in the soil due to neem cake blended urea application and deep placement of urea solution could be attributed to the reduced loses of fertiliser N (Devasenapathy, 1994).

Table 1a. Effect of seeding methods and N management practices on growth and yield of rice Thaladi'95

Treatments	LAI	Days to 50% flrg	DMP (t/ha)	No.of pani/^{2}	Grain yield (t/ha)	Straw yield (t/ha)	Net ret (Rs.ha)	Return per Reinvested
S_1	4.25	105.6	9.961	561.5	4.825	5.093	11982	1.98
S_2	4.29	98.6	10.320	558.2	4.940	5.256	13545	2.20
S_3	4.30	98.7	10.371	560.5	4.950	5.268	13960	2.29
CD(P=0.05)	NS	0.55	NS	NS	NS	NS	NS	NS
N1	5.20	101.1	11.073	597.3	5303	5.854	16068	242
N2	3.15	101.4	8.851	548.9	4.247	4.433	10216	1.94
N3	5.23	101.1	12.658	608.6	5.716	6.497	17211	2.51
N4	3.75	100.6	9.537	564.7	4.546	4.554	11.511	2.05
N5	5.10	100.8	12.082	698.9	5.978	6.518	17808	2.48
N6	3.80	101.6	9.573	566.0	4.513	4.627	11262	2.01
N7	5.16	100.7	11.083	595.8	5.501	5.858	15728	2.35
N8	2.86	101.2	6.882	399.4	3.206	3.358	5497	1.53
CD(P=0.05)	0.298	NS	0.7397	7.98	0.3690	0.4487	1670	0.151
S at N	NS	NS	NS	NS	NS	NS	NS	NS
N at S	NS	NS	NS	NS	NS	NS	NS	NS

Greater N supply and better uptake of N by plants resulted in taller plants and production of bigger sized leaves, thus resulting in increased LAI. Sharma and Rajendra prasad (1980) also reported the positive influence of neem cake blended urea on the growth parameters of rice. Devasenapathy and Palaniappan (1995) reported similar findings with placement of urea solution.

Dry matter production

The seeding methods had no marked influence on dry matter production (DMP) in both the experiments.

At harvest stage, application of 100 percent recommended N as placement of urea solution (N_3) and neem cake blended urea (N_5) significanlty increased the DMP, compared to other treatments in both the seasons. In experiment II, application of 100 percent recommended N as neem cake blended urea (N_5) produced significantly more DMP in *kuruvai* season, whereas it was on par with the placement of urea solution (N_3) and application of 75 percent recommended N as gypsum and neem cake blended urea during *thaladi* season. DMP increase may be due to increase in leaf area under favourable N nutrition and higher photosynthate production as reported by Venkitaswamy (1986). Ameta and Singh (1990). The interaction effect was not significant in both the experiments.

Days to 50 per cent flowering

The methods of seeding markedly influenced the days to 50 per cent flowering. Broadcasting of sprouted seeds and drum seeding methods had 7.2 and 6.9 days earlier flowering than transplanted crop in *kuruvai* and by 7.0 and 6.9 days in *thaladi* seasons respectively. In experiment II, line sowing of sprouted seeds manually (S_2) and drumseeding (S_3) had 7.0 and 6.9 days earlier flowering than transplanted crop, whereas in *thaladi* season the values were 6.9 and 6.7 days respectively. The delay in flower emergence by a week period in transplanting method might be due to pulling out and transplanting shock experienced by the seedlings in the third week. Impairing of the seedling physiological activity due to uprooting might also be the reason for delayed flowering under transplanting method compared to direct seeding of rice (Shad and De Datta, 1986). The N management practices and the interaction effect between the seeding methods and N management practices had no marked influence on days to 50 percent flowering.

Table 2. Effect of seeding methods and N management practices on growth and yield of rice Kuruvai'96

Treatments	LAI	Days to 50% flrg	DMP (t/ha)	No.of pani/^{2}	Grain yield (t/ha)	Straw yield (t/ha)	Net ret (Rs.ha)	Return per Reinvested
S_1	5.67	85.9	13.715	595.9	5.881	7.242	17542	2.40
S_2	5.69	78.8	13.705	595.6	5.823	7.410	18303	2.58
S_3	5.65	78.9	13.720	595.9	5.990	7.352	19453	2.75
CD(P=0.05)	NS	0.62	NS	NS	NS	NS	NS	0.180
N1	5.46	81.6	14.062	620.7	5.379	7.249	16171	2.41
N2	6.07	81.5	14.461	625.0	5.882	7.507	18517	2.61
N3	6.55	81.3	15.103	663.7	6.976	8.582	23753	3.03
N4	6.07	81.1	14.516	624.4	6.409	7.911	21208	2.86
N5	6.66	81.3	15.266	673.9	7.000	8.467	23088	2.86
N6	6.51	80.8	14.963	651.7	6.392	7.953	20539	2.71
N7	5.53	80.7	14.047	621.2	5.648	7.421	17271	2.48
N8	2.52	81.7	7.312	285.8	3.499	3.587	6922	1.66
CD(P=0.05)	0.325	NS	0.1499	16.46	0.5024	0.8567	2375	0.203
S at N	NS	NS	NS	NS	NS	NS	NS	NS
N at S	NS	NS	NS	NS	NS	NS	NS	NS

Number of panicles per m²

The panicle numbers per m² was not significantly influenced by the seeding methods in both the experiments.

Significantly more number of panicles per m² was obtained with the application of 100 per cent recommended N as urea blended with neem cake (N_5) and as placemnt of urea solution (N_3) than the other treatments in both *kuruvai* and *thaladi* seasons. Integrated application of 50 per cent N as green manure and 50 percent N as prilled urea (N_7) and conventional split application of prilled urea (N_1) were equally next best treatments in producing more number of panicles per m² in both the seasons. In experiment II, application of 100 per cent recommended N as neem cake blended urea (N_5) and as placement of urea solution (N_3) recorded significantly more number of panicles than other treatments in kuruvai season. Whereas in thaladi season, all the N management practices showed similar effect on the number of panicles and were significantly superior than the conventional split appliction of 100 per cent recommended N as prilled urea (N_1). The interaction between seeding methods and N management practices had no significant effect on the number of panicles.

Grain yield

The seedig methods showed no significant influence on grain yield of rice in both kuruvai and thaladi seasons. However in both the seasons drum seeding, recorded numerically higher grain yield and was folowed by line sowing manually and transplanting.

Application of 100 per cent recommended N as neem cake blended urea (N_5) and placement of urea solution (N_3) recorded significantly comparable higher grain yield than other treatments in both the seasons. This was followed by integrated application of 50 percent N as green manure and 50 percent as prilled urea (N_7) and conventional) split application of prilled urea (N_1). which were equally effective in producing next higher grain yield in both the seasons. In experiment II, application of 100 percent recommended N as placement of urea solution (N_3) and as neem cake blended urea (N_5) had comparable effect in recording higher grain yield and were significantly superior over other treatments in both the seasons. Application of 75 per cent recommended N as placement of urea solution (N_4) and as gypsum and neem cake blended urea (N_6) were the next best treatments in recording higher grain yield in both the seasons.

Table 2a. Effect of seeding methods and N management practices on growth and yield of rice Thaladi 96

Treatments	LAI	Days to 50% flrg	DMP (t/ha)	No.of pani/²	Grain yield (t/ha)	Straw yield (t/ha)	Net ret (Rs.ha)	Return per Reinvested
S_1	4.81	105.4	10.987	567.1	5.029	5.538	12813	2.02
S_2	4.90	98.3	11.418	568.5	5.222	5.710	14657	2.27
S_3	4.91	96.7	11.311	573.5	5.266	5.713	15046	2.30
CD(P=0.05)	NS	0.55	NS	NS	NS	NS	NS	0.172
N1	4.99	101.0	11.064	584.4	4.979	5.514	13392	2.16
N2	5.24	101.3	11.684	594.3	5.081	5.583	13878	2.21
N3	5.25	101.0	12.556	607.6	5.901	6.486	17797	2.53
N4	5.18	100.5	11.672	592.7	5.516	6.061	16214	2.43
N5	5.24	100.7	12.579	597.3	5.898	6.498	17112	2.38
N6	5.23	101.0	12.300	603.2	5.493	6.037	15470	2.29
N7	5.00	100.6	11.083	597.3	5.356	5.578	14644	2.12
N8	2.94	101.1	6.912	380.4	3.154	3.468	4869	1.46
CD(P=0.05)	0.275	NS	0.5795	16.12	0.2892	0.4488	1219.3	0.105
S at N	NS	NS	NS	NS	0.5430	NS	24140	0.211
N at S	NS	NS	NS	NS	0.5007	NS	2111.5	0.252

The interaction effects between seeding methods and N management practices showed significant influence in thaladi season, whereas it was not so in kuruvai season. Drum seeding (S_3) combined with application of 100 per cent recommended N as placement of urea solution (N_3) recorded significantly higher grain yield and was on par with manual line sowing of sprouted seeds (S_2) and transplanting (S_1) with 100 percent recommended N as neem cake blended urea (N_5). Dutta et al. (1995) also supported the positive influence of neem cake blended urea in increasing grain and straw yields of rice due to nitrification inhibition activity of the neem cake. Schnier et al (1988) reported that reduced N losses with placement of urea solution also led to development of a thicker root mat. This probably would have improved the nutrient uptake resulting in increased yield contributing factors and grain yield.

Straw yield

Straw yield was not significantly influenced by different methods of seeding in both the seasons. However, drum seeding recorded numerically higher straw yield and was followed by line sowing manually and transplanting.

The increase in straw yield with the application of neem cake blended urea at 100 per cent recommended N level (N_5) was 2.29 and 7.47 percent in kuruvai and 11.34 and 11.26 percent in thaladi season over conventional split application of prilled urea (N_1) and intergrated application of 50 percent N as green manure and 50 percent as prilled urea (N_2) respectively. In experiment II, application of 100 per cent recommended N as placement of urea solution (N_3) and as neem cake blended urea (N_5) recorded increased straw yield of 18.38 and 16.80 percent in *kuruvai* season and 17.62 and 17.84 percent in thaladi season respectively over conventional split application of prilled urea (N_1).

The interaction between seeding methods and N management practices had no significant effect on the straw yield in both the seasons.

Net return

The higher net returns were recorded by the drum seeding method (S_3) and was followed by line sowing of sprouted seeds manually (S_2) and transplanting (S_1) in both the seasons. However all of them were statistically on par.

Among the N management practices, the highest net return of Rs. 17,808/ha was recoded by the appliaction of 100 per cent recommended N as neem cake blended urea (N_5) in kuruvai season. In thaladi season, the highest net return (Rs. 24,282/ha) was obtained with placement of urea solution (N_3). In experiment II, placement of urea solution at 100 per cent recommended N recorded the highest net return of Rs. 23,753 and 17,797/ha in kuruvai and thaladi seasons respectively and was comparable with the application of neem cake blended urea at 100 per cent recommended N level (N_5) in both the seasons. Placement of urea solution at 75 percent recommended N level (N_4) increased the net return over conventional (N_1) and improved split application of 100 percent recommended N level (N_2) in both the seasons.

The interaction effects showed that placement of urea solution at 100 percent recommended N level under drum seeding method recorded the highest net return of Rs. 24,289 and 20,702/ha during *kuruvai* and thaladi seasons respectively.

Return per rupee invested

The return per rupee invested was higher under the drum seeding method (S_3) than other methods. In the first experiment, placement of urea solution at 100 percent recommended N level (N_3) increased the return per rupee invested (3.11 during *kuruvai* and 2.51 during thaladi seasons) and showed comparable effect with the application of 100 percent recommended N as neem cake blended urea (N_5) in both the seasons. In the second experiment, placement of urea solution at 100 percent recommended N level (N_3) recorded the highest values of 3.03 and 2.53 during *kuruvai* and thaladi seasons respectively. This was followed by placement of urea solution at 75 percent recommended N level.

The interaction effects showed that placement of urea solution at 100 percent recommended N level under drum seeding method recorded the highest return per rupee invested of 3.18 and 2.86 during *kuruvai* and *thaladi* seasons respectively.

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GENETIC VARIABILITY, CORRELATION AND PATH COEFFICIENT ANALYSIS IN CASTOR (*Ricinus communis* L.)

S. SEVUGAPERUMAL P. RANGASAMY and N. MUPPIDATHI

Department of Agricultural Botany
Aricultural college and Research Institute, Madurai,
Tamil Nadu Agricultural University MADURAI - 625 104.

ABSTRACT

Thirty six castor genotypes were evaluated for gentic parameters. Moderate to high heritability coupled with high genetic advance was noticed for single plant yield, plant height, 100 seed weight, length of primary raceme and racemes per plant attributed due to additive genes. The correlation Co-efficient and path analysis revealed that length of primary raceme, capsules in primary receme, racemes per plant and 100 seed weight were the major yield contributing characters.

KEY WORDS : Castor, Variability, Correlation, Path co-efficients

Castor (*Ricinus communis L*)is an important non-edible oilseed crop in which limited work has been carried out for its useful exploitation. In order to underdstand the variability present in the population and direct and indirect influence of yield contributing characters on yield, 36 genotypes of castor were subjected to variance, heritability, genetic advance, correlation co-efficients and path co-efficients studies.

MATERIALS AND METHODS

Thirty six genotypes of castor were raised at Agricultural college and Research Institute, Tamil Nadu Agricultural University, Madurai during 1992-93 in a randomised block design with three replications. Each genotype was raised in two rows of 4.8 m length adopting a spacing of 90 cm between rows and 60 cm between plants. Five plants where selected at random and observations were recorded on days to 50 percent flowering, plant height, number of nodes upto primary raceme, number of recemes per plant, 100 seed weight and single plant yield.

The phenotypic and genotypic variances and genetic advance were calculated according to Johnson *et al* (1955). Phenotypic and genotypic