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INTEGRATED NITROGEN MANAGEMENT FOR WET SEEDED RICE

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ABSTRACT

Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore to develop suitable integrated nitrogen management practice for wet seeded rice. Different sources of nitrogen integrated were *Sesbania rostrata* as green manure (GM), Azolla (Az) as biofertiliser and prilled urea as chemical fertiliser. Integrated use of green manures and biofertilisers along with chemical fertiliser enhanced the growth and yield attributing characters viz. tillers m^{-2}, LAI, number of panicles m^{-2}, number of filled grains per panicle; nutrient uptake and ultimately rice grain yield. Application of GM + $Az_{1.0}$ + PU_{125} produced comparable yields with GM + $Az_{1.0}$ + PU_{150}, the highest level tried. Inoculation of Azolla at 1.0 t ha^{-1} along with urea resulted in comparable yield with that of succeeding level of urea, but with no Azolla, suggesting a a saving of 25 kg N ha^{-1} of chemical fertiliser.

KEY WORDS : Integrated N management , Azolla, *Sesbania rostrata*.

Direct seeded flooded rice has been gradually replacing transplanted rice in many rice growing areas of the tropics. With increasing irrigate areas, availability of shorter duration modern rice varieties, effective herbicides and non-availability of costly labour, many farmers are now swithching over to direct seeding in puddled soil from transplanting (De Datta and Nantasomaran , 1990). This system was also found to be a viable alternative to the transplanted rice production system for the western zone of Tamil Nadu (Rachel and Martin, 1995).

In wet seeded rice, because of early production of large vegetative biomass, the N demand and recovery are higher, but the ability to convert it to grain yield is poor. Yield response to applied nitrogen was significant upto 60 kg ha^{-1} in transplanted rice and upto 90 kg ha^{-1} in direct seeded rice (Schnier *et al.*, 1990). So nitrogen management in wet seeded rice becomes important. But in the face of continuing world energy crisis, leading to steady escalation of fertiliser cost, a higher possible efficiency in the use of fertilisers as well as the high use of available alternative renewable sources of plant nutrients like organic materials and bioferilisers will have to be ensured. It is in this context, studies were conducted to develop integrated nitrogen management practice for wet seeded rice of west zone of Tamil Nadu.

MATERIALS AND METHODS

The field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during *rabi* 1994 – 95 and *Kharif* 1995 in randomized block design with three replications. *Sesbania rostrata* as green manure at 6.25 t ha^{-1}, at levels of 0, 0.5 and 1.0 t ha-1 and N.fertiliser. Azolla as biofertiliser as prilled urea at five levels of 0, 75, 100, 125 and 150 kg N ha^{-1} were used and combinations of these sources were assigned to the treatment plots. Fresh green manure was incorporated at 6.25 t ha^{-1} one week before sowing. Azolla was inoculated 15 days after sowing (DAS) and incorporated 30 DAS by using Japanese rotary weeder at the time of weeding. The varieties used were ADT 38 during *rabi* and ADT 36 during *Kharif*. Pre germinated paddy seeds were line sown using drum seeder at a spacing of 20 cm between rows. *Seshania rostrata* contained 3.82, 0.24 and 2.16 per cent NPK during *rabi* and 3.89, 0.29 and 2. 12 per cent NPK during *Kharif*. Azolla contained NPK at 2.82, 0.71, 2.90 per cent during *rabi* and 2.80, 0.69 and 2.86 during *Kharif* (on dry weight basis). The prilled urea was applied in four equal splits at active tillering , panicle initiation, heading and flowering stages. A uniform dose of 50 kg each of P and K per ha was applied to all plots. Phosphorus as single super phosphate was applied as basal dose. Potassium as muriate of potash was applied in four equal splits at basal, active tillering, panicle initiation and heading stages.

Table 1. Growth characters of rice at flowering as influenced by N management practices

Treatments	Plant height (cm)		No. of tillers m^{-2}		Leaf Area Index	
	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995
T_1- $GM_0+Az_0+PU_0$ (control)	59.9	60.4	387	414	3.28	3.90
T_2- $GM+Az_0+PU_{75}$	64.4	68.8	416	474	4.90	4.99
T_3- $GM+Az_{0.5}+PU_{75}$	65.6	70.1	426	483	4.95	5.16
T_4- $GM+Az_{1.0}+PU_{75}$	66.5	71.9	435	487	5.03	5.21
T_5- $GM+Az_0+PU_{100}$	66.7	72.6	433	487	5.07	5.25
T_6- $GM+Az_{0.5}+PU_{100}$	70.8	72.9	445	495	5.19	5.27
T_7- $GM+Az_{1.0}+PU_{100}$	73.6	73.0	452	505	5.23	5.39
T_8- $GM+Az_0+PU_{125}$	75.1	74.6	453	509	5.28	5.44
T_9- $GM+Az_{0.5}+PU_{125}$	75.5	74.7	471	517	5.31	5.56
T_{10}- $GM+Az_{1.0}+PU_{125}$	76.4	75.8	475	525	5.42	5.64
T_{11}- $GM+Az_0+PU_{150}$	76.7	77.3	476	526	5.46	5.64
T_{12}- $GM+Az_{0.5}+PU_{150}$	77.4	77.3	481	534	5.56	5.76
T_{13}- $GM+Az_{1.0}+PU_{150}$	79.4	78.7	483	538	5.58	5.82
SEd	1.04	0.71	3.0	2.4	0.036	0.033
CD (P = 0.05)	2.15	1.46	6.3	4.9	0.075	0.067

RESULTS AND DISCUSSION

Integrated use of green manure and biofertiliser along with urea improved the growth characters of rice like crop height, tillers per unit area, leaf area index and dry matter production (Table 1). Nitrogen mineralised during decomposition of green manure and Azolla resulted in increased contribution of nitrogen to crop. Organic materials acting as slow release sources of N are expected to more closely match the N supply and rice N demand (Becker, et al., 1994), and hence more N was available to the crop. This enhanced nitrogen availability in rhizosphere favoured higher nutrient

Table 2. Yield component and yield of rice under N management practices

Treatments	No.of panicles m^{-2}		No. of filled grains per panicle		Thousand grain weight (g)		Grain yield (kg ha^{-1})	
	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995
T_1- $GM_0+Az_0+PU_0$ (control)	287	328	65.1	80.3	20.3	20.8	2894	3155
T_2- $GM+Az_0+PU_{75}$	344	376	76.3	94.5	21.0	21.9	4418	4376
T_3- $GM+Az_{0.5}+PU_{75}$	369	402	77.9	94.7	21.1	22.0	4661	4672
T_4- $GM+Az_{1.0}+PU_{75}$	387	423	78.3	95.0	21.1	22.2	4758	4808
T_5- $GM+Az_0+PU_{100}$	403	425	79.9	94.5	21.2	22.2	4784	4906
T_6- $GM+Az_{0.5}+PU_{100}$	414	432	82.0	96.3	21.4	22.5	4993	5128
T_7- $GM+Az_{1.0}+PU_{100}$	420	436	80.2	97.4	21.5	22.6	5019	5325
T_8- $GM+Az_0+PU_{125}$	425	436	82.4	100.2	21.5	22.6	5046	5399
T_9- $GM+Az_{0.5}+PU_{125}$	431	440	83.0	103.2	21.5	22.7	5189	5522
T_{10}- $GM+Az_{1.0}+PU_{125}$	442	444	86.9	106.8	21.6	22.8	5386	5670
T_{11}- $GM+Az_0+PU_{150}$	443	445	87.3	106.5	21.7	22.8	5359	5695
T_{12}- $GM+Az_{0.5}+PU_{150}$	444	445	87.1	107.9	21.7	22.9	5399	5719
T_{13}- $GM+Az_{1.0}+PU_{150}$	445	447	88.0	108.1	21.7	22.9	5425	5769
SEd	4.3	5.5	1.33	1.37	21.9	1.04	91.1	105.7
CD (P - 0.05)	9.0	11.4	2.74	2.82	NS	NS	187.9	218.2

Table 3. NPK uptake of maturity and apparent recovery per cent of nitrogen as influenced by N management practices

Treatments	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})		Apparent recovery per cent of nitrogen	
	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995	Rabi 1994-95	Kharif 1995
T_1- $GM_0+Az_0+PU_0$ (control)	64.6	92.9	12.8	13.0	89.9	91.2	—	--
T_2- $GM+Az_0+PU_{75}$	100.5	115.9	13.8	14.6	106.9	112.9	30.45	21.87
T_3- $GM+Az_{0.5}+PU_{75}$	107.7	123.8	13.9	14.1	118.7	117.9	34.11	26.15
T_4- $GM+Az_{1.0}+PU_{75}$	113.3	131.4	15.0	14.2	121.1	119.2	36.13	30.92
T_5- $GM+Az_0+PU_{100}$	114.8	133.2	15.6	15.2	120.3	118.1	37.00	29.49
T_6- $GM+Az_{0.5}+PU_{100}$	117.2	135.6	16.9	16.5	121.9	122.5	37.01	29.16
T_7- $GM+Az_{1.0}+PU_{100}$	120.6	139.3	17.2	17.9	123.2	130.5	37.74	31.10
T_8- $GM+Az_0+PU_{125}$	126.4	143.4	17.9	18.2	123.2	135.8	38.37	31.24
T_9- $GM+Az_{0.5}+PU_{125}$	125.9	146.6	17.7	19.4	125.9	136.8	38.02	31.97
T_{10}- $GM+Az_{1.0}+PU_{125}$	129.7	152.5	18.9	19.4	127.6	141.8	38.05	33.16
T_{11}- $GM+Az_0+PU_{150}$	129.9	154.8	19.4	20.3	126.8	143.7	35.17	33.14
T_{12}- $GM+Az_{0.5}+PU_{150}$	131.9	156.2	19.9	22.7	129.9	147.3	35.05	32.7
T_{13}- $GM+Az_{1.0}+PU_{150}$	133.1	156.3	21.0	23.9	130.8	152.4	34.50	31.79
SEd	1.68	2.24	0.64	0.51	2.88	2.68	1.318	1.516
CD (P-0.05)	3.46	4.62	2.32	1.05	5.95	5.54	2.737	3.145

uptake resulting in better growth. Enhanced crop growth due to integrated nitrogen management was also observed by Chandrasekharan (1984) and Sreedevi (1988).

The nitrogen management practices influenced substantially the number of panicles and filled grains per panicle but not 1000 seed weight. The favourable influence on panicle number and grains per panicle might probably be due to the late mineralization of Azolla-N (Kempuchetty, 1989) which coincides with the N-requirement at heading stage. It was found that about 36 per cent of the total Azolla – N added at incorporation was released is about 60 days of which 71 per cent was assimilated by rice, two per cent remained in soil and 27 per cent was lost to the atmosphere (Mian, 1985).

The favourable response of most of the growth and yiled components to various levels and integrated use of nitrogen and their combined effect contributed to increased grain yield (Table 2). Application of green manure + Azolla at 1.0 t ha^{-1} + urea at 125 kg N ha^{-1} ($GM + Az_{1.0} + PU_{125}$) produced comparable grain yield with that of green manure + Azolla at 1.0 t ha^{-1} + urea at 150 kg N ha^{-1} ($GM + Az_{1.0} + PU_{150}$). Comparable LAI, N uptake and panicle production in these treatments might have resulted in comparable yields.

Application of nitrogen through Azolla applied at 1.0 t ha^{-1} along with urea resulted in comparable yield with that of suceeding higher level of urea, but with no Azolla. This shows that Azolla as a dual crop inoculated at 1.0 t ha^{-1} could save 25 kg N ha^{-1} without any reduction in yield. Supporting evidences towards increasing the grain yield due to addition of Azolla were reported by Sharma and Mahapatra (1990) and Kaur (1993).

Green manure application increased nitrogen uptake at all stages of crop growth due to higher nitrogen accumulation which favoured the release of nitrogen for growth and uptake (Table 3). Better growth and dry matter production increased the phosphorus and potassium uptake also. This is in line with the observation of Medhi and De Datta (1993). Azolla also contributed considerable quantity of P and K (Liu, 1987) which would have been supplied to rice during decomposition.

Apparent N recovery increased with increase in N application upto $GM + Az_{1.0} + Pu_{125}$ which could be attributed to reduced N losses through leaching and denitrification and increased availability of nitrogen to the crop. Reduced N recovery beyond 125 kg N ha^{-1} might be due to the fact that N uptake was not proportionate to the applied N, beyond that level.

Incorporation of Sesbania rostrata green manure at 6.25 t ha^{-1} one week prior to sowing, inoculation of Azolla at 1.0 t ha^{-1} 15 DAS and incorporation of multiplied Azolla 15 days later, in combination with application of prilled urea at 125 kg ha^{-1} in four equal splits at tillering, panicle initiation, heading and flowering can be the best integrated nitrogen management practice for wet seeded rice under West Zone agroclimatic condition of Tamil Nadu.

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INFLUENCES OF ORGANIC WASTES AND CHISELLING ON THE SOIL PHYSICAL PROPERTIES AND YIELD OF SORGHUM (CO 24) IN ALFISOLS WITH HARD PAN SUB SOIL

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ABSTRACT

In soils with hard pan sub soils chiselling increased the non-capillary porosity at the sub surface (20-40 cm) from 5.6 to 10.0 per cent. At this depth the bulk density decreased from 1.76 Mg m^{-3} to 1.66 MG m^{-3}, the hydraulic conductivity improved from 1.4 to 2.7 cm hr^{-1}. Chiselling resulted in improved grain yield by 35.5% over the control (6.09 q ha^{-1}). Addition of pressmud at 10 t ha^{-1} and coirpith at 5 t ha^{-1} over and above chiselling increased the grain yield by 37.9 and 56.4 per cent over the control respectively.

KEY WORDS : Sub soil hard pan, Chiselling, Physical properties, Sorghum.

The common soils in tropical areas are Alfisols, Ultisols and Oxisols. These soils present argillic horizons indicating that clay particles can move easily within the soil profiles. Such horizons are present in the surface as crusts and in the sub-surface as a hard pan or impervious layer. When such impervious layers are to be found at shallow depths they pose agronomic problems due to the