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NITROGEN RELEASE PATTERN OF GREEN MANURES IN SODIC SOIL

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ABSTRACT

A field experiment was conducted at ARS, Bhavanisagar, to study the N release pattern of green manure before and after rice transplanting in sodic soil. Production of N fractions (NH_4 - N and NO_3 - N) were higher with the green manure crop *Seshania aculeata* before rice transplanting and gypsum application when compared with green leaf manure crop *Pongamia glabra* due to its higher N content and instantaneous, easy decomposition. In the presence of rice crop, the NH_4 - N reached the first peak during third week and second peak during sixth week whereas NO_3 - N recorded the peak during ninth week in all the treatments. The higher N fractions were recorded in green manure (GM) + gypsum treatment and lowest in gypsum alone treatment.

KEY WORDS: Green manure, Sodic soil, Gypsum, Urea, N fractions

Sodic soil are of low productivity as crop growth is adversely affected by the presence of high amounts of sodium salts. Application of gypsum along with green manure (GM) is a common practice adopted to reclaim the sodic soils. The addition of same rate of GM - N to different soils did not release equal amounts of NH_4 - N indicating that N release from GM depends on the soil characters (Aspiras, 1996). The nitrogen release in the GM was found to depend on their composition, rate and extent of decomposition and associated N mineralisation. Hence, to study the N mineralisation of green manure in the absence of rice crop and gypsum, and to study the effect of urea, gypsum and green manure on N mineralisation in the presence of rice crop, the present investigation was carried out.

MATERIALS AND METHODS

A field experiment was conducted on a sandy clay loam at ARS, Bhavanisagar. The Soil characteristics are given in Table 1. The experiment was laid out in a split plot design with five main plot treatments (M_1 - GM alone, M_2 - GM + gypsum, M_3 - Green leaf manure (GLM) alone, M_4 - Gypsum alone and M_5 - GLM + gypsum) and four levels of nitrogen in sub plots (0 (S_1), 50(S_2), 100 (S_3) and 150 (S_4) kg ha^{-1}). The treatments were replicated thrice. *Seshania aculeata* (GM) and *Pongamia glabra* (GLM) were applied @ 10 t ha^{-1} in the main plots and allowed in the field for one week for decomposition. Gypsum was applied @ 1.73 t ha^{-1} (50 per cent GR) in the plots as per the treatment schedule before rice transplanting along with phosphorus - 50 kg ha^{-1}, potassium - 50 kg ha^{-1} and $ZnSO_4$ - 25 kg ha^{-1} in all the plots. One half of nitrogen was applied as basal according to the treatment schedule. Rice (cv. CO 43) was transplanted in the submerged condition and the same was maintained throughout the crop growth. The remaining N was top dressed in two equal splits at third and sixth week after transplantation.

Table 1 : Initial soil properties of the experimental field

Properties	Value
Physical parameters	
Mechanical fractions (per cent)	
Clay	21.5
Silt	16.0
Coarse sand	30.0
Fine sand	33.5
Chemical parameters	
CEC (c.mol (p$^+$) kg^{-1})	22
Organic Carbon (per cent)	0.41
Available N (kg ha^{-1})	106
Available P (kg ha^{-1})	5.4
Available K (kg ha^{-1})	135
Parameters to characterise sodicity	
Soil reaction	9.1
Electrical conductivity (dSm^{-1})	1.05
Exchangeable sodium percentage	56.8
Sodium adsorption ratio	16
Gypsum requirement (t ha^{-1})	1.72

Table 2. Effect of green manuring on NH_4-N and NO_3-N (kg ha^{-1})

Treatments	NH_4-N					No_3-N				
	Days after GM/GLM incorporation					Days after GM/GLM incorporation				
	1	2	3	4	5	1	2	3	4	5
M_1	37.0	40.6	45.4	51.0	51.2	14.3	14.3	14.4	22.3	18.5
M_2	36.9	38.7	48.2	51.0	51.4	14.2	14.2	17.1	17.2	28.6
M_3	42.5	37.1	39.7	40.1	48.4	17.2	11.4	14.2	17.0	26.0
M_4	34.5	37.0	33.9	25.8	14.2	11.5	11.5	11.5	14.3	22.5
M_5	37.2	37.0	42.6	42.7	50.9	11.6	14.3	19.8	17.0	28.3
SEd	0.113	2.448	0.329	0.181	0.303	0.226	0.127	0.247	0.220	1.066
CD	0.260	5.648	0.759	0.416	0.699	0.521	0.292	0.571	0.508	2.459

Wet soil samples were collected from all the sixty plots before and for first five days after GM/GLM incorporation to analyse for N fractions. Also, after transplanting the rice seedlings soil samples were collected from a depth of 15 cm at weekly intervals for immediate analysis of ammonical N and nitrate N (Bremner, 1965)

RESULTS AND DISCUSSION

N FRACTIONS (In the absence of rice crop, gypsum and urea -N)

The GM/GLM treatment recorded a gradual increase in the release of NH_4 - N and NO_3 - N during the first week in the absence of rice crop (Table 2). The higher N fractions in the GM

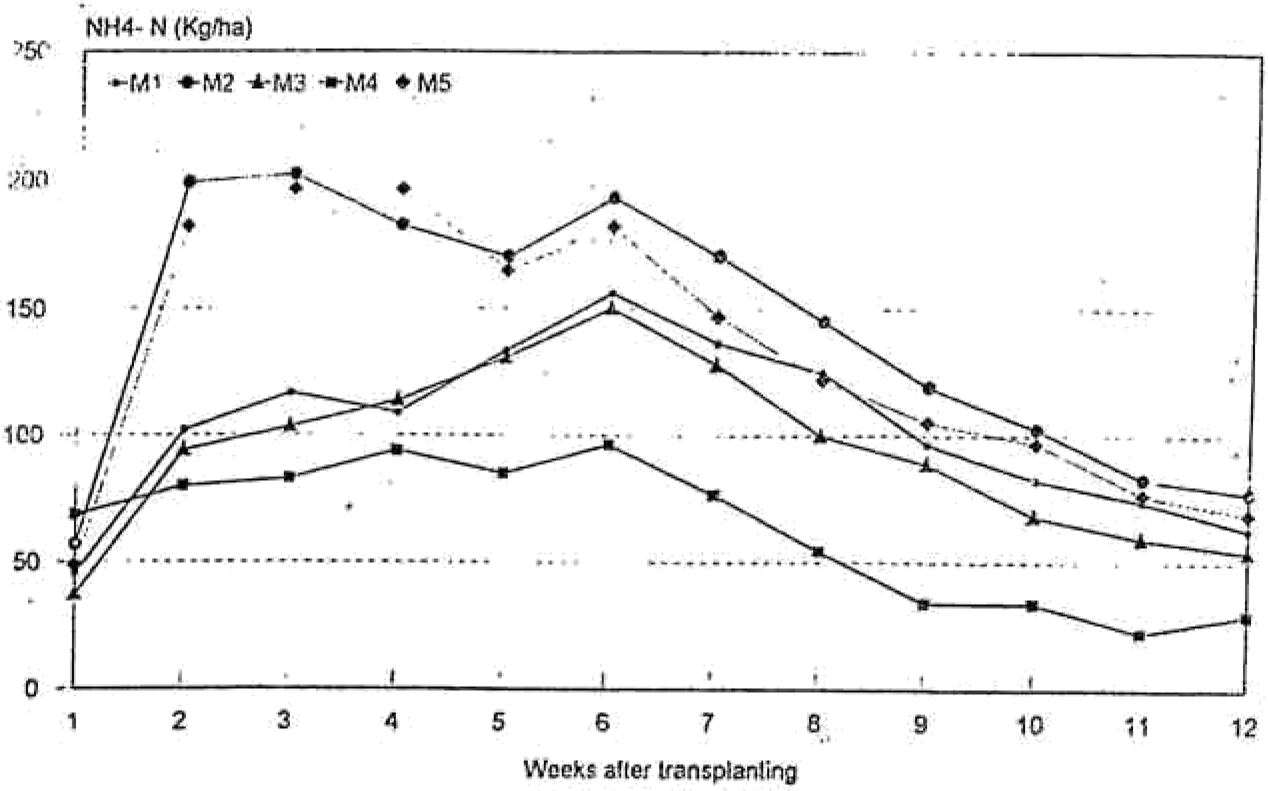

Fig. 1 Effect of green manuring and gypsum on NH_4N

treatment than in the GLM treatment was due to the instantaneous, easy decomposition and mineralisation of added green manure and higher N content.

N FRACTIONS (In the presence of rice crop, gypsum and urea - N)

NH_4 - N

The NH_4 - N increased and recorded the first peak in the third week after rice transplanting and then declined to lower levels at fourth and fifth weeks; again increased, registering the second peak in the sixth week. Thereafter, there was a steady and sharp decline in the NH_4 - N content (Fig. 1). The increasing trend of NH_4 - N in the first few weeks might be due to the mineralisation of easily decomposable nitrogenous substance present in green manure (Weeraratna, 1979) and the consequent release of NH_4 - N as well as that released from urea - N. The slight decrease in NH_4 - N content in second peak was due to the plant uptake and reduced rate of release of NH_4 - N from green manure. The steady decline after the second peak was due to plant uptake (Yadvinder Singh et al., (1992), nitrification process (Weeraratna, 1979), immobilisation (Iritani and Arnold, 1980), fixation and volatilisation losses (Nagarajah, 1988). In the presence of rice plant, the GM with gypsum produced higher NH_4 - N which was followed by GLM with gypsum treatment. Both green manuring and gypsum would have favourably affected the soil structure, reduced sodium hazard and improved the physical condition and increased the microbial growth thereby accelerating the rate of decomposition and mineralisation of GM in GM + gypsum treatment and released higher amount of NH_4 - N.

In gypsum alone treatment, the NH_4 - N content was higher than in GM/GLM alone treatment. This was attributed to the reduction in exchangeable Na and pH on account Ca^{2+}ion made available from gypsum at faster rate. Quicker the reduction in sodicity, higher rate of microbial activity and mineralisation of native organic

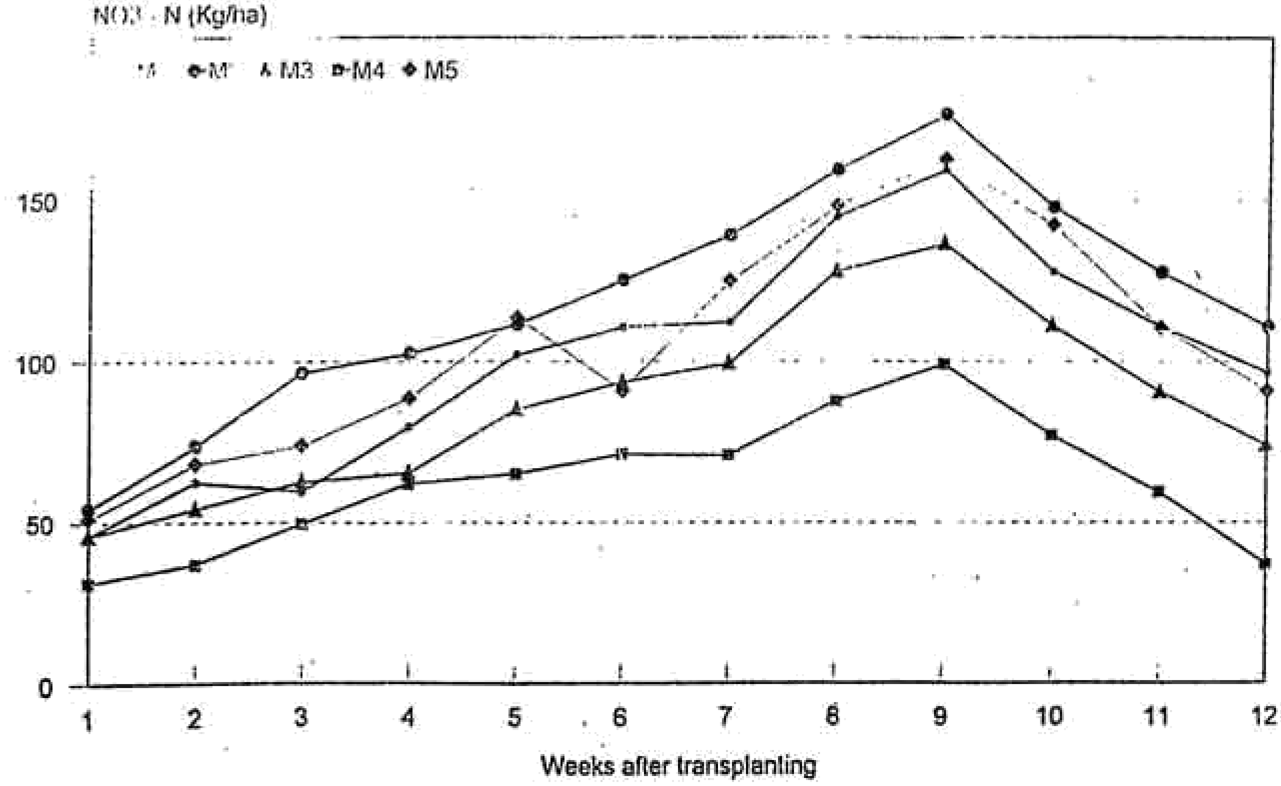

Fig. 2 Effect of green manuring and gypsum on NH_4N

substances as well as added urea - N released more of NH_4 - N in gypsum alone treatment.

NO_3 - N

The NO_3 - N recorded the peak in the ninth week and thereafter a decline was observed. Similar trend of results as in NH_4 - N was observed in all the main plot treatments (Fig. 2). The NO_3 - N concentration was significantly higher in GM+gypsum treatment followed by GLM + gypsum treatment. The reduction in NO_3 - N concentration in all the treatments after ninth week of rice transplantation was due to the crop removal or immobilisation and denitrification by general soil microflora and denitrifiers, respectively (Alexander, 1961).

The NH_4 - N and NO_3 - N concentrations increased significantly as the N levels increased at all the main plot treatments, and it was comparatively higher in GM/GLM + gypsum treatment than in GM/GLM/gypsum alone treatments. The NH_4 - N supplemented through GM/GLM over and above the liberated N from added urea would have caused significant increase in NH_4 - N, whereas the efficient microbial activity as well as the enhanced rate of nitrification would have resulted in higher NO_3 - N at all N levels. The reduction in NH_4 - N in later period and reduction in NO_3 - N at all N levels in gypsum alone treatment was due to the absence of contribution of N from organic source. In GM/GLM alone treatment the reduction was due to slower rate of decomposition and mineralisation of applied GM/GLM and urea - N.

The study reveals that the higher N content and succulent nature of GM - *Sesbania aculeata* produced significantly higher N fraction than GLM - *Pongamia glabra* which is of hardy nature with lesser N content.

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EFFECT OF PHOSPHORUS AND FARMYARD MANURE ON CHANGES IN PHOSPHORUS FRACTIONS IN A RICE SOIL

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ABSTRACT

Application of phosphorus alone and in combination with FYM increased contents of total P and different P-fractions. An increase in available P content was recorded at higher levels of P in association with FYM. The content of different P fractions as per cent of the total P followed the order : Occluded P > Fe-P > Ca-P > Al-P.

KEY WORDS: Effect of P, FYM, P Fractions, Rice Soil

Phosphorus utilization in crops is generally low. Nad and Goswamy (1984) suggested that for sustainable agriculture production, application of higher levels of P alone or in association with organic matter can enhance the contents of total P, available P and different P fractions. These