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Effect of Green Manure and Nutrient Application on the Progressive Changes in the Ammonification, Nitrification and Nitrogen Fixation

By

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ABSTRACT

A pot culture experiment was laid out with five soil groups to study the effect of nitrogen, phosphorus, molybdenum and green manure application on the progressive changes in ammonification and nitrification. Ammonification in soils was increased by green manure application. Nitrifying power of the soils was maximum at the early crop growth stage. For nitrifying power correlation was observed comparing values at tillering and at harvest stages. None of the treatments gave any significant differences in nitrogen fixing capacity, indicating that nitrogen fixation was not affected by any of the nutrient elements tried.

INTRODUCTION

The alterations in soil conditions as affected by manuring, liming, and cultivation, affect the numbers and activities of the microorganisms. Gainey (1917) observed the significance of nitrification as a factor in soil fertility. Addition of a solution containing major nutrients except nitrogen to incubated soils decreased nitrifying power of the soil (Synghal, 1959). Anderson and Bosewell (1964) observed that addition of nitrogen retarded nitrification in acid soils. Broadbent (1965) was of the opinion that addition of fertiliser nitrogen to soils resulted in increased mineralisation of soil nitrogen.

Rajagopala Iyengar *et al.* (1954) found that in phosphate plots, particularly in N+K+P plot, ammonification took place too rapidly and ammonia formed was quickly transformed during the period of incubation to nitrates. Up to a concentration of 100 ppm molybdenum enhanced the formation of NH_4-N from peptone (Kathavate *et al.*, 1964). The present study was therefore conducted to study the effect of certain nutrient elements and green manure applications to different soils

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on the progressive changes in the mineralisation at different stages of rice crop growth.

MATERIALS AND METHODS

A pot culture experiment with Co 32 rice as a test crop and with 5 soil samples collected from different parts of Tamil Nadu *viz.*, alluvial (A) soil sample from Musiri, one black (B) soil sample and one red non-calcareous (R1) soil sample from Coimbatore, another red calcareous (R2) soil sample from Namagiripet and one lateritic (L) soil sample from Nanjanad, was statistically laid out with 16 treatments, to study the effect of nitrogen (N), phosphorus (P) molybdenum (Mo) and green manure (G. M.) application on the progressive changes in ammonification nitrification and nitrogen fixation.

Nitrogen at 44.80 kg/ha as ammonium sulphate, P_2O_5 at 33.60 kg/ha as super phosphate, molybdenum at 4.94 kg/ha as sodium molybdate and green manure at 5600 kg/ha as sesbania were applied to the respective treatments. Potash was applied to all the pots uniformly at 16.80 kg/ha as muriate of potash.

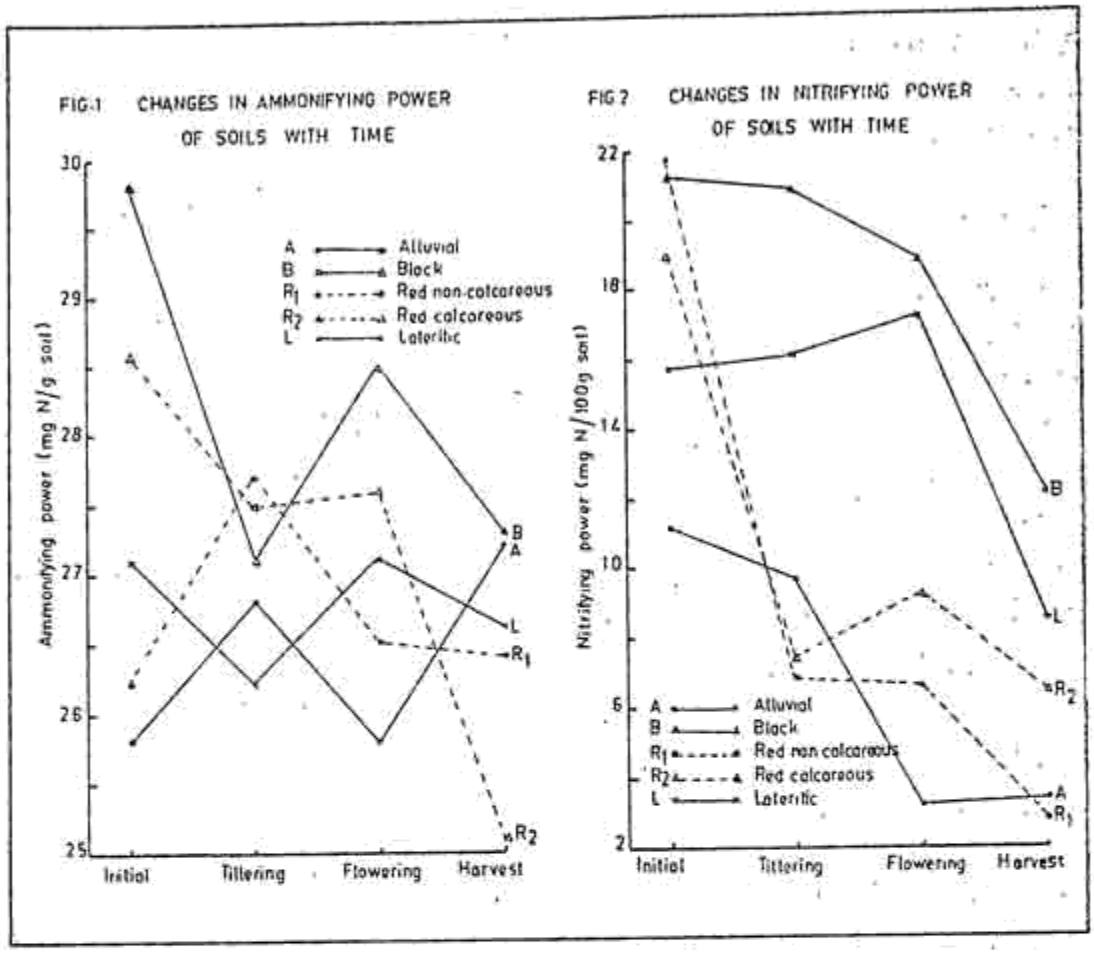
The treatments were:

1. Control
2. N
3. P
4. G.M.
5. Mo
6. N+P
7. N+G.M.
8. N+Mo
9. P+G.M.
10. P+Mo
11. G.M.+Mo
12. N+P+G.M.
13. N+P+Mo
14. N+G.M.+Mo
15. P+G.M.+Mo
16. N+P+G.M.+Mo

Soil samples drawn before planting, tillering, flowering and at harvest were analysed for nitrifying power (Waksman, 1923) ammonifying power (Allen, 1949) and Nitrogen fixing capacity (Waksman and Karunakar, 1924).

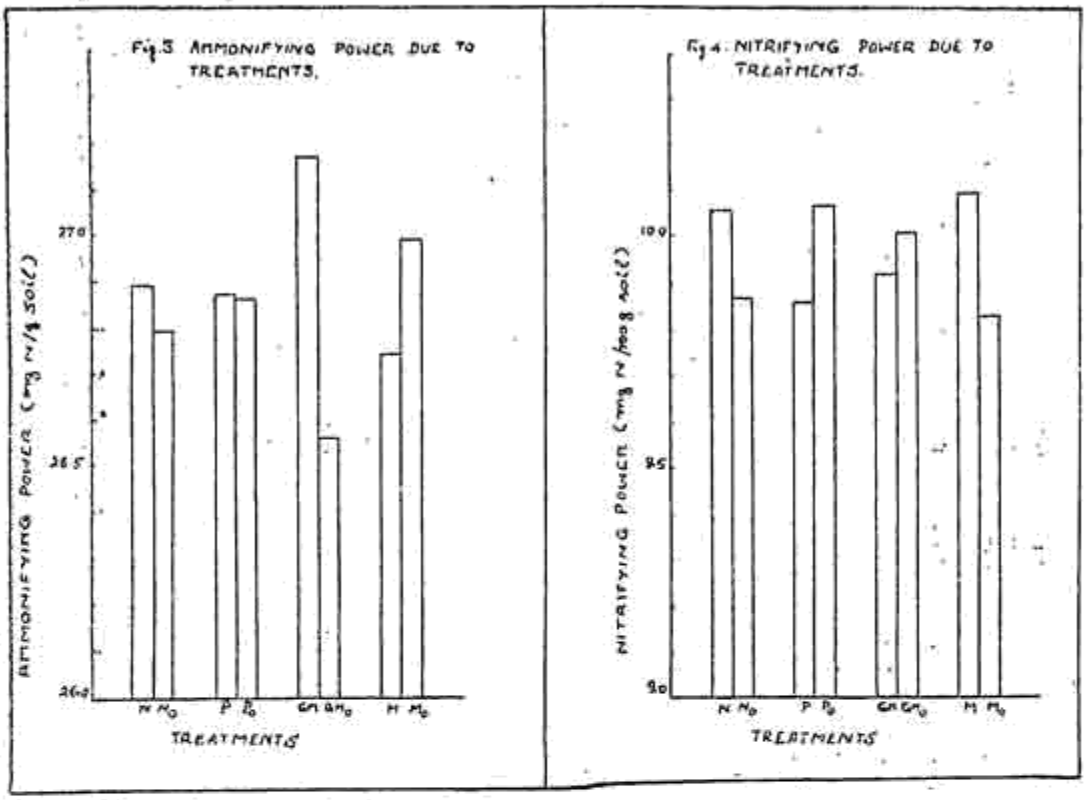
RESULTS AND DISCUSSION

Ammonifying power of soils varied widely at different stages between soils and there were no significant differences among the soils (Fig 1). The values ranged from 25 to 30 mg N/g soil. The apparent low values for ammoniacal nitrogen might be due to the dynamic biological transformation taking place in quick succession resulting in the rapid conversion of ammonium salts to nitrate. A significant difference was established between soils with regard to their nitrifying capacity (Fig 2). Black soil had maximum nitrification at all stages of crop growth followed by lateritic soil. In general, nitrification decreased during the crop growth period and attained a minimum value at harvest stage. Maximum nitrification was observed at tillering stage when the plants require more of nitrogen for their growth and establishment.



Of all the nutrients tried green manure application alone was beneficial in increasing the ammonifying power of the soils significantly (Fig 3). Kathavate *et al.* (1964) found that upto a concentration of 100 ppm, molybdenum enhanced the formation of ammoniacal nitrogen from peptone. But in the present investigation molybdenum decreased the ammonifying power of soils. Ramaswami (1966) obtained relationship between the total nitrogen content of the soils and ammonifying power of the soil.

In general nitrogen and molybdenum fertilization increased the nitrification of soils to a certain extent (Fig 4). However, phosphorus and green manure application showed a negative trend. In this regard contradictory results were obtained by early workers. Rajagopala Iyengar *et al.* (1954) observed that phosphorus fertilization increased nitrification. Synghal (1959) observed that addition of major plant nutrients except nitrogen to incubated soils decreased nitrifying power of the soil. Garbosky and Giambiagi



(1962) reported that nitrification was unaffected by organic nitrogen and levels of phosphate in soil, whereas Anderson and Bosewell (1964) observed that addition of nitrogen resulted in retarding nitrification in acid soils. Ramaswami (1966) reported that the content of either nitrogen, phosphate or potash did not significantly affect the nitrifying capacity of the soil. Siddaramappa *et al.* (1973) observed maximum nitrification in the soil which received nitrogen treatment every year followed by the soil treated with farm yard manure and super phosphate. From the previous work and based on the present investigation it is noted that nitrification in soil is not controlled by the nutrient elements alone, but also by other soil factors.

Significant differences could not be established between the soils at different stages of crop growth (Table 1). On an average lateritic soils fixed higher amounts of nitrogen (12.67 mg/g mannite) and a steady increase was noticed during the crop growth. Moore (1966) stated that nitrogen gained in soil was the result of the cumulative action of numerous micro-organisms fixing small quantities of nitrogen. This may explain the absence of significant differences obtained in the work.

Table 1. Nitrogen Fixing Capacity (mg N/g mannite)

Treat. No.	Alluvial			Black			Red Non-calcareous			Red Calcareous			Lateritic		
	T	F	H	T	F	H	T	F	H	T	F	H	T	F	H
1.	1.96	8.82	10.50	10.92	10.64	13.58	11.06	6.86	9.80	11.34	10.50	10.36	4.06	11.06	16.62
2.	7.00	7.98	11.62	3 08	8.26	11.34	8.40	6.86	7.70	9.10	8.54	11.34	10.78	11.62	12.60
3.	11.62	9.52	12.04	2.38	9.24	12.88	8.96	7.70	8.54	4.20	9.24	10.78	11.26	11.40	11.62
4.	7.28	11.48	11.20	9.66	8.68	11.20	3.92	7.56	10.92	9.66	9.52	10.64	11.82	10.50	11.79
5.	13.30	9.80	11.76	2.80	9.80	6.44	10.22	7.98	10.08	7.00	8.54	12.46	17.08	16.10	12.46
6.	7.70	13.58	11.06	2.94	9.52	9.24	8.68	6.30	11.20	2.52	10.36	10.64	8.04	9.38	12.60
7.	3.92	11.90	11.62	10.50	14.00	10.92	2.80	8.26	10.78	11.76	8.82	11.20	11.40	12.88	11.20
8.	13.86	11.20	10.50	10.64	10.36	12.18	10.64	7.00	10.36	9.94	10.64	10.78	14.56	12.74	12.46
9.	3.22	10.50	11.20	10.78	10.08	9.80	9.10	10.92	10.78	4.90	6.30	9.80	12.60	12.46	9.24
10.	15.12	13.02	12.04	11.90	10.50	13.16	8.96	9.52	12.46	9.94	10.92	13.02	15.26	12.04	12.60
11.	12.18	10.36	11.20	6.02	10.36	14.14	16.80	7.70	13.16	9.66	10.50	10.80	12.74	12.74	11.62
12.	1.82	10.50	12.04	10.22	9.80	10.50	4.48	7.70	11.34	8.82	8.12	9.52	12.60	13.16	11.20
13.	9.80	11.76	11.20	10.50	10.36	14 28	3.36	9.66	15.12	3.64	7.56	10.22	14.56	13.30	13.72
14.	11.90	10.08	14.28	1.82	10.50	11.48	2.80	11.06	12.88	21.14	10.36	10.64	13.16	15.26	13.44
15.	11.90	8.82	12.88	1.40	9.66	14.28	2.80	10.08	16.94	11.90	8.40	11.20	14.42	15.12	15.96
16.	13.30	13.02	13.16	10.92	8.82	10.22	10.92	7.84	13.58	9.66	10.08	15.96	12.46	15.26	17.64

T=Tillering stage; F=Flowering stage; H=Harvest stage

In the present study none of the treatments gave any significant differences in nitrogen fixing capacity, indicating that nitrogen fixation was not affected by any of the nutrient elements tried. Waksman (1952) found that amide, ammoniacal and nitrate nitrogen strongly depressed fixation due to preferential uptake of applied nitrogen. However, Moghe and Sinha (1965) and Ramaswami (1966) observed that phosphate content of the soils as well as added phosphate influenced favourably nitrogen fixation by microorganisms.

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