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Studies on the Application of Organic and Inorganic Forms of Phosphorus in Paddy Culture-II-Variation in Organic Carbon and Available Nitrogen Status

by

RANI PERUMAL[1], L. Md. GHOUSE[2], N. GURUSWAMY[3] and A. RAJAMANNAR[4]

The chemical study of submerged soil is of great importance and its practical significance hardly needs any emphasis. Much work has been done on the decomposition of green manure in paddy soils (Acharya, 1935; Tenny Waksman, 1930 and Harrison and Aiyer, 1916). However, the N regime under water-logged condition characteristic of the virtual absence of nitrates and accumulation of ammoniacal N has not been fully worked out and particularly under condition of application of organic and inorganic forms of phosphorus.

Though the response of paddy to the application of phosphorus in general has not been as large as in the case of nitrogen, significant yield increases in certain pockets of the major rice growing states of India have been reported, (Mukherji, 1955; and Ray Chaudhuri, 1953). Ghose *et al.* (1960) have found that the addition of phosphorus both in soluble and insoluble forms stimulated the fixation of nitrogen by algae under submerged conditions. Govindarajan and Venkatarao (1952) have shown that yield

1-4. Assistants in Chemistry, Agricultural College and Research Institute, Coimbatore-3.

increase was obtained in rice by applying P_2O_5 through a preceding green manure crop. Okada (1932) (Quoted by Enyi, 1963) explained that the increase in yield due to the application of P was due to the increased absorption of N by rice and hastened maturity. Raheja (1962) has found that the bulky organic manures were as efficient source of P as super for berseem. Black, (1960) has reported that the soil organic P increases with the increase in soil N. Studies on the efficacy of green manure as source of P to paddy as compared to superphosphate have shown (Rani Perumal and Varadarajan, 1967) that application of P fertilizers with readily available P are beneficial for the short duration crop, while green manure can itself act as a source of P for the long duration crop. The investigations now reported were undertaken with a view to assess the influence of the organic and inorganic forms of application of P, on the organic C and available N contents of the soils during the period of crop growth.

Materials and Methods: Field experiments were laid out in the black soils of wetlands, Central Farm, Coimbatore for a period of three years with paddy strains CO 29 (short duration 110 days) and CO 19 (long duration 180 days) adopting the split plot design with the following treatments replicated three times.

Treatment 1: Control (No P); Treatments 2–5: Super alone to supply 15, 30, 45 and 60 lb. P_2O_5 per acre respectively; Treatments 6-9: Sesbania alone to supply 15, 30, 45 and 60 lb P_2O_5 per acre respectively; Treatments 10–15: Coimbination of super and sesbania at (10) super 15 lb P_2O_5+sesbania 15 lb P_2O_5 per acre, (11) super 15 lb P_2O_5+sesbania 30 lb P_2O_5 per acre, (12) super 15 lb P_2O_5+sesbania 45 lb P_2O_5 per acre, (13) super 30 lb P_2O_5+sesbania 15 lb P_2O_5 per acre, (14) super 30 lb P_2O_5+sesbania 30 lb P_2O_5 per acre, (15) super 45 lb P_2O_5+sesbania 15 lb P_2O_5 per acre.

Soil samples collected at intervals of 30, 60 and 90 days for the short duration crop and at 30, 60, 90, 120 and 150 days for the long duration crop were analysed for available N by the alkaline permanganate method (Subbiah and Asija, 1956) and organic carbon by the wet digestion method (Walkley and Black, 1934).

Results: *Effect on growth periods:* The data on organic C and available N for the three years were pooled together and statistically analysed adopting the weighted analysis of variance technique (Panse and Sukhatme, 1961). The analysis revealed that the organic C and available N varied significantly in both the strains during the different growth period. The results are given in Table 1.

TABLE 1. *Mean value of organic C and available N in the soil during crop growth - CO 29 and CO 19 paddy*

		Initial	30 days	60 days	90 days	120 days	150 days	S. E.	C. D.
CO 29	Organic C %	0.85	1.13	1.43	1.05	—	—	0.02	0.07
	Available N lb/acre	182	208	213	286	—	—	7.4	22.0
CO 19	Organic C %	0.85	1.13	1.50	1.02	1.12	0.93	0.16	0.48
	Available N lb/acre	182	212	216	298	212	197	6.9	21.0

It is seen that the trends of production of organic C and available N in the soil are similar for both the strains. But the treatments were found to interact with the periodical changes in organic C accumulation as shown by the significant treatment × period interaction in variety CO 19, whereas such effect was absent in CO 29. The results are presented in Table 2.

TABLE 2. *Results of interaction of treatments on periodical changes in organic C - paddy CO 19*

Treatments	Periods				
	30 days	60 days	90 days	120 days	150 days
Control (No P)	0.85	1.03	1.02	1.12	1.33
Super alone	1.11	1.39	1.12	1.07	1.42
Sesbania alone	1.17	1.63	1.02	1.03	0.97
Super < Sesbania	1.20	1.52	1.04	1.20	0.95
Super > Sesbania	1.10	1.65	1.04	1.23	0.93
S.E. (Interaction)	....	0.09			
C.D. (Interaction)	....	0.25			

The interaction effect of periods on treatment for available N was also not significant for both CO 29 and CO 19.

ii) *Effect on treatments :* Table 3 shows the organic C and available N status of the soils due to the organic and inorganic forms of P applied at different levels and at their different combinations in two paddy strains.

TABLE 3. *Variation of organic C and available N - CO 29 and CO 19 paddy crop*

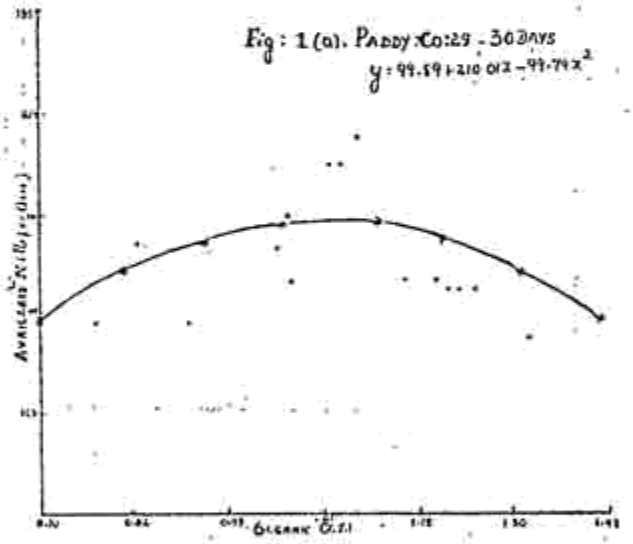
Treatments	CO 29		CO 19	
	Organic C	Available N	Organic C	Available N
Control (No P)	0.93	223	0.97	218
Super alone	1.12	219	1.13	224
Sesbania alone	1.25	242	1.17	231
Super < Sesbania	1.25	236	1.18	224
Super > Sesbania	1.28	239	1.20	221
S.E.	0.172	7.02	0.04	12.0
C.D.	....	....	0.11	....

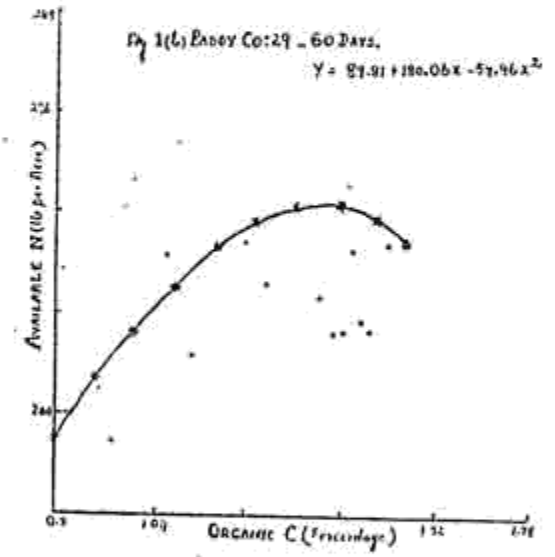
These two soil characteristics were not significantly influenced due to the forms or levels of either organic or inorganic P applied, in the case of the short duration crop CO 29, whereas there was a significant effect of the treatments on organic C in the case of the long duration crop.

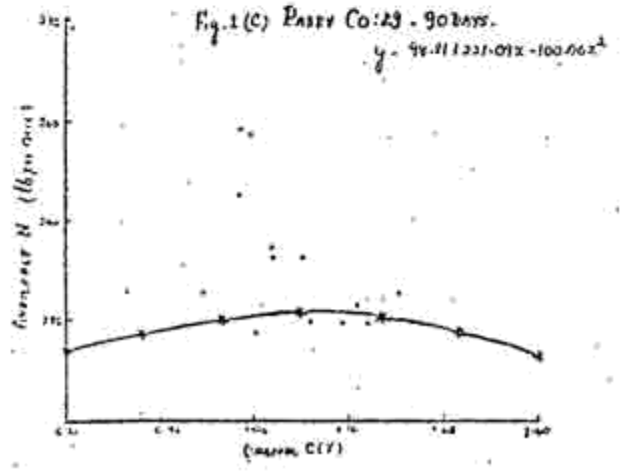
Discussion: Though there is significant variation in the quantities of available N and organic C during the different growth periods, the trend of organic C production and available N accumulation is similar for both the strains. This is also statistically proved by the absence of varietal interaction.

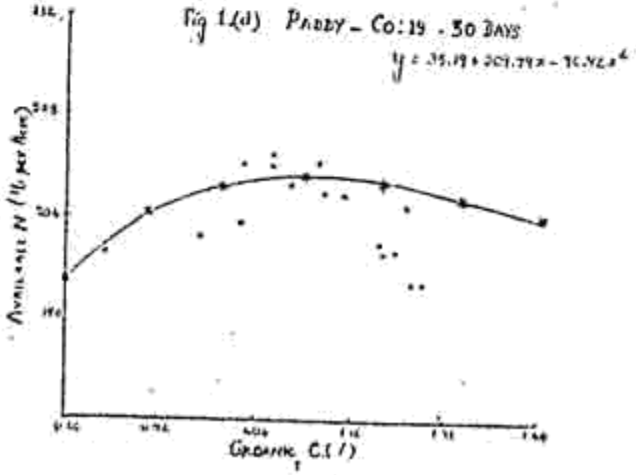
Nitrogen mineralisation is maximum at about the 90th day of crop growth by which time the short duration crop is harvested. The interaction effect of periods on treatment for available N in both the strains was found to be not significant, suggesting that the release of available N during the growth of paddy is almost uniform and is independent of any external source of P whether it be in the organic or in the organic form.

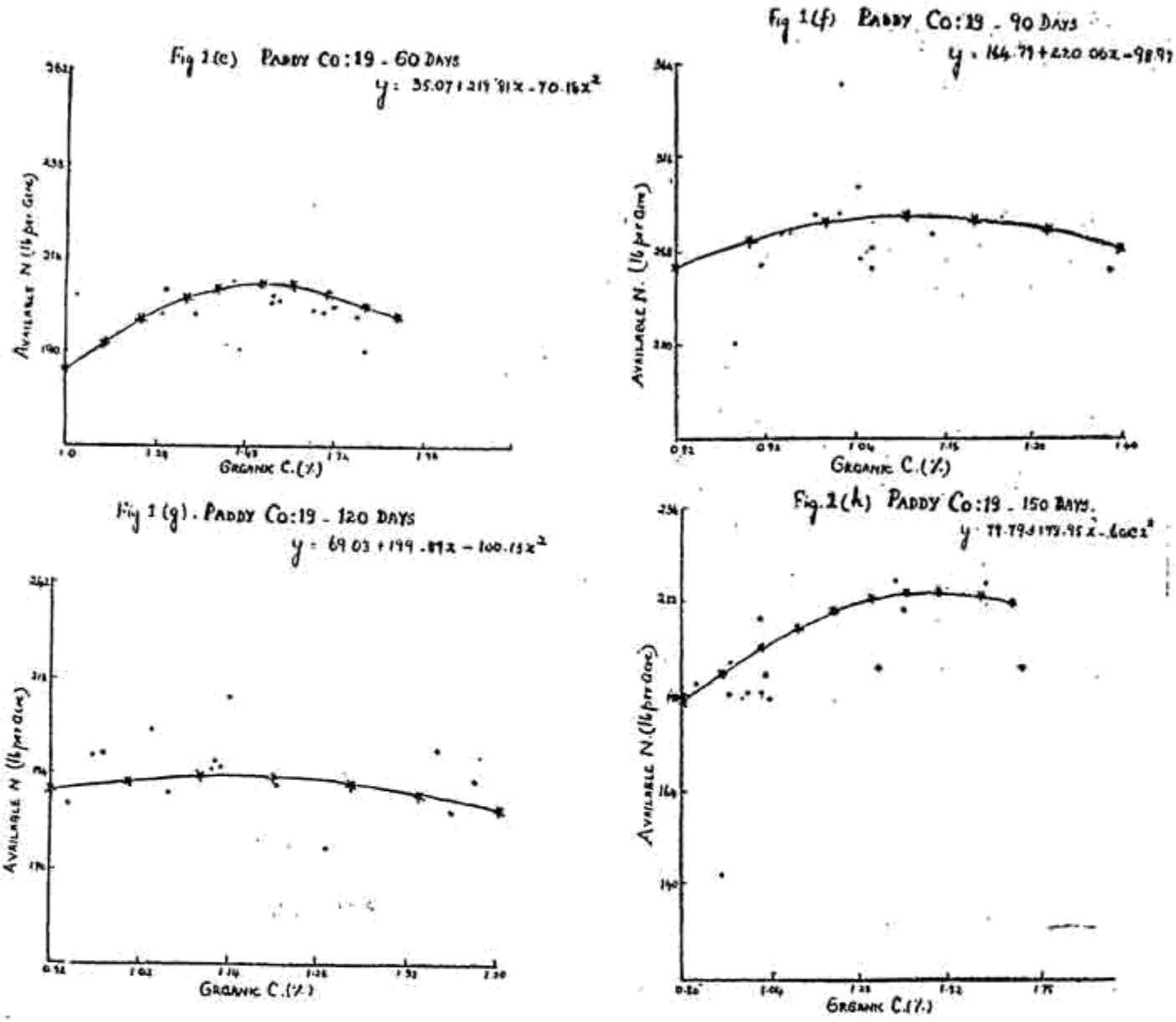
ORGANIC CARBON Vs AVAILABLE NITROGEN











In the case of organic C, the control (No P) soil has recorded significantly lesser organic C through out the growth phase, as compared to the soils receiving P. At 90 days the organic C status of the soils is found to be on the same level, irrespective of the treatments, which indicate that mineralisation of green matter attains completion within about 90 days after application.

The inter-relationship between available N and organic C changes during the different growth periods under the different treatments, represented in Fig. 1(a) to (h) show that the curve is of the second degree polynomial type indicating thereby that the available N status increases correspondingly with organic C, only up to a certain level, beyond which, increase in organic C levels depresses available N level. This trend is seen for all the periods, for both the varieties studied, indicating that the inter-relationship is independent of external factors.

Summary: Field experiments were conducted for a period of three years to study the influence of the application of organic and inorganic forms of P on the organic carbon and available nitrogen content of the soil during growth of two paddy strains CO 29 (short duration) and CO 19 (long duration).

The studies revealed that the trends of production of both organic C and available N were similar. These two soil characteristics were not significantly influenced due to the forms or levels of either inorganic or organic P applied in the case of the short duration crop, whereas a significant effect of the treatment on organic C was noticed in the case of the long duration crop.

The inter-relationship between the available N and organic C changes during the different growth periods of the crop represented graphically, show that the curve is of a second degree polynomial type. This trend is seen for all the periods for both the varieties.

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