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Fixation of Applied Phosphates in Major Soil Groups of Tamil Nadu *

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Introduction: Most Indian soils are generally low in available phosphorous, and respond well to phosphorus application. The nature of fixation and the consequent availability of applied phosphates require a detailed investigation so that we can use effectively the phosphatic fertilizers available for maximum food production.

The main objective of the study is to examine in detail the nature and extent of phosphorus fixation in the major soil groups of the State, *viz.*, alluvial, black, red and laterite soils.

Review of literature: The problem of phosphorous fixation and availability has been attracting the attention of soil scientists for many decades and its complexity is such that the last word as to its nature and form has not yet been said. According to Hemwall (1957), who reviewed the fixation of applied phosphorus in soils, chemical precipitation and physicho-chemical sorption play the major role in phosphorus retention. Larsen, Langston and Warren (1959) and Geissler (1961) showed that fixation was associated with sesquioxides in acid soils.

Rajagopal (1961) indicated that soil colloids, active sesquioxide and lime are the major soil constituents that markedly restricted the mobility of phosphate ions in the soil. Mariakulandai *et al.* (1955) and Mathan (1964) showed that lime was able to reduce phosphate fixation to some exent in laterite soils of Nilgiris when it was applied with superphosphate. Hsu (1965) indicated that the form of aluminium and/or iron present at the moment of reaction determined whether precipitation or adsorption of phosphate would occur.

Materials and Methods: An experiment on a miniature scale was carried out in beakers to evaluate the fixation of applied phosphate, using 12 soils representing the above soil groups. The fertilizers selected were superphosphate and ammophos. The two fertilizers were applied at the rate of 30 lb. P_2O_5 per acre. To compensate for the nitrogen added through ammophos, a standard schedule of all the three major nutrients (N 30 : P 30 : K 20) was adopted in both the cases.

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Treatment I : Superphosphate
Treatment II : Ammophos B (16, 20)

Two hundred and fifty grams of the air dry soil were weighed and placed in the beaker. Calculated quantities of the fertilizers were added to the soil and mixed thoroughly. The samples were kept under identical conditions, with the moisture level maintained at field capacity.

Samples were analysed six times, at fortnightly intervals, for available phosphorus, using Bray and Kurtz No. 2 extractant and Olsen's reagent.

Results and Discussion: The progressive variation of available phosphorus estimated by Bray and Kurtz No. 2 and Olsen methods are graphically represented in figures 1 and 2. The analytical data are statistically scrutinised and the results given in Table.

TABLE. *Results of analysis of variance (ppm P)*

1. *Comparison of soils:*

Soils	Alluvial	Red	Black	Laterite	S.E.	C.D.
Mean ppm, P	7.2	9.1	32.1	3.9	0.8	1.6

Conclusion: Alluvial, Black, Red, Lateriate

2. *Comparison of periods:*

Periods	I	II	III	IV	V	VI	S.E.	C.D.
Mean ppm, P	15.8	21.1	35.9	35.1	33.9	34.3	0.9	1.8

Conclusion: III, IV, VI, V, II, I

3. *Comparison of soils × periods:*

Periods (Days)	I 3rd	II 18th	III 33rd	IV 48th	V 63rd	VI 78th
Soils						
Alluvial	23.2	42.0	100.7	90.0	87.4	90.3
Red	10.7	11.5	5.6	8.8	9.2	8.8
Black	22.2	28.9	35.2	35.6	34.7	36.1
Laterite	7.2	2.1	2.2	5.8	4.3	2.0

S.E. = 1.8 C.D. = 3.6

Conclusion:

Soils	Periods
Alluvial	III, VI, IV, V, II, I
Red	II, I, V, IV, VI, III
Black	VI, IV, III, V, II, I
Laterite	I, IV, V, III, II, VI

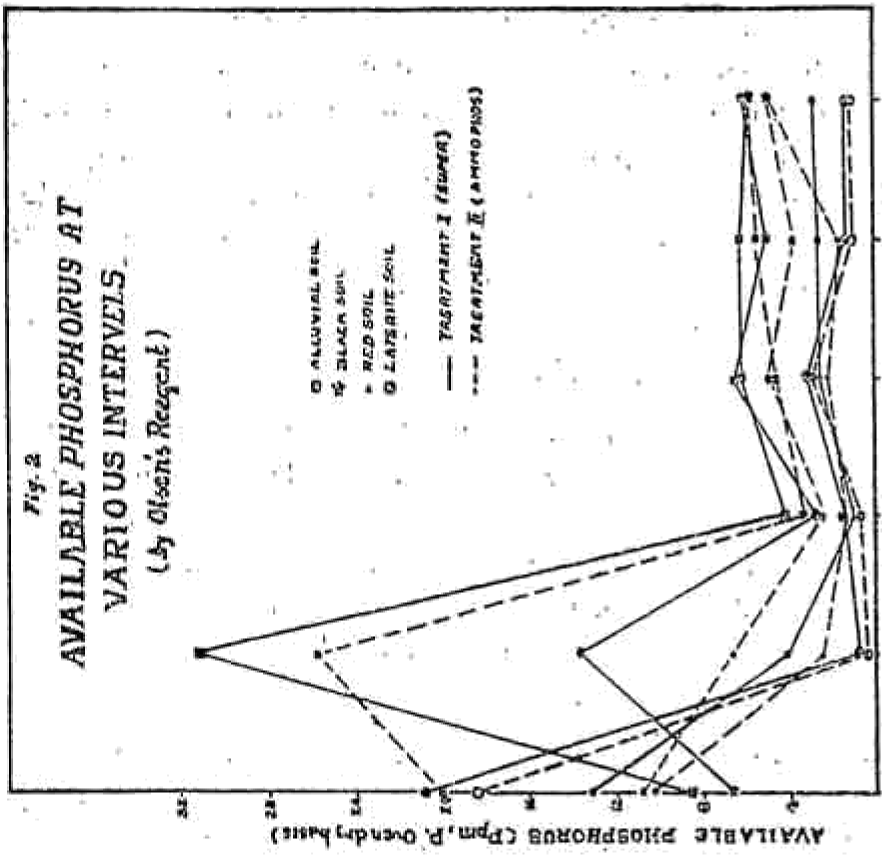
Fig. 2
AVAILABLE PHOSPHORUS AT VARIOUS INTERVELS
(by Olsen's Reagent)
ALLUVIAL SOIL
BLACK SOIL
RED SOIL
LATERITE SOIL
TREATMENT I (SUPER)
TREATMENT II (AMMO PHOS)
PERIOD (DAYS)
AVAILABLE PHOSPHORUS (Ppm. P, Ovendry basis)

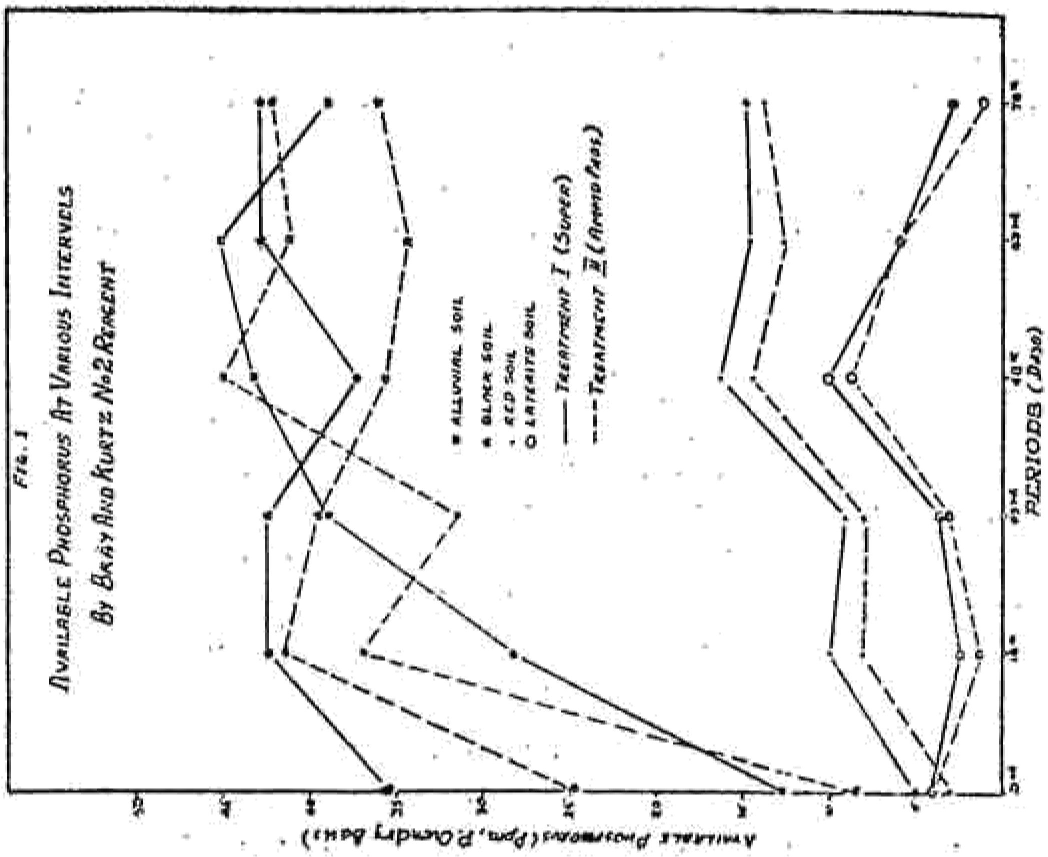
Fig. 1
Available Phosphorus At Various Intervels
By Bray And Kurtz No 2 Reagent
ALLUVIAL SOIL
BLACK SOIL
RED SOIL
LATERITE SOIL
Treatment I (Super)
Treatment II (Ammo Phos)
PERIODS (Days)
Available Phosphorus (Ppm. P, Ovendry Basis)

(a) *Effect of carriers:* No significant influence of carriers was observed in the present study on the availability of phosphorus. The available phosphorus estimated by two methods, namely, Bray and Kurtz No. 2 and Olsen, changed uniformly with time in both treatments which received the superphosphate and ammophos B. This clearly indicates that the above phosphatic fertilizers are similary fixed and removed from the soil. Ensminger (1950) reported similar results in Alabama soils. The ammophos B usually appears well adapted for use on alkaline, calcareous soils because of its high solubility, combination of N and P and residual acidity. Superphosphate is suitable for neutral to slightly acid soils.

(b) *Effect of soils:* In the present study, the phosphorus availability was high in alluvial soils, followed by black, red laterite soils in the order of decreasing availability. Menon and Mariakulandai (1957) obtained similar results and they showed that red and laterite soils were poorer in fertility status than black soils. Mathan (1964) observed that the available phosphorus was very poor in laterite soils, which were shown to exhibit high fixing capacity for applied phosphates.

(c) *Effect of periods:* When all the soils were considered the available phosphorus was highest in the third period (33rd day), followed by fourth, sixth and fifth which were on a par. The lowest availability was observed in the first (3rd day) and second (18th day) periods.

When the alluvial and black soils were considered together, the available phosphorus was the lowest in the first 18 days, after which it increased slowly and reached a maximum in the third period (33rd day) in alluvial soils and sixth period (78th day) in black soils. This clearly indicates that the added phosphorus gets fixed as unavailable forms immediately after application and then slowly becomes extractable with reagents. This is in line with the work of Mandal (1964), who reported that 0.5 N acetic acid soluble phosphate increased slightly with time.

In the case of red and laterite soils, the available phosphorus was maximum in the first 18 days, after which it decreased gradually with passage of time, thereby showing conversion of added phosphates into unavailable forms. The fixed phosphorus never became extractable with reagents in the subsequent periods. This may be due to the fact that the added phosphorus might have been converted into insoluble iron phosphates in the above soils. Larsen *et al.* (1959), Chang and Chu (1961) and Mathan (1964) obtained similar results in comparable acid soils.

Summary and Conclusion: A phosphorus fixation study was conducted on incubated soils to observe the effect of time, soils and carriers of phosphorus on the efficiency of releasing applied phosphorus to plants.

Superphosphate and ammophos were found to be similarly fixed and released from the soil.

The availability of applied phosphates was found to be high in alluvial soils, followed by black, red and laterite soils in the order of decreasing availability.

In the case of alluvial and black soils, the added phosphorus was fixed immediately after application, but became increasingly more extractable with reagents in later periods.

In the case of red and laterite soils, the fixed phosphorus never became extractable with the reagents in the subsequent periods. This suggests that the added phosphorus might have been converted into insoluble iron phosphates in the above soils.

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