

Figure 1.

In addition five sensors were buried outside the chosen area at an interval of 15 cm from each other in the horizontal direction. The moisture measurements were made using Beckman's Boyoucos moisture meter (Model BN-2B) at regular intervals for 24 hr and the observed data lead to the following inferences: (figure 1)

- (i) The rate of vertical infiltration is greater than the infiltration rate in horizontal direction. Also, for the same distance, the variations in vertical direction have higher amplitudes than the one in horizontal direction.
- (ii) Variations in the soil moisture percentage are faster, in the beginning and slower for large time values (except for the location of the first sensor where it showed a gradual rise).
- (iii) Infiltration rate at any instant of time can be obtained by the slope of the curve (figure 1) at that time.
- (iv) Variation in infiltration rate with time and depth can be studied by taking an appropriate curve and point on the curve for the computation of slope.
- (v) In the case of horizontal measurements a deviation from the expected behaviour was observed at the last sensor, resulting in greater percentage of soil moisture than those sensors which

were near the chosen area. This was attributed to a big tree present near the sensor.

(vi) Effect of capillary rise at the point of measurement near watertable is yet to be studied.

It is suggested that near the rainfall stations such areas may be chosen where continuous or discrete records are maintained for variations in soil moisture in horizontal and vertical directions using the method adopted.

The proposed method has the following advantages over the existing techniques:

- (i) No separate infrastructure is needed and the infiltration rate can be together with the rainfall data.
- (ii) The factors affecting computed infiltration rate are indirectly accounted for because the rate is measured during actual infiltration.
- (iii) Horizontal infiltration measurements give the amount of outflow to the nearby area where there is no rainfall.
- (iv) This method provides more information with greater accuracy at less additional cost.

Further work using deeper watertable areas and measurements over a longer periods of time is now in progress

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#### DETERMINATION OF WATER SOLUBLE PHOSPHORUS IN FERTILIZER MATERIALS

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ESTIMATION of water soluble phosphate ( $P_2O_5$ ) in phosphatic fertilizers by the AOAC method involves the use of perchloric acid. Nitric acid can also be used as an alternative to perchloric acid for preparing molybdovanadate solution. But the comparative efficiency of this method for P estimation has not been studied so far. An attempt has been made to study this aspect in fertilizer solutions.

Four commercial grade fertilizer materials containing different quantities of water soluble phosphate were procured from the market viz, single superphosphate (16%  $P_2O_5$ ), triple superphosphate (46%  $P_2O_5$ ), diammonium phosphate (46%  $P_2O_5$ ) and urea ammonium phosphate (28%  $P_2O_5$ ). The preparation of fertilizer solutions and the development of yellow colour was followed as given by

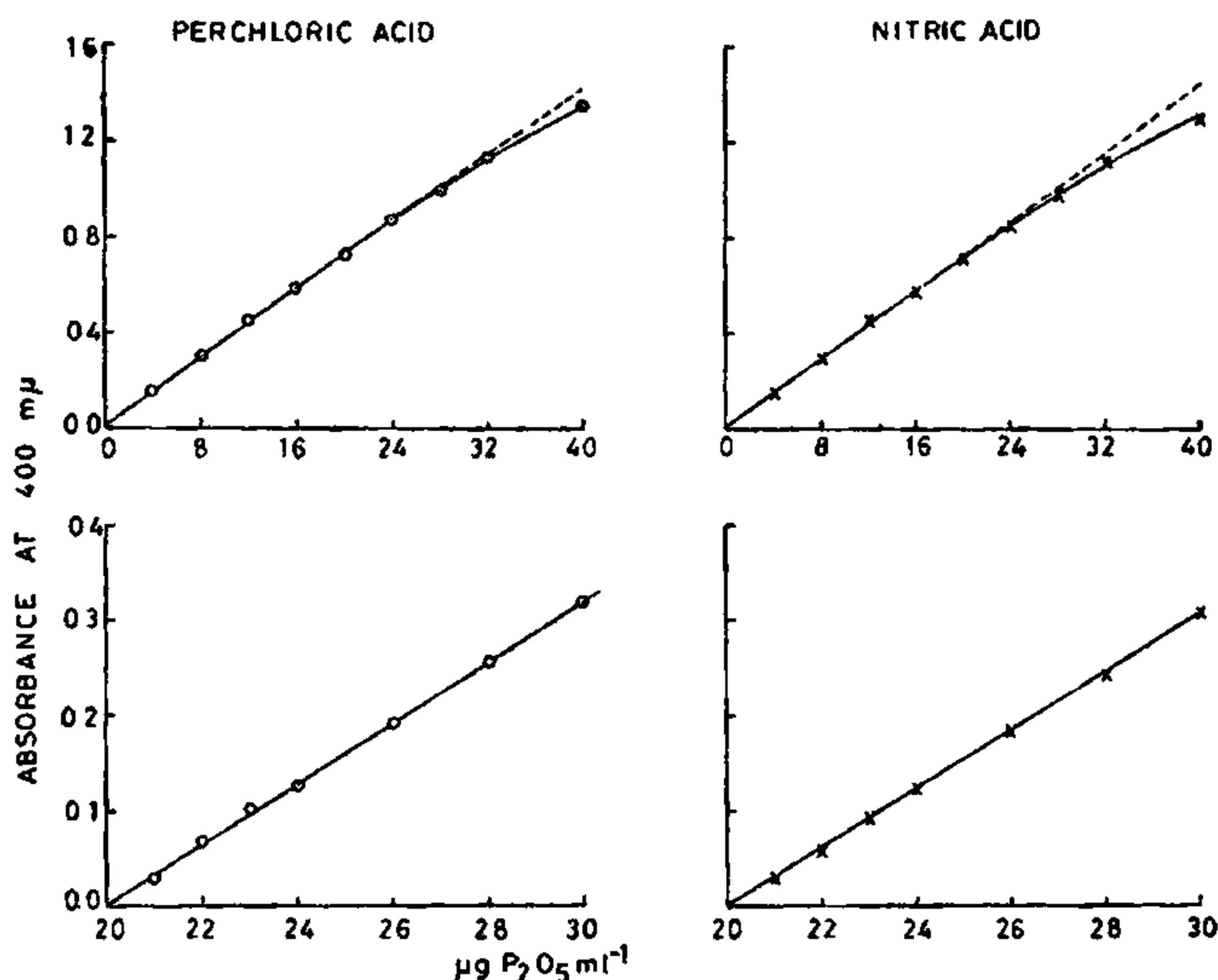


Figure 1. Standard curves for determination of P in fertilizer materials.

AOAC (1980). The absorbance of yellow colour so developed was measured at 400 mμ using a spectrophotometer (Spectronic 20). The  $P_2O_5$  content in solution was calculated from the standard curve prepared using the same procedure from  $KH_2PO_4$  solution (figure 1).

*Preparation of Vanadomolybdate-acid solution:*

(A) In Perchloric Acid: Twenty grams of ammonium molybdate tetrahydrate ( $(NH_4)_6 Mo_7O_{24} \cdot 4H_2O$ ) were dissolved in 200 ml hot distilled water. In another beaker, 1 g of ammonium meta vandate ( $NH_4VO_3$ ) was dissolved in 125 ml of hot distilled water, cooled to room temperature and 225 ml of 70% perchloric acid (E. Merck) were added. Both the reagents were added to 1 litre volumetric flask and the volume was made up with distilled water.

(B) In Nitric Acid: Same as (A) above except that 225 ml conc. nitric acid ( $HNO_3$ , sp.gr.1.42, BDH) were used instead of 70% perchloric acid.

Calibration of Standard Curve: The standard curve of P was prepared using varying concentrations of  $KH_2PO_4$  standard solution in distilled water. To set the instrument at zero absorbance, a blank was prepared in distilled water with no  $P_2O_5$  and taking 2 mg of  $P_2O_5$  solution. Absorbance was plotted against P concentration (figure 1) both for the perchloric acid and nitric acid media. It was seen

that when the blank was used, the standard curve yielded only linear relationship at lower P concentration up to 2 mg  $P_2O_5$  and deviated from linearity in 2 to 4 mg  $P_2O_5$  range. However, when the same standard solutions were used taking 2 mg  $P_2O_5$  as blank set at zero absorbance, the standard curve also yielded a linear relationship at higher concentrations. This trend was identical in both the acid media. Thus the standard curve for higher concentrations was calibrated by resetting the zero at 2 mg  $P_2O_5$  as blank.

The data on the amount of  $P_2O_5$  determined in different fertilizer materials by both the acid media are given in table 1. The results showed that the

Table 1 Water soluble  $P_2O_5$  content of fertilizers in both the acid media

Fertilizer	Water soluble $P_2O_5$ content (%)	
	Perchloric acid medium	Nitric acid medium
Single superphosphate	16.38	16.29
Triple superphosphate	43.54	44.00
Diammonium phosphate	45.91	45.78
Urea ammonium phosphate	24.45	24.65
C. D (0.05) for acid media	NS	



Table 2 Water soluble  $P_2O_5$  content (%) of triple superphosphate under different conditions

Amount of aliquot taken (ml)	Perchloric acid medium		Nitric acid medium	
	Blank (zero $P_2O_5$ )	Blank (2 mg $P_2O_5$ )	Blank (zero $P_2O_5$ )	Blank (2 mg $P_2O_5$ )
2	43.75	—	43.75	—
4	45.32	—	43.90	—
6	43.12	43.33	43.54	43.85
7	43.25	43.50	44.72	44.10
8	—	43.75	—	43.06
9	—	43.19	—	44.16
10	—	43.37	—	43.88
Mean	44.05	43.44	44.33	43.69
C. D. (0.01)	NS	NS	NS	NS

quantity of  $P_2O_5$  was almost similar in all the fertilizer materials under both the acid media and differences were statistically not significant. Calibration curve data obtained from taking different amounts of aliquot of triple superphosphate solution are given in table 2. It was found that different concentrations yielded 43.12 to 44.83%  $P_2O_5$  in perchloric acid medium and 43.06 to 44.16%  $P_2O_5$  in nitric acid medium when blank was used. However, with 2 mg  $P_2O_5$  solution as blank, the concentrations of  $P_2O_5$  in triple superphosphate varied from 43.19 to 43.75% in perchloric acid and 43.06 to 44.10% in nitric acid media. The results indicated that variations were smaller when 2 mg  $P_2O_5$  was used as blank.

These results suggest the possibility of using nitric acid (Cost: Rs. 78/- per l) as the acid medium instead of perchloric acid (Cost: Rs. 406/- per l) without sacrificing the accuracy of P determination in fertilizer materials.

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## GEOGRAPHICAL DISTRIBUTION OF THE GENUS *PIPER* LINN. IN INDIA

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*PIPER* is one of the largest of the dicotyledonous genera and is distributed throughout the tropical and subtropical regions. More than 108 species have

been recorded from the Indian subcontinent<sup>1</sup>. An investigation on the biosystematics of the genus in Karnataka region<sup>2</sup> provided the present author an opportunity to collect various references on the genus *Piper* and to examine more than 1020 herbarium specimens available at the Central National Herbarium (Howrah), Botanical Survey of India, Western Circle at Poona, Southern Circle at Coimbatore and the Centre for Taxonomic Studies, Bangalore, as well as the author's personal collection of about 300 specimens from the Western Ghats.

Hooker<sup>3</sup> recognized two distributional centres of the genus *Piper* in India viz transgangetic provinces and south Deccan. The present investigation indicated three major centres (figure 1). The first one viz the sub-Himalayan and north-east Indian centre extends from Siwalik range near Pakistan to Mismi Hills in the Arunachal Pradesh, through Kumaun, Nepal, Sikkim and Bhutan. The western half of the centre is a narrow strip comprising of the foothills of the Himalayan ranges and the eastern half is a broader region covering West Bengal, Assam, Arunachal Pradesh, Nagaland, Manipur, Tripura, Mizoram, Meghalaya, Sikkim, eastern part of Bihar and Bangladesh. The second one viz the Western Ghats centre extends from Vada near Bombay to Mahendragiri near Kanyakumari through Khandala Ghats, Mahabaleshwar, Goa, Khanapur, Bababudan hills, Anaimalai hills and Cardamom hills. It is comparatively a narrow strip covering the Western Ghats and the adjoining coast and peninsula on either side. This centre also includes Biligirirangan hills (B. R. Hills). These hills, though not seen to be geographically contiguous with the Western Ghats, have a distinct floristic link with it<sup>4</sup>. The third one