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Availability of Native Soil Phosphorus in Black Soils of South Gujarat

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ABSTRACT

The experiment was conducted in green house to study the availability of native soil phosphorus in deep black soils (Ustochrepts) of South Gujarat. Thirty soil samples were selected from the area covering very high (49.18 ppm P) to very low (0.61 ppm P) range of Olsen's P. Wheat and cowpea were grown using modified Stanford's technique.

The dry matter yield of cowpea was significantly correlated with Olsen's P (r = 0.38*). The uptake values of both the crops were also significantly correlated with Olsen's P (r = 0.83, 0.74** for wheat and cowpea, respectively). Phosphorus uptake by wheat ranged between 7.55 and 1.78 mg p/pot, whereas in cowpea, P uptake was from 7.95 to 3.14 mg p/pot. The critical soil fertility limit of Olsen's P for wheat and cowpea in black soils of South Gujarat was found to be 5 ppm.**

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INTRODUCTION

The response to applied phosphorus is affected by native soil fertility and also by the prevalent climatic conditions. The response of applied P have often been conflicting and variable in the black soils of South Gujarat. The magnitude of response is also generally low in most of the situations. One of the possible reasons for such a behaviour could be ascribed to high rate of release of P from the soil, thus making the crops non responsive to phosphorus application. The critical limit of soil P for wheat crop was found to be around 17 kg P/ha in alluvial soils of Gujarat (Goswami *et al.*, 1971). As adequate information was not available regarding correlation coefficients between the yield and P uptake with Olsen's P as well as critical levels of phosphate in cereal and legume crops in black soils of South Gujarat, hence the present investigation in green house was undertaken by collecting soil samples from cultivator's field using wheat and cowpea as test crops.

MATERIALS AND METHODS

The ninety six surface soil samples from cultivator's field of South Gujarat were collected and analysed for Olsen's available P (Olsen *et al.*, 1954), to study the availability of phosphorus to crops in different soils. Thirty soil samples were chosen with equal numbers in five different ratting classes of Olsen's P viz., very high (> 80 kg P_2O_5/ha), high (50-80 kg P_2O_5/ha), medium (20-50 kg P_2O_5/ha), low (10-20 kg P_2O_5/ha) and very low (< 10 kg

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TABLE 1

Soil test value, dry matter yield content and uptake of phosphorus by wheat and cowpea.

Sr. No.	District	Villages	Olsen's P (ppm)	Dry matter yield (g/pot)		Content of P (%)		Uptake of P (mg/pot)	
				Wheat	Cowpea	Wheat	Cowpea	Wheat	Cowpea
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1	Bharuch	Kevadia colony	19.05	1.168	2.184	0.480	0.364	5.61	7.95
2.	Valsad	Gandevi	20.29	1.108	2.031	0.512	0.283	5.67	5.75
3.	Surat	Bardoli	28.90	1.230	1.770	0.469	0.286	5.76	5.06
4.	Valsad	Sarigam	44.26	1.411	2.118	0.535	0.347	7.55	7.35
5.	Dang	Waghai R. Stn.	49.18	1.445	1.852	0.448	0.351	6.47	6.50
6.	Dang	Rambhas R. Stn.	20.90	1.196	2.086	0.386	0.297	4.62	6.20
7.	Valsad	Rupwel	9.84	1.170	1.938	0.345	0.219	4.04	4.24
8.	Surat	Chalthan	10.45	1.066	2.066	0.297	0.179	3.17	3.70
9.	Surat	Amboli	11.06	1.095	1.877	0.394	0.267	4.31	5.01
10.	Valsad	Walwada	14.14	1.014	1.849	0.316	0.283	3.20	5.23
11.	Valsad	Amalsad	14.75	0.857	1.724	0.374	0.235	3.21	4.05
12.	Valsad	Untdi	14.14	0.931	1.569	0.367	0.200	3.42	3.14
13.	Valsad	Navsari R. Stn.	3.89	0.777	1.656	0.257	0.215	2.00	3.56
14.	Bharuch	Turia	4.30	0.878	1.755	0.302	0.255	2.65	4.48
15.	Surat	Rampura	4.30	1.054	1.618	0.262	0.239	2.76	3.87
16.	Dang	Sukmal	4.30	1.175	1.733	0.254	0.231	2.98	4.00
17.	Valsad	Kontaswal	6.14	1.113	1.817	0.272	0.258	3.03	4.69
18.	Surat	Arthan	7.37	1.253	1.950	0.238	0.199	2.98	3.88

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
19.	Bharuch	Paniroli	3.69	1.092	1.525	0.253	0.227	2.76	3.46
20.	Bharuch	Pipalpani	2.46	1.339	2.062	0.285	0.222	3.82	4.46
21.	Surat	Vetanpur	2.46	1.046	1.771	0.251	0.232	2.63	4.11
22.	Surat	Buhari	2.46	0.905	1.688	0.265	0.235	2.40	3.97
23.	Valsad	Samargpur	3.07	0.925	1.904	0.267	0.224	2.47	4.26
24.	Bharuch	Gamdeshwar	3.07	0.994	1.666	0.240	0.232	2.39	3.87
25.	Valsad	Panera-Pardi	0.61	0.710	1.348	0.254	0.240	1.78	3.24
26.	Surat	Vadpada	0.61	1.119	2.086	0.262	0.179	2.93	3.73
27.	Surat	Kika-Kari	1.23	1.023	1.545	0.222	0.246	2.27	3.80
28.	Surat	Mota Varachha	1.84	1.173	1.840	0.253	0.214	2.97	3.94
29.	Bharuch	Turia	1.84	1.045	1.740	0.331	0.256	3.46	4.45
30.	Bharuch	Ashram	1.84	1.122	1.809	0.234	0.213	2.63	3.85

P_2O_5/ha) categories of Olsen's P. The uptake of phosphorus was studied by growing wheat and cowpea as per short term technique suggested by Stanford and Dement (1957) and modified by Tompkins *et al.* (1968). The short portion of the plant was harvested at the end of forty two days. Dry matter weight was recorded and subjected to chemical analysis for total phosphorus by using vanadomolybtate yellow colour method. The critical soil fertility limit of Olsen's P for wheat and cowpea was workedout using the Cate and Nelson (1973) procedure.

RESULTS AND DISCUSSION

The results of dry matter yield, P content and uptake by wheat and cowpea crops alongwith soil test values are presented in Table-1.

The results reveal that the dry matter yield of wheat ranges from 0.710 to 1.445 g/pot, whereas in cowpea it ranged from 1.348 to 2.184 g/pot. Generally dry matter yield tended to be lower in the crops when they were grown in low P soils and high in crops in high P soils. The lowest wheat dry matter of 0.710 g/pot was obtained in soil having 0.61 ppm Olsen's while the maximum dry matter production 1.445 g/pot of wheat was obtained in having an Olsen's P value of 49.18 pp Similar results were also reported by Rana a Singh (1979) and Bishnoi and Singh (1982).

The P content of wheat ranged from 0.2 (1.23 ppm Olsen's P) to 0.535 (44.20 pp Olsen's P) per cent, whereas in case of cowp it ranged from 0.179 (0.61 ppm Olsen's P) 0.364 (19.05 ppm Olsen's P) per cent (Table-1 In general, low P content was observed in bo crops having low amount of Olsen's P in soil

The P uptake by wheat and cowpea als followed the similar trend as that of dry matt production. The uptake of P by plants grown 'very high' and 'high' group soils were mo when compared to the uptake by plants whic were grown in 'low' group soils. The P uptake i wheat ranged from 1.78 to 7.55 mg/p whereas in cowpea, it ranged from 3.14 to 7.9 mg/pot (Table-1).

The correlation studies made indicate that the correlation in Olsen's P did n show significant correlation with dry matt

TABLE 2

Correlation coefficients between the dry matter yield and phosphorus uptake Vs Olsen's available phosphorus.

Details	*Crops*	
	Wheat	*Cowpea*
Dry Matter yield Vs Olsen's P	0.1092	0.3830*
P uptake Vs Olsen's P	0.8342**	0.7435**

* Significant at 5% level.

** Significant at 1% level.

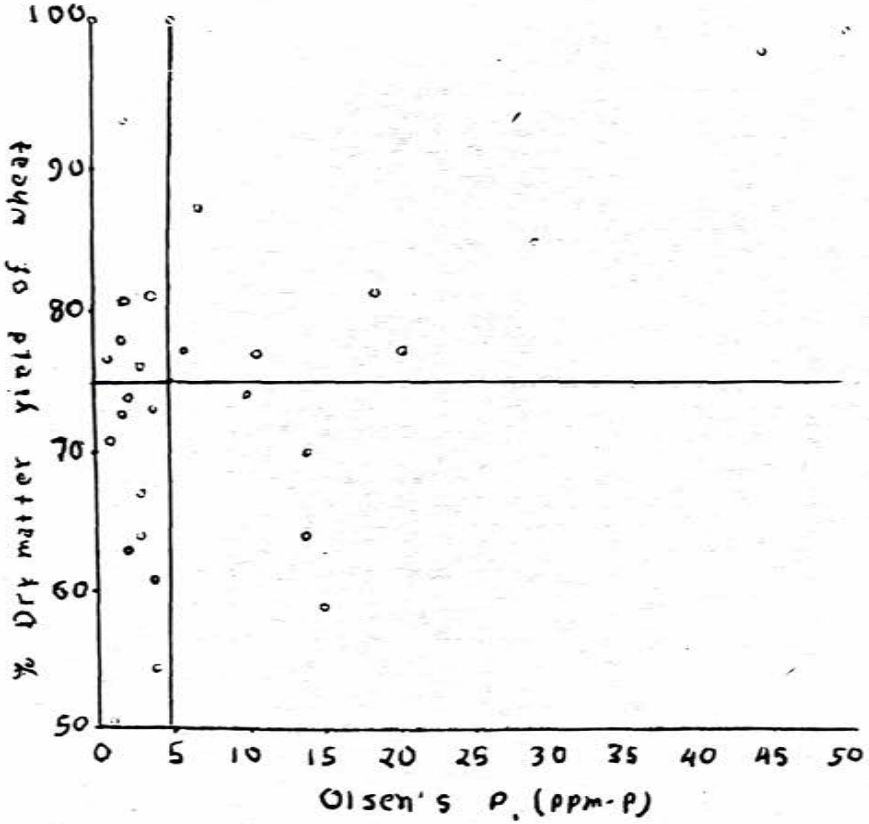

Fig 1 : Critical Olsen's P Limit in Soil with Wheat

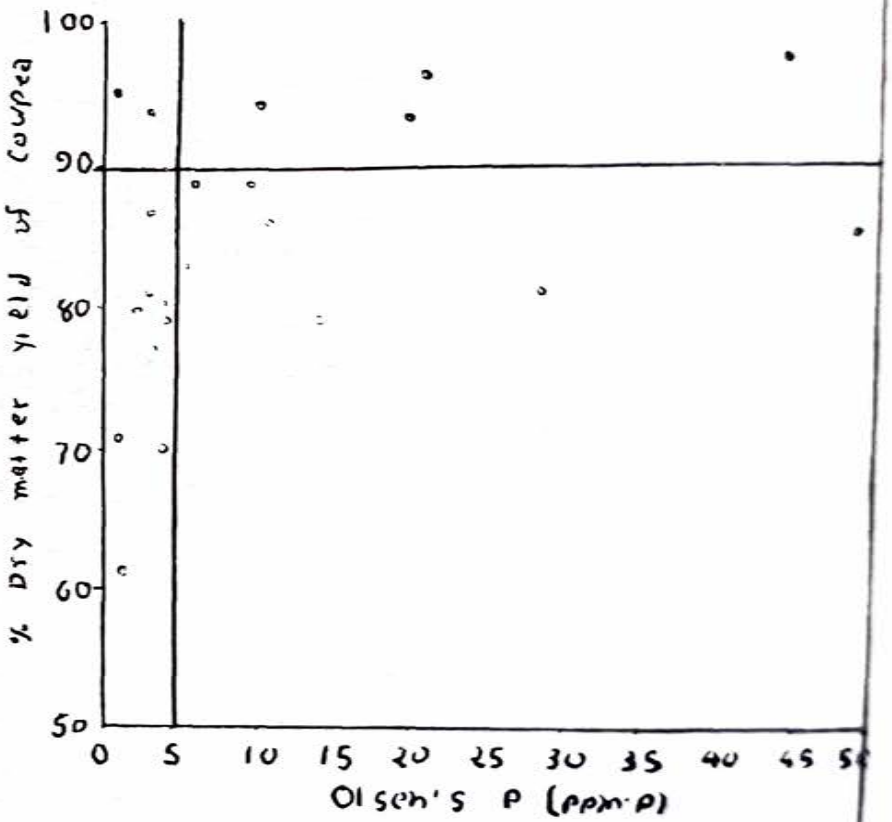

Fig. 2 Critical Olsen's P Limit in Soil with Cowpea

production of wheat (Table-2). But the dry matter production of cowpea showed a significant positive correlation with Olsen's P (r = 0.383*). Rana and Singh (1979) found that the grain and straw yield of gram were found significantly correlated with Olsen's P in Ludhiana soil.

The phosphorus uptake by both the crops viz., wheat and cowpea was found significantly correlated with Olsen's extractable P. Ryan and Ayubi (1982) in a green house study on wheat also reported that the Olsen's extractable P was significantly correlated with P uptake. Similar results were reported in wheat crop by Dubey *et al.* (1973), Dalal and Hallsworth (1976), Sharma *et al.* (1984).

A scatter diagram was prepared to obtain the critical P level in soil below which response by wheat and cowpea may be expected (Fig.1). The level of 5 ppm of Olsen's P has been observed to the critical P concentration in both wheat and cowpea crops. This is in conformity with the earlier findings of Goswami *et al* (1971). According to them a critical level of soil phosphorus for wheat crop was found to be around 17 kg P/ha of Olsen's P in the alluvial soils of Gujarat. Kanthaliya and Saxena (1989) also reported 16 kg P/ha as the critical limit for wheat for Rajasthan region (Jobner).

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