063

Table 3. *Effect of P application on dry matter yield and P uptake of wheat*

Soil		P applied (mg kg^{-1})						Bray's per cent yield	P applied (mg kg^{-1})						Bray's per cent P uptake
		0	12.5	25	37.5	50	Mean		0	12.5	25	37.5	50	Mean	
		Dry matter yield (g/ pot)							*P uptake (mg/ pot)*						
Hoshiarpur	I	2.8	5.7	6.9	7.1	7.2	5.9	38.9	3.5	9.6	15.6	20.2	23.9	14.6	14.6
Gurdaspur	I	2.6	4.8	6.3	6.7	6.9	5.5	37.7	3.6	9.1	14.2	18.4	21.5	13.4	16.7
Ludhiana	I	2.3	5.7	6.7	6.9	7.1	5.8	32.4	3.4	10.5	15.4	20.2	23.8	14.7	14.3
Faridkot	I	2.0	4.3	5.4	5.8	6.0	4.7	33.3	2.9	7.9	12.6	17.1	19.8	12.1	14.6
Bathinda	I	1.7	4.9	5.8	6.0	6.1	4.9	27.9	2.1	9.3	13.4	17.2	19.1	12.3	11.0
Hoshiarpur	II	4.3	5.8	7.1	7.2	7.2	6.3	59.7	6.6	12.4	18.0	22.8	24.3	16.8	27.2
Gurdaspur	II	4.5	5.4	6.3	6.7	7.0	6.1	64.3	6.7	12.2	16.6	20.4	23.0	15.8	29.1
Ludhiana	II	4.3	6.1	6.9	7.1	7.1	6.3	60.6	6.5	14.0	19.4	23.7	27.4	18.2	23.7
Faridkot	II	4.4	5.7	6.7	7.0	7.2	6.2	61.1	6.9	12.2	17.3	22.1	24.4	16.6	28.3
Bathinda	II	4.2	5.6	6.6	6.9	7.1	6.1	59.2	7.2	11.5	16.4	22.9	25.0	16.6	28.8
Hoshiarpur	III	7.3	8.4	8.7	8.8	8.9	8.4	82.0	13.5	19.7	25.9	29.0	30.9	23.8	43.7
Gurdaspur	III	7.7	8.6	9.3	9.5	9.5	8.9	81.1	13.5	19.9	23.7	27.3	28.8	22.6	46.9
Ludhiana	III	7.0	8.3	8.7	8.9	9.1	8.4	76.9	13.7	25.5	31.7	35.0	36.3	28.4	37.7
Faridkot	III	6.9	8.0	8.4	8.6	8.8	8.1	78.4	13.6	20.8	25.9	30.4	32.3	24.6	42.1
Bathinda	III	7.3	8.4	8.7	9.0	9.1	8.5	80.2	14.8	20.4	25.4	29.6	33.7	24.8	43.9
Mean		4.6	6.4	7.2	7.5	7.6			7.9	14.3	19.4	23.7	26.2		

CD (P = 0.05), For dry matter yield: Soil = 0.36; P level = 0.21; Soil × P level = 0.79. For P uptake : Soil = 1.11; P level = 0.64; Soil × P level = 2.46. I, II & III indicate low, medium and high P status soils, respectively

1973). Among the current soil tests, the acidic reagents like Bray-I, Bray-II *etc.* are suitable for the acid soils and Olsen's reagent for alkaline and calcareous soils. The Pi test has been found to be less sensitive to soil type and can be used in acid, alkaline and calcareous soils (Menon *et al.* 1989b, 1990a). The paper strip does not react with the soil but acts as a sink for soil solution P. The procedure is similar to the mechanism in natural soil systems. As in the present study, this test is correlating highly significantly with dry matter yield and P uptake, so it should serve as an index of plant available P for wheat crop in the soils of Punjab.

The critical levels of soil P extracted by Olsen and Pi tests were calculated statistically by the procedure of Cate and Nelson (1971). The critical level for soil P by strip shaking and Olsen method came out to be 10 and 5.5 mg kg^{-1} and for strip embedding method this was 7.5 mg/strip (Table 4).

Table 4. *Correlation coefficients of available P extracted before sowing with yield and P uptake by wheat and critical levels of P*

Method	Dry matter yield	P uptake	Critical level
Olsen	0.768**	0.901**	5.5 mg kg^{-1}
Strip shaking	0.855**	0.923**	10.0 mg kg^{-1}
Strip embedding	0.869**	0.940**	7.5 mg/strip

In conclusion, it may be stated that Pi soil tests have potential for measuring the P supplying capacity of soils and prediction of crop response to applied P. The Pi strips are easy to prepare and the procedure is simple, precise and suitable for use in routine soil testing. Further studies, especially under field conditions are needed to calibrate the test under different soils, crops, fertilizers and environmental conditions.

References

Bray, R.H. & Kurtz, L.T. (1945) *Soil Sci.* **59**, 39.

Cate, R.B. Jr & Nelson, L.A. (1971) *Proc. Soil Sci. Soc. Am.* **35**, 658.

Hauser, G.F. (1973) *Soils Bull.* **18**, FAO, Rome, Italy.

Menon, R.G., Chein, S.H., Hammond, L.L. & Henao, J. (1989a) *Fert. Res.* **19**, 85.

Menon, R.G., Hammond, L.L. & Sissingh, H.A. (1989b) *Soil Sci. Soc. Am. J.* **53**, 110.

Menon. R.G., Chien, S.H. & Hammond, L.L. (1990a) *Commun. Soil Sci. Pl. Anal.* **27**, 1137.

Menon, R.G., Chien, S.H., Hammond, L.L & Arora, B.R. (1990b) *Pl. Soil*, **126**, 287.

Morgan, M.F. (1941) *Bull. Conn. agric. Exp. Stn*, **4**, 450.

Murphy, J. & Riley, J.P. (1962) *Anal. Chim. Acta*, **27**, 31.

Nelson, W.L., Mehlich, A. & Winters, E. (1953) *Agron. Monogr.* **4**, 153.

Olsen, S.R., Cole, C.V., Watanabe, F.S. & Dean, L.A. (1954) *Circ. U.S. Dep. Agric.* **939**.

Truog, E. (1930) *J. Am. Soc. Agron.* **22**, 874.

Journal of the Indian Society of Soil Science, Vol. 43, No.4, pp 627-629 (1995)
Received July 1994; Accepted August 1995

Increasing Efficiency of Fertilizer Phosphorus through Addition of Organic Amendments in Groundnut

B.S. TRIVEDI, P.M. BHATT, J.M. PATEL AND R.C. GAMI
Gujarat Agricultural University, Navsari Campus, Navsari, Gujarat, 396450

Abstract: *In a field experiment, the phosphatic fertilizers, applied in conjuction with FYM and pressmud increased pod and haulm yield of groundnut, total P uptake and available soil P after harvest of the crop. Combined application of P and organic amendments showed higher beneficial effects. Application of pressmud @ 5.0 t ha^{-1} + P @ 22 kg ha^{-1} proved superior for all the parameters.* (**Key words:** P levels, organic amendments, groundnut yield, P uptake and available P)

Groundnut is one of the important cash crops of Gujarat. Being a leguminous crop, the rate of P addition is higher than that of N. The soils of South Gujarat are clayey in texture and also contain $CaCO_3$ (Kanzaria & Patel 1985) which lower down the efficiency of fertilizer phosphorus. Addition of organic amendments like FYM, compost or even pressmud increased not only the availability of native P but has also increased the availability of fertilizer P (Narwal *et al.* 1990; Singh & Sarkar 1992). Keeping these facts in view, an experiment was conducted on groundnut for determining the optimum dose of P and increasing the efficiency of fertilizer P.

Materials and Methods

In an experiment, the FYM @ 5.0 and 10.0 t ha^{-1}, pressmud @ 2.5 and 5.0 t ha^{-1} along with a control and three levels of P (0, 11 and 22 kg ha^{-1}) were tried on groundnut cv. G.G. 11 in a randomized block design with three replications during *kharif* 1988 and 1989. The N, P and K contents in FYM and pressmud were 0.78, 0.10, and 0.50 and 1.02, 0.91 and 0.03 per cent, respectively. The treatments were applied 15 days before sowing while P as per treatments was applied in furrows through superphosphate at the time of sowing. Nitrogen @ 25 kg ha^{-1} was applied at the time of sowing in the form of urea. No potash was added.

The experimental soil belongs to Jalalpur series having Ustochrepts at Great Group level and clay texture and are deficient in Olsen P, total N and fairly rich in available K (Table 1). The crop of groundnut was harvested after complete maturity. The pooled yields of these components are given in table 2. In the triacid digest of plant samples, P was determined by vanadomolybdophosphoric yellow colour method (Jackson 1967) and the uptake values were calculated. The available P (Olsen *et*

al. 1954) of the soil was determined from each plot after harvest of crop.

Results and Discussion

Application of P @ 22 kg ha^{-1} out yielded significantly the lower P levels in cases of pod and haulm yields (Table 2). This is in agreement with the dose recommended by Wani *et al.* (1988) for groundnut. A critical value of less than 11 kg P ha^{-1} for Olsen-P has been suggested by Dhillon and Sidhu (1992) for getting P response in groundnut. The experimental soil contained 9.96 and 5.50 kg available P ha^{-1}, respectively in the sites of 1988 and 1989 and this low availability resulted in the response. The treatments, application of FYM @ 10.0 and pressmud @ 2.5 and 5.0 t ha^{-1} were significantly superior to control. Although, application of pressmud @ 5.0 t ha^{-1} showed highest yield (2.44 t ha^{-1}), it was at par with the treatment receiving pressmud @ 2.5 t ha^{-1}. The organic amendments significantly increased the haulm yield. Pressmud application @ 5.0 t ha^{-1} showed highest yield (3.85 t ha^{-1}) but it was at par with pressmud application @ 2.5 t ha^{-1}. The FYM and pressmud applications showed relatively higher yield of both the components but the magnitude of increase was more with pressmud. A similar beneficial effect of organic amendments on pod and haulm yields has been obtained by Patil *et al.* (1986, 1987).

Interaction between levels of P and organic amendments showed relatively higher yield at a given level of P in presence of pressmud and between the two levels of pressmud, the 5.0 t rate had an edge over 2.5 t rate. This is verified from the data on per cent increase in yield over no amendment at 11 and 22 kg rates of P application. Application of FYM @ 10.0 t ha^{-1} increased yield by 43 and 52 per cent, respectively at 11 and 22 kg P rates. The increase in yield at same levels of P in presence of 2.5 and 5.0 t pressmud application was 48 and 60 and 69 and 87 per cent, respectively. This indicates better utilization of fertilizer P when it is applied with pressmud. The behaviour of haulm yield was also identical to pod yield.

The data on total uptake (Table 3) showed significant effect of levels of P as well as the organic amendments and the uptake values were found to increase with increase in rates of P application or the amendments FYM and the pressmud. In this case also, the pressmud application at both the rates had an edge over levels of FYM at a given level of P which is also reflected in statistically positive significant interaction. On an average, the organic amendment treatments also gave higher values of available P (Table 3) at each level of fertilizer P after harvest of the groundnut crop. In this

Table 1. *Pertinent characteristics of the soil*

	Site of 1988	Site of 1989
Sand (%)	24.0	25.0
Silt (%)	22.7	23.3
Clay (%)	50.5	49.1
Texture	c	c
$CaCO_3$ (g kg^{-1})	11.9	21.6
pH	7.6	7.2
EC (dS m^{-1})	0.35	0.34
CEC [cmol(p^+) kg^{-1}]	56.2	50.2
Total N (g kg^{-1})	0.48	0.40
Available P (kg ha^{-1})	9.96	5.50
Available K (kg ha^{-1})	380	359

Table 2. *Pooled effect of different levels of organic amendments and P on pod and haulm yield of groundnut*

Organic amendments	P levels (kg ha^{-1})				P levels (kg ha^{-1})			
	0	11	22	Mean	0	11	22	Mean
	Pod yield (t ha^{-1})				*Haulm yield (t ha^{-1})*			
No amendment	1.47	1.76	1.90	1.71	2.12	2.51	2.86	2.50
FYM @ 5.0 t ha^{-1}	1.87	2.00	2.13	2.00	2.36	2.76	3.16	2.76
FYM @ 10.0 t ha^{-1}	1.96	2.11	2.24	2.10	2.73	3.16	3.42	3.10
Pressmud @ 2.5 t ha^{-1}	1.92	2.18	2.36	2.15	3.09	3.44	3.67	3.40
Pressmud @ 5.0 t ha^{-1}	2.07	2.50	2.75	2.44	3.51	3.87	4.15	3.85
Mean	1.86	2.11	2.28	-	2.76	3.15	3.45	-
	P levels	*Organic amendments*	*Interaction*		*P levels*	*Organic amendments*	*Interaction*	
CD (P = 0.05)	0.13	0.30	0.11		0.16	0.49	NS	

Table 3. *Pooled effect of different levels of organic amendments and P on total P uptake and available P after harvest of groundnut*

Organic amendments	P levels (kg ha^{-1})				P levels (kg ha^{-1})			
	0	11	22	Mean	0	11	22	Mean
	Total P uptake (kg ha^{-1})				*Available P (kg ha^{-1})*			
No amendment	3.75	6.59	9.13	6.49	5.90	10.95	12.31	9.72
FYM @ 5.0 t ha^{-1}	6.65	8.12	10.15	8.31	8.44	11.33	12.41	10.73
FYM @ 10.0 t ha^{-1}	8.21	10.22	12.16	10.20	9.73	11.33	13.47	11.51
Pressmud @ 2.5 t ha^{-1}	8.27	10.82	13.16	10.75	9.06	11.71	13.42	11.40
Pressmud @ 5.0 t ha^{-1}	10.16	14.22	18.02	14.13	9.90	13.62	14.92	12.81
Mean	7.41	9.99	12.52		8.61	11.79	13.31	
CD (P = 0.05)	*P levels* 1.15	*Organic amendments* 2.74	*Interaction* 1.03		*P levels* 0.78	*Organic amendments* 1.01	*Interaction* NS	

case also, the pressmud treated plots showed relatively higher values of available P.

The probable reason of getting higher yield of pod and haulm as well as higher total P uptake with addition of organic amendments might be the release of native P due to intermediate acids (Singh & Jones 1976) produced during decomposition, in addition to chelating effect of complex intermediate organic molecules (Datta & Goswami 1962). The effect of pressmud was better than FYM on yields of pod and haulm, total uptake of P and available P after harvest of the crop. This might be due to originally high concentration of P in pressmud and its subsequent release during decomposition (Kapur & Kanwar 1989).

Thus, addition of FYM and pressmud increased the efficiency of fertilizer P in clay soils of the region. The values of uptake were relatively high whenever either FYM or the pressmud accompanied the fertilizer P. The fertilizer P efficiency at 22 kg P level increased by 11, 33, 44 and 97, per cent, respectively when FYM @ 5.0 and 10.0 and pressmud @ 2.5 and 5.0 t ha^{-1} were applied.

References

Datta, N.P. & Goswami, N.N. (1962) *J. Indian Soc. Soil Sci.* **10**, 263.

Dhillon, N.S. & Sidhu, A.S. (1992) *J. Indian Soc. Soil Sci.* **40**, 478.

Jackson, M.L. (1967) *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd., New Delhi.

Kanzaria, M.V. & Patel, M.S. (1985) In *Soils of India and Their Management*, Fertiliser Association of India, New Delhi.

Kapur, M.L. & Kanwar, R.S. (1989) *J. Indian Soc. Soil Sci.* **37**, 57.

Narwal, R.P., Gupta, A.P. & Antil, R.S. (1990) *J. Indian Soc. Soil Sci.* **38**, 51.

Olsen, S.R., Cole, C.V., Watanabe, F.S. & Dean, L.A. (1954) *Circ. U.S. Dep. Agric.* **939**.

Patil, G.D., Patil, M.D., Adsule, R.N. & Patil, J.D. (1985) *J. Maharashtra agric. Univ.* **11**, 321.

Patil, G.D., Patil, M.D., Patil, N.D. & Adsule, R.N. (1987) *J. Maharashtra agric. Univ.* **12**, 168.

Singh, B.B. & Jones, J.P. (1976) *Soil Sci. Soc. Am. J.* **40**, 389.

Singh, K.P. & Sarkar, M.C. (1992) *J. Indian Soc. Soil Sci.* **40**, 762.

Wani, B.B., Patil, G.D. & Patil, M.D. (1988) *J. Maharashtra agric. Univ.* **13**, 302.