RATIONALISED FERTILISER PRESCRIPTION FOR GROUNDNUT BASED ON SOIL TEST CROP RESPONSE STUDIES

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Soil Test-Crop Response Studies have been conducted on red soil-Irugur series (Typic Ustorthent) with groundnut-POL 2 as test crop. Fertilizer prescription equations have been developed, test verified on other varieties/on allied soil series. The fertiliser prescription equation developed for Irugur series holds good for association/allied series- Palladam and Somayanur; and also suitable for other variety-Groundnut TMV 7.

Groundnut (*Arachis hypogoea* L·) a large seeded legume plant occupies an important place in Indian economy. Since India accounts for 41 and 31 per cent of the world out put and area respectively, the potentialities of groundnut as a valuable earner of foreign exchange, cannot be over emphasised. It is cultivated over one million hectare in Tamil Nadu producing one million tons resulting in an average productivity of one t/ha. Efficient fertiliser management holds the key in enhancing groudnut production under irrigated condition. With spiralling of fertiliser cost, it is all the more necessary to rationalise the fertiliser use so as to increase the production without affecting soil fertility status. Hence, the rationalised fertiliser recommendation should take into account of nutrient supplying power of soil as well as crop requirement. Soil test crop responses studies on groundnut have been focussed in this direction and developed fertiliser prescription equations based on efficiencies of soil and fertiliser nutrients and nutrient requirement of the crop. This study was taken to evaluate the validity of the fertiliser adjustment equation developed for one series/variety to other allied series/varieties so as to give rationalised fertiliser recommendation for large area of association/similar soils and to assess the fertility changes in the post–harvest soil.

MATERIALS AND METHODS

Soil test crop response field trial conducted at Bhavanisagar with test crop of groundnut–POL. 2 over four fertility gradient artificially created and biologically stabilised by growing maize Ganga 5. From the test crop experiment the basic informations viz., nutrient requirement to produce, one quintal of economic produce, per cent contribution from soil and fertiliser were calculated using yield, uptake and soil test values. The prescription equations were derived from the above parameter.

These equations were test verified over 10 locations on Irugur soil series (Typic Ustorthent) and on associated series namely Somayanur series (Udic Haplustalf) and Palladam series (Typic Ustorthent) with two groundnut varieties POL 2 and TMV 7. The physico

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chemical characteristics of the soils is presented in Table 1. The basic data and the fertiliser prescription equations are given in Table 2.

Irugur series consists of dark reddish brown to red, *in situ* soils developed from weathered gneiss. The soil is sandy loam in texture, free from salinity as well as sodicity problems. The soils of Somayanur and Palladam series also exhibited similar physio-chemical properties since they come under same association with Irugur series (Anonymous, 1972).

The verification trials were conducted with two groundnut varieties viz., POL 2 and TMV 7 in simple randomised block design with six treatments. The treatments consisted absolute control, blanket recommendation, soil test recommendations based on Mitscherlitch Bray equation, fertiliser recommendations for 15, 20 and 25 q/ha yield targets based on soil nutrient status. The post-harvest soil fertility status was assessed with $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-p (Olsen *et al*, 1954) and Neutral-N, NH_4 OAc-K, (Hanway and Heidal, 1952).

RESULTS AND DISCUSSION

The mean values of pod yield, post-harvest soil analysis, per cent achievement and value/cost-ratio (VCR) are given in Table 4. The mean pod yield ranged from 7.38 to 25.80 q/ha. The control plots registered the lowest yields at all sites. Among the ten sites. Bhavanisagar recorded the highest yield (Table 3). The pooled mean values of the sites showed a variation in yield which ranged from 10.62 for control to 22.60 q/ha for 25 q/ha

yield target. The yield target of 15 q/ha recorded a mean yield of 15.65 q/ha resulting in more than cent per cent achievement. The yield targets 20 and 25 q/ha showed achievements of 92.3 and 90.4 per cent respectively. However the 't' test was not significant at all yield targets tried indicating that there was not significant variation between the yields aimed and achieved.

The value/cost ratio varied from 3.31 to 22.67. In all the sites, the soil test recommendation based on Mitch. erlitch Bray's concept recorded the lowest VCR. The yield target 15 q/ha gave the highest VCR. Eventhough the yield increased with target, the VCR showed a reverse trend. It declined from 22.67 in 15 q/ha to 7.47 in 25 q/ha (Table 4).

The data on influence of soil series and varieties on the validity of the equation is given in Table 5. The results clearly revealed that achievement was in the range of 87.8 to 108.5 per cent. Among the series, the Somayanur series recorded the lower value of yield achievement. for 20 q/ha of yield target. However, the 't' value was found to be insignificant for all the locations indicating the quantum of variation was not much. Though the equations have been developed for Irugur soil series, it holds good for the other two allied soil series, viz., Somayanur and Palladam. This trend my be due to the fact that these two series were under the association with Irugur (Anonymous, 1972). A full achievement of target was noticed at 15 q/ha in groundnut-POL 2 while in the case of TMV 7 it was up to 20 q/ha. The per cent achievement was higher for groundnut TMV 7 than

Table 1. Physico-Chemical Properties of soil

	Palladam	Somayanur	Irugur
Mechanical Composition (per cent)			
Coarse sand	25.12	28.60	30.40
Fine sand	32.15	33.40	35.60
Silt	20.43	21.32	18.00
Clay	19.54	16.00	16.20
Chemical Properties			
EC (m. mhos/cm)	0.24	0.32	0.28
pH	7.40	7.80	7.30
Bulk density (G cm⁻³)	1.35	1.28	1.30
CEC (me/100 g)	14.30	12.60	11.80
$KMnO_4$ — N (kg/ha)	247.00	253.00	257.00
Olsen — P (kg/ha)	9.26	10.02	8.96
NH_4 OAc — K (kg/ha)	489.00	457.00	270.00
Organic carbon %	0.68	0.68	0.66

Table 2 Basic informations and prescription equations

Basic Data	N	P_2O_5	K_2O
Nutrient Requirement (kg/q)	6.85	1.24	2.73
Soil Efficiency (%)	42.80	73.10	9.30
Fertiliser Efficiency (%)	149.30	26.30	30.30

Prescription Equations

$$FN = 4.59 \ T — 0.29 \ SN$$
$$FP_2O_5 = 4.71 \ T — 6.36 \ SP$$
$$F K_2O = 9.01 \ T — 0.37 \ SK$$

(F, S = Fertiliser and Soil Nutrients in kg/ha)
(T = Yield Target in q/ha)

Table 3 Test verification trial-groundnut pol. 2 and TMV. 7

Locations	Fertility Status (kg/ha)			Treatments	Fertilizer level (kg/ha)			Yield q/ha	Achievement %	VCR	Post-harvest Analysis		
	N	P	K		N	P_2O_5	K_2O				N	P	K
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Mr. A R Natarajan Arasampalayam	250	8.96	588	Control	—	—	—	9.92	—	—	273	10.16	459
				B. Recom.	18	36	54	16.27	—	6.78	297	12.60	571
				S. T. L.	10	115	0	16.80	—	4.18	289	16.64	493
				15 q/ha	0	15	0	15.40	102.7	27.40	280	10.64	465
				20 q/ha	18	35	0	16.56	82.8	9.89	299	11.75	516
Mr. A. R. Subbiah Arasampalayam	260	8.96	526	Control	0	0	0	11.00	—	—	279	10.16	482
				B. Recom	18	36	54	17.75	—	7.20	289	12.32	555
				S. T. L.	10	115	0	18.50	—	4.39	296	16.00	488
				15 q/ha	0	15	0	16.00	106.7	25.00	286	11.47	504
				20 q/ha	15	35	0	18.00	90.0	10.43	298	13.15	493
Mr. Lakshman Gounder, Arasampalayam	254	10.20	515	Control	0	0	0	10.10	—	—	272	10.72	493
				B. Recom.	18	36	54	13.34	—	3.56	282	14.00	549
				S. T. L.	11	115	0	13.34	—	2.01	279	18.48	493
				15 q/ha	0	10	0	12.00	80.0	15.00	275	14.00	504
				20 q/ha	13	30	0	18.86	63.3	4.66	281	16.00	493
Mr. Mani Nadar Arasampalayam	231	8.96	504	Control	0	0	0	7.38	—	—	209	9.89	526
				B. Recom	18	36	54	18.25	—	11.59	245	10.64	526
				S. T. L.	13	102	0	18.25	—	7.61	232	10.64	541
				15 q/ha	0	15	0	17.00	113.3	48.10	237	10.64	523
				20 q/ha	18	35	0	18.75	93.6	16.94	229	11.20	578
				25 q/ha	40	60	50	19.00	76.0	7.80	240	8.96	548

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Table-3 (contd....)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Mr. Velusamy Gounder Arasampalayam	257	8.86	560	Control	0	0	0	10.00	—	—	242	9.80	566
				B.Recom.	18	36	54	21.00	—	11.73	245	10.36	555
				S.T.L.	18	115	0	19.50	—	5.47	248	10.92	543
				15 q/ha	0	15	0	16.00	106.7	30.00	250	10.92	583
				20 q/ha	17	40	0	21.67	108.4	14.82	245	10.64	560
				25 q/ha	40	50	0	24.00	96.0	9.43	245	10.36	571
Agrl Res Station Bhavanisagar	273	11.20	213	Control	0	0	0	12.70	—	—	190	10.64	157
				B.Recom.	18	36	54	25.80	—	13.97	298	11.20	163
				S.T.L.	0	102	35	16.49	—	1.83	234	10.92	163
				15 q/ha	0	0	55	15.50	101.6	34.90	243	10.64	157
				20 q/ha	15	20	100	23.50	108.5	11.92	278	11.76	152
				25 q/ha	35	40	145	24.80	99.2	7.51	253	10.92	179
Tmt Sarojini Ammal. Arasampalayam	250	8.86	525	Control	0	0	0	8.50	—	—	223	8.42	566
				B.Recom.	18	36	54	14.25	—	6.23	326	10.64	578
				S.T.L.	13	115	0	10.00	—	3.22	301	11.20	555
				15 q/ha	0	15	0	13.58	90.5	25.18	251	8.42	560
				20 q/ha	18	35	0	14.16	70.8	7.29	308	9.80	571
Mr. Nataraja Gounder Arasampalayam	251	8.86	525	Control	0	0	0	8.75	—	—	263	8.96	570
				B.Recom	18	36	54	11.25	—	2.67	302	9.80	555
				S.T.L.	10	138	0	10.63	—	2.50	297	10.36	560
				15 q/ha	0	15	0	12.75	85.6	2.00	279	9.80	560
				20 q/ha	15	35	0	14.88	74.4	9.68	298	9.80	571

Table-3 (contd—)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Mr Kanakaraj	230	9.00	560	Control	0	0	0	14.29	—	—	245	10.16	571
Arasampalayam				B. Recom	18	36	54	21.12	—	5.67	248	9.00	583
Dasampalayam				S. T. L.	18	115	0	18.55	—	1.91	237	9.80	560
				15 q/ha	3	14	0	16.18	103.9	6.66	278	8.42	560
				20 q/ha	25	37	0	17.85	89.3	3.40	237	9.80	545
				25 q/ha	48	61	53	24.90	99.6	5.14	245	10.92	583
*Chettipalayam	213	8.96	437	Control	0	0	0	14.05	—	—	213	7.56	405
				B. Recom	18	36	54	21.72	—	6.61	220	8.96	426
				S. T. L.	17	114	0	20.51	—	3.95	220	13.60	420
				16 q/ha	7	15	0	15.26	101.7	8.21	215	9.20	415
				20 q/ha	29	37	20	20.77	103.9	6.93	227	10.64	410
*Chettipalsyem	213	8.96	437	Control	0	0	0	13.35	—	—	203	8.00	395
				B. Recom	18	36	54	19.73	—	8.70	216	9.36	415
				S. T. L.	17	114	0	20.37	—	3.75	210	14.72	405
				15 q/ha	7	15	0	15.83	105.5	4.36	210	9.80	410
				20 q/ha	29	37	20	19.90	99.5	7.34	220	11.20	405

*Groundnut TMV 7   Other locations-Groundnut POL 2

B. Recom : Blanket recommendations

S. T. L. : Soil Test Recommendation (M & B)

VCR : Value/cost Ratio

N @ Rs. 5.11/kg
P$_2$O$_5$ @ Rs. 6.00/kg
K$_2$O @ Rs. 2.11/kg
Groundnut @ Rs. 4.50/kg

Table 3   Mean of Statestical Analysis

Treatment	Yield (kg/ha)	Per Cent Achievement	't' Value
Control	1062	—	
B . Recom	1769	—	
S.T.L.	1654	—	—
15 q/ha	1565	104.3	0.79NS
20 q/ha	1846	92.3	0.74NS
25 q/ha	2260	90.4	1.32NS

Table 4   Yield, achievement, value/cost ratio and post harvest soil fertility status (Mean of 10 locations)

Treatment	Pod yield q/ha		Achieve-ment (%)	't' value	Value cost Ratio	Post Harvest Soil Analysis (kg/ha)		
	Range	Mean				KMNO$_4$-N Mean	Olsen-P Mean	NH$_4$OAc-K Mean
Control	7.38 — 14.29	10.62	—	—	—	236	9.50	428
Blanket Recommendation	9.25 — 25.80	17.69	—	—	7.21	269	11.81	497
Soil Test Recommendation	10.00 — 20.51	16.54	—	—	3.31	258	12.60	475
15 q/ha	12.00 — 21.70	15.65	104.30	0.79NS	22.67	255	10.48	426
20 q/ha	11.88 — 23.50	18.46	92.30	0.74NS	9.08	265	11.30	437
25 q/ha	19.60 — 24.90	22.60	90.40	1.32NS	7 47	256	10.29	470

INITIAL SOIL TEST VALUES (MEAN)						248	9.30	495

for groundnut POL 2. The reason may be the yield potentiality of TMV 7 is higher than POL 2. In both the varieties of groundnut, the variation between observed and aimed was not statistically significant as judged by the 't' test.

The post-harvest soil fertility status of the individual locations is given in Table 3. The values of $KMnO_4$-N ranged from 190 to 308 kg/ha, Olsen-P from 7.56 to 18.48 kg/ha and NH_4 OAc-K from 157 to 583 kg/ha. The value indicated that $KMnO_4$-N was slightly enhanced in all the sites. The reason could be attributed as the groundnut is a leguminous crop, it could have added N by its symbiotic relationship with rhizobia. The highest 'P' was noticed in the treatment which received soil test recommendation based on Mitcherlitch-Bray concept. The reason may be higher quantity of 'P' applied based on this approach. In general there was a slight enhancement in Olsen-P status. Since groundnut being a leguminous crop, it could have solubilised some native 'P' also due to the rhizosphere-effect (Swaby and Joan Sherbery, 1958), Rani Perumal (1972), Dhillon and Dev (1979) also reported similar findings. The available-K status showed a declining trend. Similar phenomena of decrease in available-K status after groundnut in red soil was met with by Rani Perumal (1972).

In extending this concept over larger area a block demonstration was conducted on red soil (Irugur series- Typic Ustorthent) at Bhavanisagar with Groundnut POL 2 as test crop in an area of one acre. The soil registered low in $KMnO$ -N as well as in Olsen-P and high in NH_4 O Ac-K. Based on soil analysis the fertiliser recommendation was given for 20 q/ha of yield target. The yield, fertiliser applied and soil analysis are presented in Table 5. The results showed that the yield of 19.70 q/ha was recorded with an achievement of 98.5 per cent. The post-harvest soil analysis revealed that a slight, increase in available-N and P status while the K status followed a reverse trend.

The above trials concluded that the fertiliser prescription equations developed for groundnut POL 2 can be used for TMV 7 also. In addition this equation can be extended to other allied- series/association of soil series namely for Somayanur and Palladam soil series. Based on fertiliser prescription equations, the fertiliser doses for yield targets of 15 and 20 q/ha for varying soil test values are given in the Table 7.

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Table-5 Influence of soil series and variety on yield and achievment

Series	Target q/ha	Mean Yield q/ha	Achievement(%)	'T' value
Palladam	15	14.99	99.9	0.02NS
(Typic Ustorthent)	20	18.01	90.0	1.03NS
Somayanur	15	16.18	107.2	0.95NS
Udic Haplustalf)	20	17.55	87.8	1.55NS
	25	24.90	99.6	0.24NS
Irugur	15	15.25	101.6	0.54NS
(Typic Ustorthent)	20	21.70	108.5	2.26NS
	25	24.80	99.2	0.44NS
Variety POL 2	15	15.79	105.2	0.83NS
	20	18.23	91.2	1.09NS
	25	22.60	90.4	1.21NS
TMV 7	15	15.26	101.7	0.54NS
	20	20.77	103.6	1.61NS

Table 6 Block Demonstration-Groundnut POL 2

Location	Fertility Status (kg/ha)			Fertiliser Level (kg/ha)			Yield (q/ha)		Achievement (%)	Post-Harvest Analysis (kg/ha)		
	N	P	K	N	P_2O_4	K_2O	Aimed	obtained		N	P	K
Bhavanisagar	235	7.7	278	24	76	20.00	20.00	19.70	98.5	251	9.8	245

Table 7 Fertiliser Requirement kg/ha For Different Yield Target with Varying Soil Test Value

Soil Test Values (kg/ha)			15 q/ha	Target		20 q/ha		Target
N	P	K	N	P_2O_4	K_2O	N	P_2O_5	K_2O
150	5	250	25	39	43	48	62	78
200	10	300	11	7	24	34	31	69
250	15	350	—	—	6	19	—	51
300	20	400	—	—	—	5	—	32

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