RESEARCH ARTICLE Legume Research- An International Journal, Volume 48 Issue 5: 861-866 (May 2025)

Soil Test and Yield Target Based Balanced Fertilizer Prescription Model for Green Gram on Alfisols of Tamil Nadu

P. Malathi[1], S. Maragatham[1], R. Rajeswari[1], K.M. Sellamuthu[1], Sanjay Srivastava[2], Pradip Dey[3], A.S. Mailappa[4]

10.18805/LR-5466

ABSTARCT

Background: Green gram, also known as "mungbean" is rich in protein and vitamins. Either chemical fertilizers or organic manures alone may not suffice to meet the nutrient demand with sustenance of soil health. Hence, soil test based fertilizer prescription for green gram becomes need of the hour.

Methods: Fertilizer prescription equations (FPEs) were developed for green gram grown under Integrated Plant Nutrition System (IPNS) on *Typic Rhodustalf* (Palaviduthi soil series) in Tamil Nadu. The developed FPEs were validated through four field experiments with Green gram variety CO 8 conducted during 2023 and 2024 in Dindigul district in the farmers holdings with ten treatments *viz.*, Blanket (RDF alone), Blanket+FYM (RDF + FYM @ 12.5 t ha^{-1}), STCR-NPK alone and STCR-IPNS for 8, 10 and 12 q ha^{-1}, Farmer's Practice and Absolute control in non replicated manner. Growth, yield parameters and grain yield were recorded and soil fertility was assessed.

Result: The highest growth and yield attributes were observed in the treatment receiving STCR-IPNS-12 q ha^{-1} with an increase of 34.1 per cent over blanket recommendation and 58.08 per cent over farmers practice. The post-harvest soil available NPK indicated the build up and maintenance of soil fertility due to soil test based fertilizer recommendation under IPNS. Results highlighted that in all the four locations, the per cent achievement of the targeted yield was within ± 10 per cent deviation from the yield target proving the validity of the STCR-IPNS equations developed for recommending fertilizer doses for green gram.

Key words: Alfisols, Fertilizer prescription, Green gram, STCR-IPNS.

INTRODUCTION

In agriculture, fertilizer is one of the costliest inputs, hence use of right quantity of fertilizer is basic for farm profitability and environmental protection (Kimetu *et al.,* 2004) Application of fertilizers in the farmers fields without the knowledge on soil fertility status and nutrient requirement by crop leads to adverse effects on soil and crop (Ray *et al.,* 2000). Soil testing is highly essential for optimal fertilizer use where general fertilizer recommendation leads to over use or suboptimal level of fertilizers doses for crops leads to wide variations in growth and yield of crops. Balanced supply of nutrients is not only provides adequate amount of nutrients at required ratios but also fulfilling the requirement of nutrients to achieve the yield target of the crops. Among the various soil fertility evaluation methods, an inductive methodology known as Soil Test Crop Response approach provides a holistic way to manage soil fertility with aimed yield target of crops. Soil Test Crop Response (STCR) approach based site-specific fertiliser prescription is essential for achieving higher crop productivity besides maintaining the soil health. Integrated plant nutrition system (IPNS) provides the scientific way of nutrient budgeting under combined use of fertilizers and manures. An annual net negative balance of about 8-10 million tonnes of nutrients is reported in India (Tandon, 2007).

Fertilizer prescription based on soil testing and combined use of mineral and natural manures can avoid deterioration in soil health due to indiscriminate use of chemical fertilisers. India is the second largest consumer of fertilisers in the world, after China with a consumption of 306.42 lakh tonnes (www.indiastat.com). India accounts for 20.21 million MT and 7.92 million MT of consumption of

[1]Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
[2]All India Coordinated Research Project on Soil Test Crop Response, ICAR-Indian Institute of Soil Science, Bhopal-462 001, Madhya Pradesh, India.
[3]ICAR-Agricultural Technology Application Research Institute, Kolkata-700 001, West Bengal, India.
[4]Department of Natural Resource Management, College of Horticulture and Forestry, Central Agricultural University, Pasighat-791 102, Arunachal Pradesh, India.

Corresponding Author: P. Malathi, Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
Email: malathi.p@tnau.ac.in
ORCIDs: 0000-0002-6781-6720, 0000-0002-5787-2390, 0000-0002-4800-5420, 0000-0002-2192-8030, 0009-0001-2935-4852, 0000-0002-9161-4707, 0000-0002-6417-6588.

How to cite this article: Malathi, P., Maragatham, S., Rajeswari, R., Sellamuthu, K.M., Srivastava, S., Dey, P. and Mailappa, A.S. (2025). Soil Test and Yield Target Based Balanced Fertilizer Prescription Model for Green Gram on Alfisols of Tamil Nadu. Legume Research. 48(5): 861-866. doi: 10.18805/LR-5466.

Submitted: 26-12-2024 **Accepted:** 18-01-2025 **Online:** 07-03-2025

N and P_2O_5 during 2022-23 and registered an increase of 4% and 1.2%, respectively, over 2021-22. However, consumption of K_2O at 1.72 million MT witnessed a sharp decline of 32.2% during the period (Fertiliser Association of India, 2023). By adopting soil test based fertiliser prescription, use efficiency, economic return and quality of crops can be improved.

Green gram (*Vigna radiata* L.), is an important pulse crop in India. Green gram grown in an area of 51.9 lakh ha with a production of 31.02 lakh tonnes in India (www.indiastat.com). Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Karnataka, Telangana and Andhra Pradesh are the major pulse-producing states in India.

Considering the inadequate adoption of production technologies that led to low productivity of pulses, various alternatives were considered over the conventional cultivation practices (Sowmya *et al.,* 2023). In the recent times, targeted yield concept found to be useful which considers available nutrient status in the soil and also the crop requirements that facilitates balanced fertilization. Targeted yield approach was first developed by Troug (1960). A theoretical basis and experimental technique was established by Ramamoorthy *et al.* (1967) to suit the same to Indian conditions. This target yield model is considered as a soil and fertilizer based precision farming technique to meet nutrient demands for a specified yield target of crops (Balasubramanian, 1999). Fertiliser prescription equations has been developed for Glory Lily (Sellamuthu *et al.,* 2015a) under IPNS based concept. The STCR equations have been developed for green gram with optimum use of fertilizers (Saren *et al.*, 2017).

To harvest the maximum benefit, better nutrient use efficiency and reduced nutrient losses, mineral fertilizers must be applied in the right quantity and proportion, from the right sources at the right time using the right methods. In the present context, it is essential to develop fertiliser prescription equations for getting maximum yield and sustaining soil fertility. Hence, the present study was undertaken to validate the STCR-IPNS based fertilizer prescription equations developed for maximising the productivity of green gram on *Typic Rhodustalf* (Palaviduthi soil series) in Tamil Nadu.

MATERIALS AND METHODS

To validate the fertilizer prescription equations developed for green gram under IPNS on Palaviduthi soil series in Tamil Nadu, four verification experiments were conducted during 2023 and 2024 at Kallipatti, Viralipatti, Kunjanampatti and Theppakulathupatti villages of Dindigul district. Initial soil samples were collected from each location and analyzed for pH, EC, alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-P (Olsen *et al.,* 1954), NH_4OAc-K (Stanford and English, 1949) and DTPA extractable micronutrients (Lindsay and Norwell, 1978). The initial soil fertility status for different locations is shown in Table 1.

Fertilizer prescription equations developed for green gram under IPNS on Palaviduthi soil series are furnished below:

Fertiliser prescription equations

$$FN = 9.75\ T - 0.29\ SN - 0.70\ ON$$

$$FP_2O_5 = 12.12\ T - 2.83\ SP - 0.79\ OP$$

$$FK_2O = 8.65\ T - 0.14\ SK - 0.62\ OK$$

Where,

FN, FP_2O_5 and FK_2O = Fertiliser N, P_2O_5 and K_2O in kg ha^{-1}, respectively.

T = Grain yield target in q ha^{-1}.

SN, SP and SK = Soil available N, P and K in kg ha^{-1}, respectively.

ON, OP and OK = N, P and K supplied through FYM in kg ha^{-1}, respectively.

The treatments imposed are Blanket (RDF alone) (T_1), Blanket (RDF+ FYM@12.5 t ha^{-1}) (T_2), STCR-NPK alone-8 q ha^{-1}(T_3), STCR-NPK alone-10q ha^{-1}(T_4), STCR-NPK alone-12 q ha^{-1}(T_5), STCR – IPNS-8 q ha^{-1}(T_6), STCR – IPNS-10 q ha^{-1} (T_7), STCR - IPNS-12 q ha^{-1}(T_8), Farmer's Practice (T_9) and Absolute Control (T_{10}). Based on the initial soil test values of available N, P and K and the quantities of N, P_2O_5 and K_2O supplied through FYM, fertilizer doses were calculated and applied for STCR treatments for various yield targets. STCR-NPK alone treatments received only inorganic fertilizers based on STCR-NPK equations developed, where as for IPNS treatments receiving (NPK+FYM @ 12.5 t ha^{-1}), fertilizers were applied after adjusting the nutrients supplied through FYM based on STCR-IPNS equations (Table 2).

All the packages of practices were carried out periodically. Green gram variety CO 8 was grown to maturity. Growth parameters, yield attributes and grain yield were recorded plot wise. During the cropping season 416 mm of cumulative rainfall was received in Dindigul District which was nearer to the normal rainfall of 460 mm (https://mausam.imd.gov.in). Using the data on grain yield and fertilizer doses applied, the parameters *viz.*,

$$\text{Per cent achievement} = \frac{\text{Yield obtained}}{\text{Yield target}} \times 100$$

Table 1: Initial soil fertility status of the field experiments.

Location	pH	EC (dS m^{-1})	Available N	Available P	Available K	Available Zn	Available Fe	Available Mn	Available Cu
Kallipatti	7.90	0.12	225	23.9	315	1.34	6.13	7.18	1.05
Viralipatti	7.52	0.22	206	26.5	367	1.52	5.34	6.56	1.11
Kunjanampatti	7.56	0.14	220	22.2	344	1.31	4.96	5.89	1.09
Theppakulathupatti	7.85	0.12	213	18.2	315	1.12	7.11	8.12	0.98

Response ratio (RR) =

$$\frac{\text{Response in kg ha}^{-1}}{\text{Quantities of fertilizer N, } P_2O_5 \text{ and } K_2O \text{ applied in kg ha}^{-1}}$$

B:C ratio were worked out. Post-harvest soil samples were collected and analyzed for available N, P and K.

RESULTS AND DISCUSSION

Growth parameters

Plant height, number of pods per plant, number of seeds per pod and 100 seed weight were recorded in all the four experiments. Mean values of four experiments indicated that the highest plant height was recorded in the treatment receiving STCR-IPNS-12 q ha^{-1} (50.3 cm) followed by STCR-IPNS-10 q ha^{-1}(48.6 cm) and STCR-NPK-12 q ha^{-1} (48.6 cm). The STCR-IPNS treatments recorded relatively higher plant height over STCR -NPK alone treatments (Table 3). Blanket recorded markedly lower plant height than STCR-IPNS treatments. Arulmani *et al.* (2024) reported the highest plant height in beet root due to the STCR-IPNS based fertilization. The soil test based balanced fertilization might have boosted photosynthetic activity, chlorophyll content, nitrogen and auxin metabolism in plants, resulting in a notable increase in plant height (Kirad *et al.,* 2010 and Yanthan *et al.,* 2012).

The mean highest number of pods per plant was recorded in the treatment receiving STCR-IPNS-12 q ha^{-1} (36.4) followed by STCR-NPK alone -12 q ha^{-1} (35.4). When compared to STCR-NPK treatments, STCR-IPNS treatments recorded relatively higher number of pods per plant (Table 3).

Farmers practice and blanket recorded lesser pods per plant than STCR-IPNS treatments. Absolute control recorded the lowest pods per plant. The number of seeds per pod indicated that the highest value in the treatment receiving STCR-IPNS-12 q ha^{-1} (12.60) followed by STCR-IPNS -10 q ha^{-1} (11.53). Relatively higher number of seeds per pod was noted in the STCR-IPNS treatments over other treatments (Table 3).

The highest 100 seed weight was recorded in the treatment receiving STCR-IPNS-12 q ha^{-1} (4.23 g) followed by STCR-IPNS -10 q ha^{-1} (4.18 g) indicating that the STCR -IPNS treatments recorded relatively higher number of 100 seed weight over other treatments (Table 3). Kanchana *et al.* (2020) observed the highest yield attributes in pearl millet under STCR-IPNS.

Grain yield of green gram

The pooled mean grain yield of four locations revealed that the highest mean grain yield was recorded in the treatment STCR-IPNS-12 q ha^{-1} (11.51 q ha^{-1}) followed by STCR-NPK alone -12 q ha^{-1} (11.23 q ha^{-1}) indicating that the STCR-IPNS

Table 2: Fertilizer doses (kg ha^{-1}) imposed in four locations based on fertilizer prescription equations.

Treatments	Kallipatti			Viralipatti			Kunjanampatti			Theppakulathupatti		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
T_1	25	50	25	25	50	25	25	50	25	25	50	25
T_2	25	50	25	25	50	25	25	50	25	25	50	25
T_3	13	29	25	18	25*	18	14	35	21	16	46	25
T_4	32	53	38**	38	45	35	34	59	38	36	70	38**
T_5	38**	75**	38**	38**	69	38**	38**	75**	38**	38**	75**	38**
T_6	13*	25*	13*	13*	25*	13*	13*	25*	13*	13*	27	13*
T_7	13*	36	13*	13*	25*	13*	13*	38	13*	13*	51	13*
T_8	16	60	26	20	48	21	20	62	21	18	75**	27
T_9	23	30	15	23	30	18	21	30	15	23	34	20
T_{10}	0	0	0	0	0	0	0	0	0	0	0	0

*Maintenance dose, **Maximum dose.

Table 3: Effect of treatments on growth and yield parameters of green gram (Mean of four field experiments).

Treatments	Plant height (cm)	No. of pods per plant	No. of seeds per pod	100 Seed weight (g)	Grain yield (q ha^{-1})	Per cent achievement	Response ratio (kg kg^{-1})	B:C ratio
T_1	43.9	27.0	8.32	3.62	8.59	-	2.77	1.71
T_2	48.1	34.1	11.00	3.76	9.93	-	2.18	1.95
T_3	43.8	28.2	9.26	3.71	7.64	95.43	2.59	1.59
T_4	46.8	32.9	10.21	3.92	9.61	96.05	2.97	1.93
T_5	48.6	35.4	10.90	4.02	11.23	93.60	3.65	2.23
T_6	45.9	31.8	10.56	4.09	7.90	98.75	2.96	1.60
T_7	48.6	34.3	11.53	4.18	9.82	98.18	3.13	1.98
T_8	50.3	36.4	12.60	4.23	11.51	95.95	3.84	2.26
T_9	41.2	26.3	8.00	3.58	7.28	-	2.09	1.53
T_{10}	36.9	22.8	6.80	3.46	5.82	-	-	1.28

treatments recorded relatively higher yield over STCR-NPK alone treatments (Table 3 and Fig 1). STCR-IPNS-12 q ha^{-1} recorded an yield increase of 34.1 per cent over blanket recommendation (8.59 q ha^{-1}) and followed by STCR -NPK-12 q ha^{-1} (30.84 per cent). Also STCR-IPNS-12 q ha^{-1} and STCR-INPK-12 q ha^{-1} recorded yield increase of 58.08 and 54.24 per cent respectively, over Farmers Practice.

Higher yield of green gram is possible with integrated use of inorganic and organic sources (Kumar *et al.,* 2024). During the organic residue decomposition, intermediate acids produced and they solubilise fixed forms of nitrogen and phosphorus in soil leading to increased available nitrogen and phosphorus (Henri *et al.,* 2008) which leads to overall enhanced productivity of green gram. Similar findings indicated that application of inorganic fertilizers along with organic manures recorded higher grain and straw yield (Sellamuthu *et al.,* 2015b and Sellamuthu *et al.,* 2016) and ultimately due to higher uptake (Sathish *et al.,* 2011) and increased use efficiency of nutrients (Sahu *et al.*, 2017). Similar results were also recorded by Bagavathi Ammal *et al.* (2019) in rice-rice sequence where saving of fertilizers were with combining organic and inorganic fertilizers based on STCR approach. The conjoint application of mineral fertilizers and organic manures have beneficial impact on both root nodules and grain yield (Krithika *et al.*, 2023) by enhancing the use efficiency of phosphorus in black gram.

Per cent achievement, response ratio and cost benefit ratio

The highest per cent achievement of the yield target was recorded with STCR-IPNS-8 q ha^{-1} (98.75) followed by STCR-IPNS-10 q ha^{-1} (98.18) (Table 3). Yield targeting with IPNS recorded relatively higher per cent achievement than that aimed under their respective NPK alone treatments. The per cent achievement of the targeted yield among the four verification trials, was within ±10 per cent variation. STCR-IPNS technology ensures sustainable crop production with economical use of fertilizer inputs (Mahajan *et al.,* 2013).

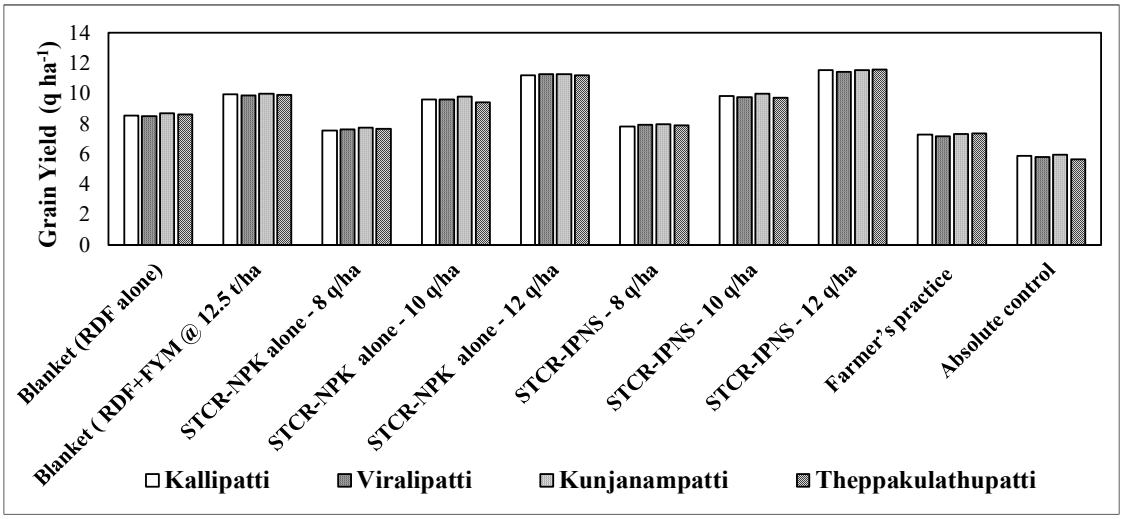


Fig 1: Effect of treatments on grain yield of green gram in four locations.

Table 4: Post harvest soil fertility as influenced by various treatments.

Treatments	Kallipatti			Viralipatti			Kunjanampatti			Theppakulathupattipatti		
	SN	SP	SK	SN	SP	SK	SN	SP	SK	SN	SP	SK
	kg ha^{-1}											
T_1	214	22.2	306	198	24.9	346	209	19.7	328	204	16.9	306
T_2	230	26.1	325	208	28.4	378	227	23.1	356	215	19.9	325
T_3	216	21.8	308	198	22.8	353	211	19.5	330	206	16.6	308
T_4	219	22.7	315	201	24.8	362	222	20.9	340	211	17.3	315
T_5	227	24.7	322	210	27.2	374	227	22.6	348	217	18.8	322
T_6	223	23.8	315	206	25.1	362	220	21.0	340	212	18.1	315
T_7	228	24.2	324	211	27.1	376	229	22.7	350	216	18.4	324
T_8	236	26.2	329	214	28.9	385	232	24.3	358	223	19.9	329
T_9	209	20.6	294	194	23.0	337	205	18.6	318	200	15.7	294
T_{10}	199	19.3	278	181	21.1	317	195	17.2	302	192	14.7	278
Initial soil test values	225	23.9	315	206	26.5	367	220	22.2	344	213	18.2	315

The mean RR recorded for various treatments ranged from 2.09 kg kg^{-1} in Farmers practice to 3.84 kg kg^{-1} in STCR-IPNS-12 q ha^{-1} (Table 3). Among the STCR treatments, IPNS recorded relatively higher RR than NPK alone due to the better use efficiency of applied fertilizers under IPNS. The results are confirmed with the findings of Muralidharudu *et al.* (2011). STCR-IPNS-12 q ha^{-1} was found to record the highest B:C ratio of 2.26 (Table 3) which was in close conformity with the findings reported by Sellamuthu *et al.* (2015b) and Sellamuthu *et al.* (2016).

Post harvest soil fertility

Soil available N ranged from 199 to 236 kg ha^{-1} at Kallipatti, 181 to 214 kg ha^{-1} at Viralipatti, 195 to 232 kg ha^{-1} at Kunjanampatti and 192 to 223 kg ha^{-1} at Theppakulathupatti (Table 4). In all the locations, the higher available N was recorded in STCR-IPNS treatments followed by STCR-NPK alone. When compared with the initial soil fertility, control, farmers practice and blanket, recorded reduction in available N but the degree of reduction was less in blanket.

Soil available P ranged from 19.3 to 26.2 kg ha^{-1} at Kallipatti, 21.1 to 28.9 kg ha^{-1} at Viralipatti, 17.2 to 24.3 kg ha^{-1} at Kunjanampatti and 14.7 to 19.9 kg ha^{-1} at Theppakulathupatti (Table 4). In available phosphorus also, STCR-IPNS treatments recorded higher available P in all the locations followed by STCR-NPK alone treatments and blanket while control and farmers practice recorded lower available P.

Soil available K ranged from 278 to 329 kg ha^{-1} at Kallipatti, 317 to 385 kg ha^{-1} at Viralipatti, 302 to 358 kg ha^{-1} at Kunjanampatti and 278 to 329 kg ha^{-1} at Theppakulathupatti (Table 4). Higher available K was recorded in STCR-IPNS treatments in all the four locations followed by STCR-NPK alone treatments while control and farmers practice recorded lower available K. The degree of reduction was higher in control and farmers practice when compared to the initial soil fertility while in blanket reduction in available K was less.Similar results were recorded by Sellamuthu *et al.* (2016).

Post harvest soil fertility values of $KMnO_4$-N, Olsen-P and NH_4OAc-K highlighted the build up and maintenance of soil fertility owing to soil test based fertilizer prescription under IPNS, despite higher uptake of nutrients by green gram, the soil fertility status was maintained in STCR-IPNS as compared to STCR-NPK alone (Table 4). Application of organic manures in conjunction with mineral fertilizers not only enhances the productivity but also improve the soil fertility (Jaga and Upadhyay, 2013). A notable reduction in fertilizer requirement was observed with application of inorganic fertilizer along with FYM due to the nutrient supplement through FYM (Selvam *et al.,* 2022).

CONCLUSION

The results revealed that STCR-IPNS-12 q ha^{-1} recorded the highest growth and yield parameters with the grain yield 34.1 and 58.08 per cent higher than blanket fertilizer application and farmers practice, respectively. The per cent achievement of the targeted yield of all the four validation experiments was within ±10 per cent deviation proving the validity of the equations for prescribing balanced fertilizer doses for green gram to achieve targeted grain yield. The post-harvest soil available N, P and K status also shown the maintenance of soil fertility due to soil test based fertilizer prescription under IPNS.

ACKNOWLEDGEMENT

The present study was supported by ICAR - All India Coordinated Research Project on Soil Test Crop Response and Tamil Nadu Agricultural University, Coimbatore.

Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal care and handling techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

REFERENCES

Arulmani, R., Sellamuthu, K.M., Maragatham, S., Senthil, A., Thamaraiselvi, S.P.,Anandham, R., Malathi, P. and Sridevi, G. (2024). Yield and quality of beetroot to soil test crop response (STCR) - integrated plant nutrient system (IPNS) based fertilizer prescription in Ultisols of Western Ghats of Tamil Nadu, India. Plant Science Today. 11(4): 91-97. https://doi.org/10.14719/pst.4623.

Balasubramanian, V. (1999). Farmer adoption of improved nitrogen management technologies in rice farming: Technical constraints and opportunities for improvement. Nut. Cycling in Agro-Ecosystem. 53: 93-101.

Bagavathi A.U., Coumaravel, K., Sankar, R. and Pradip, D. (2019). Fertilizer prescriptions under STCR-IPNS for rice-rice cropping sequence on an inceptisol (*Typic ustropept*). Indian Journal of Agricultural Reseach. 53(6): 698-702. doi: 10.18805/IJARe.A-5228.

Fertiliser Association of India. (2023). Annual Review of Fertilizer Production and Consumption. 2022-23. September 2023: P. 921.

Henri, F., Laurette, N.N., Annette, D., John, Q., Wolfgang, M., François-Xavier, E. and Dieudonné, N. (2008). Solubilisation of inorganic phosphates and plant growth promotion by strains of *Pseudomonas fluorescens* isolated from acidic soils of Cameroon. African Journal of Microbiological Research. 2: 171-178.

https://mausam.imd.gov.in/chennai/mcdata/ne_monsoon_2023.pdf

Jaga, P.K. and Upadhyay, V.B (2013). Effect of FYM, biofertilizer and chemical fertilizers on wheat. An Asian Journal of Soil Science. 8: 185-188.

Kanchana, B., Santhi, R., Maragatham, S. and Chandrasekhar, C.N. (2020). Validation of inductive cum targeted yield model based fertiliser prescription equations for pearl millet (*var.* CO 10) on Inceptisol. Madras Agriculture Journal. 107(4-6): 1-6. doi:10.29321/MAJ 2020.000353.

Kimetu, M., Mugendi, D.N., Palm, C.A., Mutuo, P.K., Gachengo, C.N. and Nandwa, S. (2004). African Network on Soil Biology and Fertility. pp 207-224.

Kirad, K.S., Swati, B. and Singh, D.B. (2010). Integrated nutrient management on growth, yield and quality of carrot. Karnataka Journal of Agricultural Sciences. 23(3): 542-543.

Krithika, C., Santhi, R., Maragatham, S., Vijayalakshmi, D., Parimala Dev, R. (2023). Enhancing blackgram yield: Validating a soil test-driven fertilizer prescription equation for *Alfisol*. Agricultural Science Digest. pp 1-7. doi: 10.18805/ag.D-5891.

Kumar, S.P., Singh, N., Kishore, A., Parashar, A., Sharma, J.D., Reddy, S.K.and Teja, M.S. (2024). Effect of integrated nutrient management on growth and yield of green gram [*Vigna radiata* (L.) Wilczek]. Journal of Food Legumes. 37(1): 114-116.

Lindsay, W.L. and Norvell, W.A. (1978). Development of a DTPA soil test for Zinc, iron, manganese and Copper. Soil Science Society of America Proceedings. 42(3): 421-428.

Mahajan, G.R., Pandey, R.N., Datta, S.C., Kumar, D., Sahoo, R.N. and Prasad, R. (2013). Soil test based fertilizer recommendation of nitrogen, phosphorus and sulphur in wheat (*Triticum aestivum* L.) in an Alluvial soil. International Journal of Agriculture and Environmental Biotechnology. 6(2): 271-281.

Muralidharudu, Y., Mandal, B.N., Sammi Reddy, K. and Subba Rao, A. (2011). In: Progress Report of the All India Coordinated Research Project for Investigation on Soil Test Crop Response Correlation. Indian Institute of Soil Science, Bhopal. p. 11-61.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L. (1954). Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate. USDA Circ 939, US Govt. Printing Office, Washington DC.

Ramamoorthy, B., Narasimham, R.L. and Dinesh, R.S. (1967). Fertilizer application for specific yield targets on Sonora 64 (wheat). Indian Farming. 17(5): 43-45.

Ray, P.K., Jana, A.K., Maitra, D.N., Saha, M.N., Chaudhury, J. and Saha, S. (2000). Fertilizer prescriptions on soil test basis for jute, rice and wheat in Typic Ustochrept. Journal of Indian Society of Soil Science. 48: 79-84.

Sahu, V., Mishra, V.N. and Sahu, P.K. (2017). Soil test based fertilizer recommendation for targeted yield of crops: A review. International Journal of Chemical Studies. 5(5): 1298-1303.

Saren, S., Mishra, A. and Dey, P. (2017). Site Specific nutrient management through targeted yield equations formulated for green gram [*Vigna radiata* (L.) Wilczek]. Legume Research. 41(3): 436-440. doi: 10.18805/LR-3754.

Selvam, R., Santhi, R., Maragatham, S., Gopalakrishnan, M. and Rejeswari, R. (2022). Targeted yield model-based balanced nutrient recommendation for barnyard millet on inceptisol of Tamil Nadu. Indian Journal of Agricultural Research. 56(6): 638-645. doi: 10.18805/IJARe.A-5891.

Sathish, A., Govinda Gowda, V., Chandrappa, H. and Nagaraja K. (2011). Long termeffect of integrated use of organic and inorganic fertilizers on productivity, soil fertility and uptake of nutrients in rice and maize cropping system. International Journal of Science and Nature. 2(1): 84-88.

Sellamuthu, K.M., Santhi, R., Maragatham, S. and Dey, P. (2015a). Balanced fertiliser prescription for glory lily through inductive cum targeted yield model on an Alfisol. Research on Crops. 16(3): 555-561.

Sellamuthu, K.M., Santhi, R., Maragatham, S.and Dey, P. (2015b). Validation of soil test and yield target based fertiliser prescription model for wheat on an Inceptisol. Research on Crops. 16(1): 53-58.

Sellamuthu, K.M., Santhi, R., Maragatham, S. and Dey, P. (2016). Validation of soil test and yield target based balanced fertilizer prescription model for rainfed maize on inceptisol. Madras Agriculture Journal. 103(4-6): 114-119.

Sowmya, K., Bindhu, J.S., Pillai, P.S., Jacob, D. and Gladis, R. (2023). Productivity and profitability of green-gram [*Vigna radiata* (L.) Wilczek] under system of crop intensification. Agricultural Science Digest. doi: 10.18805/ag.D-5703.

Stanford, S. and English, L. (1949). Use of flame photometer in rapid soil tests of K and Ca. Agronomy Journal. 41: 446.

Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for estimation of available nitrogen in soils. Current Science. 25: 259-260.

Tandon, H.L.S. (2007). Soil nutrient balance sheets in India: Importance, status, issues and concerns. Better Crops-India. p.15-19.

Troug, E. (1960). Fifty Years of Soil Testing. Transactions of 7th International Congress of Soil Science, Madison Wisconsin, USA, Part III and IV: pp 36-45.

www.indiastat.com:https://www-indiastat-com.elibrarytnau.remotexs.in/table/moong-green-gram/selected-state-season-wise-area-production-product/1457200.

Yanthan, T.S., Singh, V. and Singh, A. (2012). Growth, yield and nutrient uptake by turnip (*Brassica rapa* L.) cv. Pusa Sweti and their economics. Journal of Soils and Crops. 22(1): 1-9.