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EFFECT OF SOIL AND FOLIAR APPLICATION OF NUTRIENTS ON GREEN GRAM

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Abstract

Field investigation was carried out for the productivity enhancement of green gram through soil and foliar application of nutrients at Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University. The field experiment was conducted during August–October, 2013. The experiment was laid in split plot design and replicate thrice with different nutrient levels *viz.,* M_1–Control (no fertilizer application), M_2–RDF (25:50:25 kg NPK ha^{-1}), M_3–Soil application of 85% concentrated Humic acid + fulvic acid and 15% inert ingredients, M_4–RDF+ Soil application of 85% concentrated Humic acid + fulvic acid and 15% inert ingredients, as the main plot treatments and foliar spray as the sub plot treatments *viz.,* S_1–Control (no foliar application), S_2–2% DAP application, S_3–foliar application of 85% concentrated Humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material, S_4–Seaweed extract application, S_5–Nitrobenzene application and S_6–Pulse wonder application on 25th and 45th DAS were allocated. The result of the main field experiment showed that M_4S_3 excelled all other treatments by recording higher growth and yield attributes, yield, nutrient uptake and post-harvest available nutrient status during the cropping period. It also recorded enhanced monetary benefit in terms of net income and return $rupee^{-1}$ invested.

Key words: RDF, NPK, Humic acid, Fulvic acid, pulse wonder, Seaweed extract, Nitrobenzene.

Introduction

Pulses are important food crops due to their high protein and essential amino acid content. Pulses are used as food and animal feed. Many exporting countries are dependent on India for marketing their pulses. Even though India is the world's largest producer and consumer of pulses still there is a gap of 2.4 million tonnes between the production and consumption of pulses in the country, which is met through imports. Protein malnutrition has created disorder in developing countries including India. The per capita consumption of pulses in India is around 30-35 g day^{-1} as against the recommendation of Indian Council of Medical Research (ICMR) at 45 g day^{-1} and World Health Organization (WHO) at 80 g day^{-1} (Kannaiyan, 2000).

The low yield is attributed to several seasons *viz.,* cultivated as rainfed crops, as intercrops in marginal lands, poor management practices and low yield potential of varieties. In addition to that the lack of nutrients during the critical stages of crop growth leads to nutrient stress, which leads to poor yield and productivity of the crop. Proper nutrient management is an important factor to be considered for sustaining pulse productivity. Soil application of nutrients will give the initial boost for soil and growing seedlings (Muhammad Hamayun *et al.,* 2011). Kalaichelvi *et al.*(2006) reported that humic acid application along with recommended inorganic fertilizers and organic manures play a greater role in plant bio-chemical, physical activities and soil fertility, consequently resulting in better growth and yield of crops.

Foliar application of both essential nutrients and growth regulators also plays a vital role in pulse production by stimulating root development, nodulation, energy transformation, various metabolic processes, translocation activity in plants and increasing pod setting and thereby increasing the yield. Similarly, application of DAP, TNAU Pulse wonder, humic based micronutrients as foliar spray significantly improved the yield attributing characters by reducing flower shedding and resulted in increasing number of pods $plant^{-1}$ (Ravisankar *et al.,* 2003). Keeping these points in view, the present investigation was carried out to develop specific management practices such as application of nutrients through soil or foliar or combination of both and plant growth regulating chemicals for the green gram to enhance the yield and productivity. To achieve this, the following objectives were fixed.

- To find out the effect of soil application and foliar spray of nutrients on the productivity of green gram.
- To study the interaction effect of soil and foliar nutrition on the growth and yield of green gram.

- To work out the economics of soil and foliar nutrition and to develop a viable nutrient management practice for green gram.

Materials and Methods

Field investigations was carried out to study the productivity enhancement of green gram through soil and foliar application of nutrients during August-October, 2013 at Annamalai University experimental farm, Annamalai Nagar, Tamil Nadu. The experimental farm is situated at 11°24' N latitude and 79°41' E longitude with an altitude of +5.79 metres above mean sea level.The weather at Annamalai Nagar warm with hot summer months during 2012 and 2013, respectively. The soil was clay loam in texture with low in available nitrogen, medium in phosphorus and high in available potassium. The green gram variety CO 6 was chosen for the study.

The field experiments were conducted in split plot design with 3 replications. In main plot, treatment *viz.,* M_1–Control (no fertilizer application), M_2–RDF (25:50:25 kg NPK ha^{-1}) alone, M_3–Soil application of 85% concentrated humic acid @ 125g ha^{-1}, M_4–RDF+ Soil application of 85% concentrated humic acid @ 125g ha^{-1}. In sub plots, this constitutes foliar nutrition *viz.,* S_1–Control (No spray), S_2–2% DAP spray at 25 and 45 DAS , S_3–foliar application of 85% concentrated Humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material @ 750 g ha^{-1} at 25 and 45 DAS, S_4–Seaweed extract spray@ 750ml ha^{-1} at 25 and 45 DAS, S_5–Nitrobenzene spray@ 750ml ha^{-1} at 25 and 45 DAS, S_6–Pulse wonder spray @ 5.265 kg ha^{-1} at 25 and 45 DAS were allocated. The sailent finding of field experiment are presented below.

Five plants from each plots were chosen by simple random sampling method and tagged. These tagged plants were used for recording all biometric observations like plant height, LAI, DMP, No. of branches $plant^{-1}$, root nodules $plant^{-1}$, no. of pods $plant^{-1}$, no. of seeds pod^{-1}, seed yield and haulm yield were recorded.

The estimated data were analysed as per the procedure outlined by Panse and Sukhatme (1978). The critical difference was worked out at 5 per cent probability level for significant result. The economic parameter such as gross return and benefit cost ratio for all the treatments were worked out based on the prevailing market price. The net return was worked out for different treatments by subtracting the cost of cultivation from gross return. The return $rupee^{-1}$ invested was calculated by using the following formula.

$$\text{Return rupee}^{-1}\text{ invested} = \frac{\text{Gross return (Rs. ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

Results and Discussion

The field experiments were programmed to assess and identify an efficient nutrient schedule and foliar nutrient management practices for augmenting the growth and yield of green gram.

Growth Characters

All the growth components were significantly influenced by RDF along with soil application of 85% concentrated humic acid and foliar spray of nutrients. The growth components *viz.*, plant height, leaf area index, number of branches and dry matter production were enhanced due to RDF along with soil application of 85% concentrated humic acid and foliar spray of nutrients.

Irrespective of treatment combinations, RDF (25:50:25 kg NPK ha^{-1}) + soil application of 85% concentrated humic acid @ 125g ha^{-1} registered higher values of growth components *viz.*, plant height, leaf area index, number of branches, dry matter production and root nodules increased than all other soil application nutrients practices. Regarding foliar nutrition S_3–foliar application of 85% concentrated Humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material @ 750 g ha^{-1} at 25 and 45 DAS recorded enhanced values of above growth components in the cropping seasons. This treatment was followed by S_5–Nitrobenzene spray@ 750ml ha^{-1} at 25 and 45 DAS and S_6–Pulse wonder spray @ 5.265 kg ha^{-1} at 25 and 45 DAS they were at on par with each other. The least was recorded the treatment S_1–Control (No foliar application).

Regarding the interactions, M_4 S_3–RDF (25:50:25 kg ha^{-1}) + 85% concentrated Humic acid @ 125g ha^{-1} alone (85% concentrated Humic acid + fulvic acid and inert ingredients 15%) along with foliar application of 85% concentrated Humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material @ 250 g ha^{-1} at 25 and 45 DAS exceeded all other combinations. This might be due to addition of NPK applied in the initial stages which might have helped in the formation and growth of root in the initial stages. The usefulness of N supplement for initial growth of roots and formation of nodules has been enlightened by Sathyamoorthi *et al*., (2008).

Effective nutrient management in green gram ecosystem by rational application of humic acid accompanied by micro and macronutrients might have caused internal root growth, which occurred primarily from the lower hypocotyls and it resulted in increased the total length of lateral root and enhanced the rhizobium activity in legumes. Similar findings also reported by Jack *et al.,* (2000) and Suriyalakshmi, (2013).

Yield characters

Yield attributes *viz.,* number of pods $plant^{-1}$, number of seeds $plant^{-1}$, grain yield, haulm yield and harvest index were also found remarkably increased through M_3– RDF (25:50:25 kg NPK ha^{-1}) + soil application of 85% concentrated humic acid @ 125g ha^{-1} then all other soil

application nutrients practices. Regarding foliar nutrition S_3–foliar application of 85% concentrated humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material @ 250 g ha^{-1} at 25 and 45 DAS recorded enhanced values of above yield components of the cropping seasons. It was followed by S_5–Nitrobenzene spray@ 250ml ha^{-1} at 25 and 45 DAS and S_6–2% Pulse wonder spray @ 5.265 kg ha^{-1} at 25 and 45 DAS they were at on par with each other. The least was recorded the treatment S_1–control (no foliar application).

Regarding the interactions, M_4 S_3–RDF (25:50:25 kg ha^{-1}) + 85% concentrated Humic acid + fulvic acid and inert ingredients 15% @ 125g ha^{-1} along with foliar application of 85% concentrated Humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material @ 250 g ha^{-1} at 25 and 45 DAS exceeded all other combinations. Advantages with soil application of nutrients together with better foliar application as followed in the above treatment could partially due to favourable physical, chemical and biological condition of soil brough out by balanced application of macronutrients along with humic acid and fulvic acid based micronutrient combination application against the unbalanced nutrition application in other treatment combinations. (Muhammad Hamayun *et al.,* 2011).

In addition to above favourable physiological soil condition offering efficient and prolonged nutrition supply have favoured the crop with better rooting, higher LAI, pre and post flowering photosynthesis and yield attributes. It is logic to postulate that the parameters had a favourable effect on source and sink capacity resulting in increased grain yields. The above result is in line with the findings of Pandya and Bhatt (2007), Singh (2008) and Suriyalakshmi, (2013).

Among the treatment combinations, M_4 S_3 in green gram registered the higher net return ha^{-1} invested. This might be due to higher grain yield and haulm yield. Despite the addition input cost involved, the substantial yield increment obtained with this treatment combination might have result in increased net income and benefit cost ratio. These finding are line with findings of Anitha Bindhani (2007) and Suryavanshi *et al.,* (2008) and Suriyalakshmi, (2013).

Based on the results of field experiment, it might be inferred that the RDF (25:50:25 NPK kg ha^{-1}) + soil application of 85% concentrated humic acid formulation @ 125g ha^{-1} combined with foliar application of 85% concentrated Humic acid and fulvic acid +12% Chelated zinc and 3% other traces and inert material @ 250 g ha^{-1} at 25 and 45 DAS application is economically viable, efficiently suitable nutrient management practices for green gram growers in Cauvery deltaic zones of coastal Tamil Nadu.

Table 1: Effect of soil and foliar application of nutrients on dry matter production (kg ha^{-1}) and number of pods $plant^{-1}$ at harvest stage of green gram

Main plot Treatment										
Sub plot treatment	Dry matter production (kg ha^{-1})					Number of pods $plant^{-1}$				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
S_1	2996.25	2696.69	2761.32	3037.74	**2873**	16.57	16.22	17.24	19.21	**17.31**
S_2	2835.97	3043.24	3109.87	3249.12	**3059.55**	15.21	19.16	20.08	21.95	**19.10**
S_3	3087.54	3529.71	3595.37	3758.02	**3492.66**	20.46	25.53	26.54	28.35	**25.22**
S_4	2911.43	3119.75	3182.36	3326.72	**3135.65**	16.58	20.35	21.34	23.21	**20.37**
S_5	2942.70	3309.50	3374.03	3626.37	**3313.15**	17.91	23.25	24.27	27.01	**23.11**
S_6	3017.05	3327.45	3394.08	3599.85	**3334.60**	18.81	21.99	23.02	25.94	**22.44**
Mean	**2965.15**	**3171.05**	**3236.17**	**3432.97**		**17.59**	**21.08**	**22.08**	**24.27**	

	$S.E_d$	CD(P=0.05)	$S.E_d$	CD(P=0.05)
Main	33.31	66.63	0.51	1.03
Sub	39.77	79.55	0.64	1.28
M x S	43.54	87.08	0.62	1.25
S x m	42.68	85.37	0.61	1.22

Table 2: Effect of soil and foliar application of nutrients on grain yield, haulm yield (kg ha^{-1}) of green gram

Main plot Treatment										
Sub plot treatment	Grain Yield (kg ha^{-1})					Haulm Yield (kg ha^{-1})				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
S_1	628.64	917.00	923.00	1127.00	**898.91**	1809.22	1923.06	2003.71	2102.93	**1959.73**
S_2	850.34	999.48	1027.48	1287.41	**1041.17**	2154.23	2366.95	2297.59	2507.56	**2331.58**
S_3	1378.00	1467.00	1492.00	1583.00	**1480.00**	2636.62	2898.72	2861.71	2986.95	**2846.00**
S_4	937.56	1078.72	1113.72	1322.00	**1108.12**	2241.88	2394.59	2375.24	2593.21	**2401.23**
S_5	970.21	1193.84	1273.95	1422.00	**1215.00**	2481.46	2594.92	2621.24	2794.38	**2623.00**
S_6	1002.94	1106.62	1286.75	1434.77	**1207.77**	2494.73	2552.95	2533.59	2706.73	**2572.00**
Mean	**961.28**	**1127.11**	**1186.15**	**1362.69**		**2303.02**	**2455.19**	**2448.84**	**2615.29**	

	$S.E_d$	CD(P=0.05)	$S.E_d$	CD(P=0.05)
Main	40.06	80.13	40.32	80.65
Sub	43.62	87.24	43.82	87.65
M x S	47.00	94.01	49	98
S x m	46.67	93.34	51.08	102.16

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Table 3: Effect of soil and foliar application of nutrients on economics of green gram

Treatments	Cost of cultivation (Rs.ha^{-1})	Gross income (Rs.ha^{-1})	Net return (Rs.ha^{-1})	Return rupee^{-1} (Rs.ha^{-1})
$M_1 S_1$	14875	33593.89	18718.89	2.25
$M_1 S_2$	15747	45294.79	29547.79	2.87
$M_1 S_3$	19950	72974.31	53024.31	3.65
$M_1 S_4$	15381	49874.06	34493.06	3.24
$M_1 S_5$	15465	51691.65	36226.65	3.34
$M_1 S_6$	15725	53400.24	37675.24	3.39
$M_2 S_1$	19858	48645.53	28787.53	2.44
$M_2 S_2$	20730	53156.43	32426.43	2.56
$M_2 S_3$	24933	77733.36	52800.36	3.11
$M_2 S_4$	20364	57290.73	36926.73	2.81
$M_2 S_5$	20448	63377.14	42929.14	3.09
$M_2 S_6$	20708	58820.71	38112.71	2.84
$M_3 S_1$	16340	48997.85	32657.85	2.99
$M_3 S_2$	17212	54577.75	37365.75	3.17
$M_3 S_3$	21415	79014.85	57599.85	3.68
$M_3 S_4$	16846	59101.06	42255.06	3.50
$M_3 S_5$	16930	67556.02	50626.02	3.99
$M_3 S_6$	17190	68177.79	50987.79	3.96
$M_4 S_1$	19283	59655.46	40372.46	3.10
$M_4 S_2$	20155	68199.10	48044.10	3.38
$M_4 S_3$	20475	83809.47	63334.47	4.09
$M_4 S_4$	19789	70040.60	50251.60	3.53
$M_4 S_5$	19873	75341.19	55468.19	3.79
$M_4 S_6$	20133	75961.40	55828.40	3.77