Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5147

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 914-919 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Studies on Yield Maximization in Soybean (*Glycine max*.) through Different Approaches of Fertilizer Recommendation in Vertisol

C. P. Sankalpa[1*] and K. K. Math[2]

[1]Ph.D Scholar and [2] Professor

Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dharwad, UAS, Dharwad

*Corresponding Author E-mail: sankalpacp@gmail.com

Received: 6.07.2017 | Revised: 20.08.2017 | Accepted: 26.08.2017

ABSTRACT

The field experiments were conducted on yield maximization in soybean through different fertilizer recommendation approaches at the Main Agricultural Research Station, Dharwad during kharif season of the year 2015 and 2016. The treatments consisted of different fertilizer recommendation approaches viz., site specific nutrient management (SSNM) and soil test crop response (STCR) each targeted yield at 20, 25. 30 and 35 q ha^{-1} and soil test laboratory (STL) approach and these were compared with graded levels of fertilizer (125 and 150 % of RDF) and control (RDF). The experiment laid out in randomized completely block design with twelve treatments replicated thrice.

The yield attributes and yield of soybean was significantly influenced by different nutrient management practices in both the seasons. Pooled data indicated that the highest grain yield was recorded in the treatment SSNM yield targeted at 30 q ha^{-1} which was significantly superior over 125 and 150 per cent of RDF, STL approach, SSNM yield targeted at both 20 and 25 q ha^{-1} and STCR yield targeted at 20, 25, 30 and 35 q ha^{-1} and control but was on par with SSNM yield targeted at 35 q ha^{-1} and the magnitude of increase was 48.62 and 40.0 per cent over 125 and 150 per cent of RDF, respectively and 48.00 and 36.80 per cent in SSNM yield targeted at 20 and 25 q ha^{-1}, respectively, 17.28, 45.43, 38.27 and 30.59 per cent, in STCR yield targeted at 20, 25, 30 and 35 q ha^{-1}, respectively. Accordingly, benefit cost ratio was also higher in the treatment with SSNM yield targeted at 30 q ha^{-1} and lowest ratio was recorded in 125 per cent of RDF and control. Therefore, fertilizer recommendation by SSNM yield targeting at 30 q ha^{-1} helps in getting higher yield with higher net returns over other approaches.

Key words: *Site specific nutrient management, Soil test crop response, Soil test laboratory method, Targeted yield, Soybean and Graded levels of fertilizer.*

INTRODUCTION

A healthy soil is a prerequisite for the health of all living beings. In Indian context, diagnosis of soil health is often considered synonymous to soil testing carried out for assessment of soil fertility status or appraisal of salinity/ alkalinity problems.

Cite this article: Sankalpa, C. P. and Math, K. K., Studies on Yield Maximization in Soybean (*Glycine max*.) through Different Approaches of Fertilizer Recommendation in Vertisol, *Int. J. Pure App. Biosci.* **6(2):** 914-919 (2018). doi: http://dx.doi.org/10.18782/2320-7051.5147

In recent years, soil fertility is deteriorating owing to depletion of native nutrient reserves and decline in factor productivity of applied nutrients due to imbalanced and excessive application of nutrients and their replenishment through fertilizers and manures through blanket nutrient recommendations. There is need to improve the use efficiency of applied fertilizer not only for soil health and also for enhancement of crop productivity. Application of fertilizer is one of the most efficient means of increasing agricultural profitability but fertilizer prices have gone up and hence their use in required amounts depends much upon the purchasing capacity of the farmers. Soil testing is one of the tool for judicious fertilizer recommendation and well-recognized practice all over the world which takes care of too little, too much or disproportionate application of nutrients. Different methods of fertilizer recommendation are in practice and soil test laboratory research (STL) is one such nutrient management which is purely based on soil testing. So in recent soil test laboratory is gaining importance because less risky and easy interpret. This approach also helps to improve the crop productivity and maintains soil fertility by avoiding the imbalanced fertilizer application.

Fertilizer recommendation based on soil test value needs considerable attention that the fertilizer requirement of crop also depends upon the yield targets to be achieved. For achieving definite crop yield target, a definite quantity of nutrients must be applied to the crop and nutrients can be calculated by considering the contribution of soil available nutrients and fertilizer nutrients for total uptake. This forms the basis for the fertilizer recommendation for targeted yield of crops. In this context, yield target based on site specific nutrient management (SSNM) and soil test crop response (STCR) approaches are important which provides the balanced nutrition to the crop productivity and maintains soil fertility[7].

Site specific nutrient management provides need based feeding of crops while recognizing the inherent spatial and temporal variability in soil fertility and intends for balanced precision nutrition of N, P and K along with secondary and micronutrients based on the nutrient supplying capacity of the soil, the nutrient requirement of a crop. It aims at nutrient supply at optimal rates and times to achieve higher yield/targeted yield, higher nutrient use efficiency and avoids indiscriminate use of fertilizers.

Soil test crop response circumvents the effect of soil heterogeneity, management practices and climatic condition on the response of crops to applied and native nutrients with practical solutions to enhance nutrient use efficiencies narrowing down to each farm or field. This approach helps in improving economic yield for specific yield targets and maintains soil fertility and it will be useful only when it is based on important factors like soil, crop, variety, fertilizer and management interaction for a given soil condition. However, fertilizer adjustment equation in STCR approach should be used within the experimental range of soil test values and achievable yield levels obtained.

Fertilizer requirements tocrops vary due to their differential production potential and ability to mine nutrients from native and fertilizer sources. Soybean is an important oilseed crop and finds its place in policy agenda of industrial, medical and food sector of India due to wide spectrum of its chemical composition which contains high quality protein (40%) and oil (20%) for human consumption and as it is an exhaustive crop, optimization of mineral nutrition is a key to maximize its production. Blanket recommendation of fertilizers for soybean over large area irrespective of soil type has leads to indiscriminate use of costly inputs. Hence for a given soil-plant system located in a climatic belt, STL, SSNM and STCR approaches provide a scientific basis for balanced fertilization. With this in view field experiments were conducted for consecutive years to study the “yield maximization in soybean through different approaches of fertilizers recommendation in soybean in a Vertisol”.

MATERIAL AND METHODS

The field experiments were conducted at Main Agricultural Research Station, Dharwad, Karnataka during *kharif* season of 2015 and 2016 under *rainfed* situation in plot number 126 of E-block. The soil of the experimental site was *Typic Haplustert* with clay texture, neutral in pH (7.67) with low total soluble salts content (0.24 dSm^{-1}), the site was low in nitrogen (172.5 kg ha^{-1}), medium in phosphorus (34.0 kg ha^{-1}) and high in potassium (369.4 kg ha^{-1}) and fertilizer recommendations/ levels were worked out based on these soil test values. The treatments consisted of different fertilizer recommendation approaches *viz*., T_1: RDF (40:80:25 kg NPK ha^{-1}), T_2: 125% of RDF, T_3: 150% of RDF, T_4: STL based NPK application (50:80:12.5 kg NPK ha^{-1}), T_5: SSNM yield targeted at 20 q ha^{-1} (120:34.4:64.8 kg NPK ha^{-1}), T_6: SSNM yield targeted at 25 q ha^{-1} (150:43:81 kg NPK ha^{-1}), T_7: SSNM yield targeted at 30 q ha^{-1} (180: 51.6:97.2 kg NPK ha^{-1}), T_8: SSNM yield targeted at 35 q ha^{-1} (kg NPK ha^{-1} 210.0:60.2:113.4), T_9: STCR yield targeted of 20 q ha^{-1} (19.9:0: 31.2 kg NPK ha^{-1}), T_{10}: STCR yield targeted of 25 q ha^{-1} (54.2: 2.6: 51.0 kg NPK ha^{-1}), T_{11}: SSNM yield targeted of 30 q ha^{-1} (88.5: 33.5: 70.8 kg NPK ha^{-1}) and T_{12}: SSNM yield targeted of 35 q ha^{-1} (122.8: 64.3: 90.6 kg NPK ha^{-1}). The chemical fertilizers were applied as per treatments.

RESULT AND DISCUSSION

Growth of soybean

Yield and yield attributes indirectly depend on growth parameters like plant height, leaf area index, number of branches and others. These are indirectly related to photosynthesis, which provides food for plant growth and development. Significantly higher plant height and dry matter accumulation was recorded in the treatment SSNM targeted at 30 q ha^{-1} (64.6 cm and 46.92 g $plant^{-1}$) over RDF (49.9 cm and 33.72 g $plant^{-1}$) in both the years but was on par with SSNM yield targeted at 35 q ha^{-1} (64.6 cm and 49.6 g $plant^{-1}$), SSNM yield targeted at 25 q ha^{-1} (59.3 cm and 43.45 g $plant^{-1}$) and STCR yield targeted at 35 q ha^{-1} (59.2 cm and 45.61 g $plant^{-1}$).

Number of branches and leaf area index at 60 DAS were also higher in the treatment SSNM yield targeted at 30 q ha^{-1} (5.50 and 3.33) compared to RDF (3.80 and 2.42) and was on par with SSNM yield targeted at 35 q ha^{-1} (5.80 and 3.60). The higher plant height, leaf area index, dry matter accumulation and number of branches $plant^{-1}$ in SSNM based treatments was due nutrient availability, translocation of nutrients from source to sink to and higher photosynthetic activity. However, lower values in the said growth parameters in control was due to lower nutrient availability which resulted in lower uptake and hence reduced photosynthetic efficiency. The results are in agreement with Satalagaon *et al*[6]., who reported that higher levels of N, P_2O_5 and K_2O resulted in significant improvement in the plant height, number of branches and leaf length compared to lower doses. Gami *et al*[3]., stated that as far as physiological parameters like leaf area and leaf area index are concerned, they were significantly influenced with increased level of fertilizers for higher yield target which helped in better crop growth and dry matter production and increased grain number per ear.

Yields attributes

Different nutrient management practices significantly influenced yield attributes in soybean in both the consecutive years (Table 2). Significantly higher number of seeds and their weight $plant^{-1}$ and test weight were observed in the treatment SSNM yield targeted at 30 q ha^{-1} (210.3, 31.5 g and 15.35 g, respectively) over RDF (168.0, 20.56 g and 12.55 g, respectively) but was on par with SSNM yield targeted at 35 (217.0, 33.08 g and 15.63 g, respectively). The improvement in yield attributes was mainly associated with higher availability of nutrients and their uptake and effective translocation of food assimilates from vegetative to reproductive parts compared to control and STL approach. The results are in line with the observations of Kulkarni[4] in wheat crop who reported that SSNM treatment with yield target at 4 t ha^{-1} resulted in higher grain ear head and test weight compared to SSNM yield targeted at 3, 5 and 6 t ha^{-1}. Deshmukh[2] also made similar observations in chilli crop where number of chilli fruits hill^{-1}, seed to pod ratio, dry fruit weight and dry chilli fruit yield hill^{-1} recorded higher values in SSNM yield targeted at 30 q ha^{-1} over SSNM yield targeted at 10, 15, 20 and 25 q ha^{-1}.

Grain and haulm yield

Different nutrient management practices significantly influenced seed and haulm yield in soybean. The treatment with SSNM yield targeted at 30 q ha^{-1} recorded 30.91 and 33.21 q ha^{-1} of seed and haulm yield, respectively and was significantly superior over all the treatments except SSNM yield targeted at 35 q ha^{-1}. The higher seed and haulm yield in SSNM treatment with 30 q ha^{-1} yield target was attributed to improvement in growth and yield contributing characters. *et al*[8]., also made similar observation in maize crop, where significantly higher seed yield was recorded in SSNM treatment compared to STCR approach and RDF. The extent of increase in seed yield in this particular treatment over control was 40.73 per cent while 35.0 and 32.0 per cent over 125 and 150 per cent RDF, respectively. However, the highest seed yield of 31.93 q ha^{-1} was recoded in SSNM treatment yield targeted at 35 q ha^{-1}. The higher seed yield under SSNM approach might be due to balanced application of nutrients which is based on soil analysis and takes into account the amount of nutrients removed by the crops, native nutrient status and nutrients added through the fertilizer. The SSNM approach helps in providing nutrients at the time of crop requirement which might have led to better translocation of photosynthates from source to sink and these observations were in agreement with the results recorded by Umesh *et al*[8]., and Madhusudan[5] in maize crop where SSNM based treatment recorded higher cob yield over graded nutrient levels, STCR and RDF. Similarly, the treatment with STCR yield target at 30 and 35 q ha^{-1} resulted in significantly higher seed and haulm yield over control but on par with STL approach. The extent of increase in seed yield over control was 7.74 per cent in STCR yield targeted at 30 q ha^{-1} and 18.34 per cent in STCR yield targeted at 35 q ha^{-1}.

Economics in soybean

Economics is an important factor that determines practical utility/ feasibility of the technology in crop production. Different nutrient management practices increased seed yield accordingly net returns and benefit cost ratio. The treatment with SSNM at 30 q ah^{-1} recorded higher net returns and higher B:C ratio. Need based application of fertilizers to the crop under SSNM might have led to the higher production. Hence higher net returns and B: C ratio than control were observed under SSNM approach. Biradar *et al*[1]., made similar observation in wheat, rice and chickpea crops. Lower net returns and B: C ratios were recorded in RDF with blanket recommendation.

Table 1: Effect of different approaches of fertilizer recommendation to soybean on growth attributes at harvest

Treatments	Plant height			Dry matter accumulation			Number of branches			Leaf area index (%)		
	-----------------------(At harvest)-----------------------						(At 60 DAS)					
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1: RDF	50.3	49.6	49.9	35.4	32.01	33.72	3.87	3.73	3.80	2.36	2.48	2.42
T_2: 125% of RDF	53.3	52.4	52.9	39.9	34.33	37.13	4.07	3.93	4.00	2.71	2.78	2.75
T_3: 150% of RDF	55.9	54.5	55.2	42.3	35.58	38.93	4.33	4.27	4.30	2.81	2.81	2.81
T_4: STL based NPK	53.8	51.3	52.5	39.2	33.28	36.24	4.40	4.13	4.27	2.70	2.78	2.74
T_5: SSNM targeted at 20 q ha^{-1}	55.5	55.0	55.7	42.7	39.48	41.08	4.53	4.20	4.37	2.94	2.85	2.89
T_6: SSNM targeted at 25 q ha^{-1}	59.9	58.7	59.3	46.5	40.59	43.54	5.20	4.80	5.00	3.27	3.03	3.15
T_7: SSNM targeted at 30 q ha^{-1}	63.9	61.7	62.8	49.1	44.76	46.92	5.80	5.20	5.50	3.33	3.33	3.33
T_8: SSNM targeted at 35 q ha^{-1}	65.4	63.8	64.6	54.2	45.04	49.60	6.00	5.60	5.80	3.69	3.51	3.60
T_9: STCR targeted at 20 q ha^{-1}	53.0	50.8	51.9	41.7	33.73	37.73	3.93	3.87	3.90	2.42	2.52	2.47
T_{10}: STCR targeted at 25 q ha^{-1}	53.7	52.9	53.3	45.3	35.53	40.40	4.07	4.00	4.03	2.81	2.61	2.71
T_{11}: STCR targeted at 30 q ha^{-1}	57.7	55.4	56.6	48.8	37.05	42.91	4.60	4.33	4.47	2.94	2.85	2.90
T_{12}: STCR targeted at 35 q ha^{-1}	60.3	58.2	59.2	51.7	39.49	45.61	4.93	4.80	4.87	3.20	3.03	3.12
SEm±	3.2	2.8	2.0	2.46	2.51	1.77	0.23	0.35	0.21	0.19	0.18	0.11
CD @ 0.05	9.5	8.1	5.8	7.21	7.37	5.20	0.68	1.02	0.62	0.55	0.52	0.33

Table 2: Effect of different approaches of fertilizer recommendation to soybean on yield attributes of soybean

Treatments	Seed yield (g plant^{-1})			Number of seed plant^{-1}			Test weight (g)		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T_1: RDF	20.09	21.20	20.65	167.7	168.3	168.0	12.33	12.78	12.55
T_2: 125% of RDF	22.08	22.62	22.35	172.0	177.7	174.8	12.80	13.07	12.93
T_3: 150% of RDF	22.73	23.28	23.01	181.0	187.7	184.3	13.18	13.45	13.32
T_4: STL based NPK application	22.14	22.25	22.19	172.3	173.3	172.8	13.06	13.15	13.11
T_5: SSNM targeted at 20 q ha^{-1}	22.29	24.40	23.34	176.3	185.7	181.0	12.60	13.09	12.85
T_6: SSNM targeted at 25 q ha^{-1}	25.70	26.23	25.96	185.0	202.7	193.8	13.27	13.15	13.21
T_7: SSNM targeted at 30 q ha^{-1}	30.29	32.02	31.15	201.7	219.0	210.3	15.28	15.42	15.35
T_8: SSNM targeted at 35 q ha^{-1}	32.08	34.08	33.08	211.3	222.7	217.0	15.41	15.85	15.63
T_9: STCR targeted at 20 q ha^{-1}	20.20	22.42	21.31	170.7	166.0	168.3	12.55	12.93	12.74
T_{10}: STCR targeted at 25 q ha^{-1}	21.49	23.18	22.33	174.3	170.0	172.2	13.02	13.19	13.11
T_{11}: STCR targeted at 30 q ha^{-1}	22.95	25.19	24.07	178.3	185.0	181.7	13.25	13.27	13.26
T_{12}: STCR targeted at 35 q ha^{-1}	24.54	27.34	25.94	182.0	192.0	187.0	13.76	13.92	13.84
SEm±	1.64	1.71	1.32	5.7	5.6	4.0	0.7	0.71	0.64
CD @ 0.05	4.80	5.01	3.86	16.6	16.3	11.8	2.0	2.09	1.88

Table 3: Effect of different approaches of fertilizer recommendation on yield and economics of soybean

Treatments	Grain yield			Haulm yield			Harvest index	B:C ratio
	-----------------q ha^{-1}------------------							
	2015	2016	Pooled	2015	2016	Pooled	(Pooled)	
T_1: RPP (control)	22.14	21.79	21.97	28.09	26.61	25.85	43.69	2.20
T_2: 125% of RDF	22.98	22.80	22.89	29.20	27.76	26.98	43.72	2.18
T_3: 150% of RDF	23.42	23.41	23.41	30.89	29.90	29.42	43.27	2.12
T_4: STL based NPK	23.09	23.27	23.18	29.48	27.34	27.16	44.01	2.32
T_5: SSNM targeted at 20 q ha^{-1}	23.85	23.59	23.72	31.48	29.09	28.65	43.56	2.16
T_6: SSNM targeted at 25 q ha^{-1}	25.54	26.08	25.81	32.91	30.79	30.12	45.19	2.54
T_7: SSNM targeted at 30 q ha^{-1}	30.57	31.26	30.91	34.40	33.35	33.21	47.70	2.91
T_8: SSNM targeted at 35 q ha^{-1}	31.31	33.09	32.20	36.20	34.75	35.34	47.53	2.76
T_9: STCR targeted at 20 q ha^{-1}	22.34	22.50	22.42	28.28	26.86	25.07	44.99	2.72
T_{10}: STCR targeted at 25 q ha^{-1}	22.93	23.78	23.36	30.95	27.05	27.16	44.70	2.73
T_{11}: STCR targeted at 30 q ha^{-1}	22.52	24.82	23.67	32.38	28.88	28.79	43.69	2.48
T_{12}: STCR targeted at 35 q ha^{-1}	25.84	26.16	26.00	33.99	32.04	30.94	44.02	2.47
SEm±	1.64	1.75	1.26	1.75	1.73	0.83	1.65	0.12
CD @ 0.05	4.81	5.15	3.69	5.15	5.06	2.43	NS	0.34

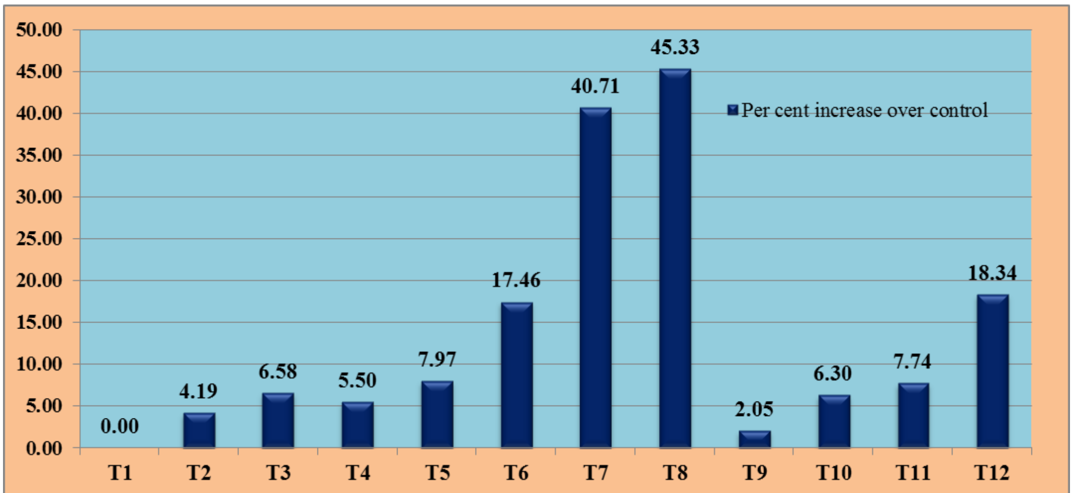

Fig. 1. Per cent grain increase in diffeent treatments over control

CONCLUSION

SSNM approach yield targeted at 30 q ha^{-1} successfully reached the yield target and also recorded higher yield with higher net returns over other approaches such as STL and STCR approach, 125 and 150 per cent RDF and control.

REFERENCES

1. Biradar, D.P., Aladakatti, Y.R., Rao, T.N. and Tiwari, K.N., Site-specific nutrient management for maximization of crop yield in northern Karnataka. *Better crops*, **90(3):** 33-35 (2006).
2. Deshmukh, Response of chilli (*Capsicum annuum* L.) to site specific nutrient management through targeted yield approach in Northern transition zone of Karnataka. *M. Sc (Agri) Thesis*, Univ. Agric. Sci., Dharwad (2008).
3. Gami, J.K., Parmar, M.T., Patel, J.C. and Malavia, D.D., Effect of rates, time and method of nitrogen application on dwarf wheat. *India J. Agron*., **31(4):** 401-402 (1986).
4. Kulkarni, M.M., Response of dicoccum wheat genotypes to site specific nutrient management (SSNM) for targeted yield. *M. Sc (Agri) Thesis*, Univ. Agric. Sci., Dharwad (2008).
5. Madhusudan, Assessment of soil test based nutrient management approaches in maize (*Zea mays* L.). *M. Sc (Agri) Thesis*, Univ. Agric. Sci., Dharwad (2013).
6. Satalagaon, G.S., Chandranath, H.T. and Potdar, M.P., Response of drill sown onion to nutrient management through soil test crop response (STCR) and soil test laboratory (STL) approach, *Karnataka J. Agric. Sci*., **27(2):** 232-233 (2014).
7. Singh, Y.N., Singh, S.K., Sharma, P.K. and Priyanka Singh, Soil test based integrated fertilizer recommendation for wheat (*Triticum aestivum*) in an Inceptisol of Eastern Plain Zone of Uttar Pradesh. *J. Indian Soc. Sci.*, **62(3):** 255-258 (2014).
8. Umesh, M.R., Manjunath, N., Shankar, M.A. and Jagadeesh, N., Influence of nutrient supply levels on yield, nutrient uptake, grain quality and economics of corn (Zea mays L.) in Alfisol of Karnataka. *Indian J. Dryland Agric. Res. And Devlop*., **29(1):** 73-78 (2014).