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Validation of fertilizer prescription equations developed for soybean by conjoint use of FYM and fertilizers on Entisols

D. S. Waghdhare[1], A.S. Takate[2], U. K. Bhoye[3], S. R. Bachkar[4] and R. U. Nimbalkar[5]

Division of Soil Science and Agricultural Chemistry, College of Agriculture, Pune 411 005, India

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ABSTRACT

Fertilizer prescription equations developed based on nutrient requirement, contribution from soil and contribution from fertilizers for soybean by conjoint use of graded levels of FYM and fertilizers on Entisols was validated by conducting follow up trial comprising eight treatments. It was found valid and suitable for achieving desired yield target of 15 and 20 q ha^{-1} by integration of both the sources and helps in maintaining soil health.

Key words *: Validation, Fertilizer prescription equations, Soybean, Entisols*

Introduction

Soybean [*Glycine max* (L.) Merill] is a rich source of protein and is also identified as important oil seed energy rich crop. The productivity of soybean is however low due to number of constraints. Inadequate and imbalance nutrient supply to the crop is one of the foremost factors influencing crop production. Besides, soybean is cultivated under varying climatic and soil fertility having stress and strain conditions. Substantial increase in production of oil seed crop like soybean could be achieved by mitigating above conditions through integrating the fertilizers and organic manures (Bisht and Chandel, 1991).

Nitrogen requirement of soybean is much higher than that of cereals because of high protein content (Subba Rao and Ganeshmurty, 1994). Soybean being a leguminous oil seed, can fix atmospheric nitrogen and thus it can meet a major part of its nitrogen requirement. Phosphorus is very critical particularly at flowering and pod development stages of soybean. Potassic fertilizers are used in very low amount in the country because most of soils are adequately rich in available potassium (Singh *et al.*, 2006).

Soil fertility evaluation is the most important approach for judicious use of organic manures and chemical fertilizers (Melste and Peck, 1973). Soil testing helps to assess available nutrient status of the soil and fertilizers recommendations based on the soil test ratings (Muhr *et al.*, 1965). Ramamoorthy *et al.* (1967) and Kanwar (1971) established basis for making scientific fertilizer recommendations under commercial farming based on soil test crop response. Ramamoorthy and Velayutham (1971) found yield target approach to be more useful for fertilizer recommendations. In view of above, present investigation was planned.

***Corresponding author's email:** dip_981@rediffmail.com
1. Sr. Res. Asstt., SSAC, AC, Pune, 2. Asstt. Prof., ZARS, Solapur 3. Jr. Res. Asstt., SSAC, AC, Pune, 4. Agril. Asstt., MPKV, Rahuri, 5. Jr. Res. Asstt., SSAC, AC, Pune,

Materials and Methods

The validation trial for soybean was conducted during 2006-2007 on Entisols (Typic ustorthent) for validation of fertilizer prescription equations derived from main experiment conducted during 2005-2006 at soil test crop response correlation project, Department of Soil Science and Agricultural Chemistry, M.P.K.V., Rahuri.

In the main experiment the nutrient requirement, contribution from soil, fertilizers and contribution from fertilizers in presence of FYM were calculated as given below (Table 1).

Fertilizer prescription equations for yield targeting in soybean

The above basic data for soybean were transformed into workable fertilizer prescription equations as given below.

i. Sole use of fertilizers

$FN = 7.26\ T - 0.61\ SN$

$FP_2O_5 = 8.01\ T - 5.77\ SP$

$FK_2O = 3.42\ T - 0.17\ SK$

Where, F and S indicate the fertilizer and soil nutrients, respectively

(Kg ha^{-1}) and T indicates yield target (q ha^{-1}).

ii. Conjoint use of fertilizers and FYM

$FN = 6.43\ T - 0.55\ SN - 0.21\ FYM$

$FP_2O_5 = 7.22\ T - 5.25\ SP - 0.53\ FYM$

$FK_2O = 2.43\ T - 0.13\ SK - 0.43\ FYM.$

Where, T is yield target, FN, FP_2O_5 and FK_2O are fertilizers nutrients Kg ha^{-1} and SN, SP and SK are soil available NPK in Kg ha^{-1} respectively, FYM is farmyard manure in Mg ha^{-1}.

These equations were further ascertained, validated and used to compute fertilizer doses for different yield targets on *kharif* soybean with varying soil test values and ready reckoners were prepared for fertilizer N, P_2O_5 and K_2O requirements for sole use of fertilizes and for conjoint use of manure and fertilizers.

The validation trial was conducted taking into account the optimum yield level during *Kharif*, 2006 for soybean on Entisol using cultivar DS-228. Randomized block design was used using eight treatments as control, General recommended dose + 5 Mg FYM ha^{-1}, As per soil test, Target I^{st} (15 q ha^{-1}), Target II^{nd} (20 q ha^{-1}), Target I^{st} + FYM 10 Mg ha^{-1}, Target II^{nd} + FYM 10 Mg ha^{-1} and Only FYM 20 Mg ha^{-1} with three replications.

The necessary other package of practices were adopted during crop growth. After harvest of soybean crop, the grain and straw yield was recorded and economics was calculated.

Results and Discussion

The data in respect of grain and straw yield of soybean obtained in the validation trial on Entisol are given in Table 2. The results revealed that the grain yield varied from 10.77 to 20.90 q ha^{-1}. Application of fertilizer based on general recommended dose (50:75:0) recorded 14.51 q ha^{-1}, while as per soil test (62.5:75:0) recorded 16.77 q ha^{-1}. There was 15.58 per cent increase in grain yield in as per soil test treatment over general recommended dose. The yield target of 15 q ha^{-1} was achieved within +8.5 per cent variation. However, application of FYM @ 10 Mg ha^{-1} along with fertilizers @ 14.2:19.32:0 Kg, N, P_2O_5 and K_2O ha^{-1} recorded 16.27 q ha^{-1} (+ 8.47 % variation) grain yield of soybean.

Further application of FYM @ 10 Mg ha^{-1} along with fertilizer @ 46.3:55.02:10.5 kg N, P_2O_5 and K_2O kg ha^{-1} for 20 q ha^{-1} yield target resulted in 20.90 q ha^{-1} grain yield of soybean. This suggests that the inclusion of FYM along with calculated dose of NPK

Table 1. Basic parameters *viz.*, NR, CS, CF and CFYM for soybean

Nutrient	NR (kg q^{-1})	CS (%)	CF (%)	C FYM (%)
		Without FYM		
N	6.16	51.94	84.83	-
P	0.42	30.21	5.24	-
K	3.18	15.57	92.79	-
With FYM				
N	6.16	52.64	95.80	4.03
P	0.42	30.57	5.82	1.25
K	3.18	16.60	130.49	9.38

Table 2. Yield and economics of fertilizer use for yield targeting of soybean on Entisols

Sr. No.	Treatment	Yield (q ha^{-1}) Grain	Yield (q ha^{-1}) Straw	Cost of fertilizer (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Monetary returns (Rs ha^{-1}) Gross	Monetary returns (Rs ha^{-1}) Net	Increase over control (Rs ha^{-1})	Returns per rupee invested on fertilizer	B:C ratio
1.	Control (0:0:0)	10.77	14.38	-	10000	14001	4001	-	-	1.40
2.	GRD (50:75:0)	14.51	20.58	2600	12600	18863	6263	4862	7.25	1.50
3.	AST (62.5:75:0)	16.77	23.69	2493	12493	21801	9308	7800	8.74	1.74
4.	Target Ist 15 q ha^{-1} (19.97:28.2:7.1)	13.72	20.76	913	10913	17836	6923	3835	19.54	1.63
5.	Target IInd 20 q ha^{-1} (56.3:68.2:24.2)	18.43	26.23	2347	12347	23959	11612	9958	10.21	1.94
6.	Target Ist+ FYM 10 Mg ha^{-1} (14.2:19.32:0)	16.27	22.81	7594	17594	21151	3557	7150	2.78	1.20
7.	Target IInd + FYM 10Mg ha^{-1} (46.3:55.02:10.5)	20.90	29.14	8834	18834	27170	8336	13169	3.07	1.44
8.	Only FYM 20 Mg ha^{-1} 0(120):0(70):0(144)	12.07	16.55	14000	24000	15691	-8309	1690	1.12	0.65
	S.E. $\pm$	0.714	1.197	-	-	-	-	-	-	-
	CD at 5%	2.166	3.630	-	-	-	-	-	-	-
	C.V. %	8.02	9.60	-	-	-	-	-	-	-

Available nitrogen (Kg ha^{-1}) : 145.79
Available phosphorus (Kg ha^{-1}) : 15.94
Available potassium (Kg ha^{-1}) : 260
Rate of Fertilizer : N-10.8, P_2O_5-22.80, K_20-7.6 Rs. Kg^{-1}
Rate of FYM : 700 Rs. Mg^{-1}
Rate of soybean : 1300 Rs. q^{-1}

fertilizer have helped in achieving the grain yield target of soybean on Entisols. However, application of FYM @ 20 Mg ha^{-1} only without fertilizers recorded hardly 12.07 q ha^{-1} suggesting application of organic manure alone is of limited use in improving the grain yield of soybean. For achieving 15 q and 20 q ha^{-1} grain yield targets Rs. 19.54 and Rs. 10.21, were obtained respectively on per rupee invested by using fertilizer only (Table 2). The highest cost benefit ratio i.e. 1:1.94 was obtained under 20 q ha^{-1} target. This is mainly because of increased yield due to fertilizers.

Thus, it can be concluded that the fertilizer prescription equation developed for fertilizer recommendation using organics could be used for achieving yield target in the soil; however the benefit cost ratio is always higher using only fertilizers. Inclusions of organics helps to maintain soil health for sustainable production of soybean on Entisols.

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