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Research Article

TO INTRODUCE THE TARGETED YIELD CONCEPT OF SOYBEAN IN VERTISOLS FOR FERTILIZER RECOMMENDATION TO MAINTAIN SOIL FERTILITY

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Abstract: The objectives of the study were to study the effect of different treatment combinations of fertilizer and FYM on to introduce the targeted yield concept for fertilizer recommendation for maintaining soil fertility. To adjudge the performance of conjunctive use of chemical fertilizer and organic manures using targeted yield concept of recommendation.

Keywords: Soybean, Vertisols for Fertilizer, Soil Fertility

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Introduction

In the modern era, intensive crop cultivation system is highly productive but it largely depends on the use of fertilizers and organic manures. Their continuous use may cause environmental pollution. Soil health gets deteriorated and the soil becomes prone to erosion by wind and water. Use of fertilizers containing one or two essential elements impede the uptake of other nutrients and induce considerably imbalance in nutrient supply capacity of the soil. Soybean (*Glycine max* L. merril) is a major legume crop, recognized as the efficient producer of the two scarce nutritional resources *i.e.*, the protein and oil which are not only the major components in the diet of vegetarian mass but a boon to the developing countries as well .Soybean is an excellent source of protein and oil with a very high nutritional value as it contains 40-42 percent protein and 20 percent oil [1]. Also due to its capacity to fix the atmospheric nitrogen into the soil by virtue of the symbiotic nitrogen fixing bacteria on its roots, it adds huge amount of plant residue and fixed nitrogen in the field which ultimately. Soybean ranks high amongst the other leguminous crops of the world for its potential source of protein and edible oil. The crop is dominant in the state of Madhya Pradesh, Uttar Pradesh and parts of Maharashtra. In Madhya Pradesh the area under soybean is about 4.4 million ha, which contributes to about 80 % of the total production of soybean in the country. Due to these, the state has been designated as Soybean State. The yield targeting method provides soil test-based fertilizers doses and also the level of desired yield of the crop. The farmer can hope to achieve the desired yield with his limited resources. Targeted yield concept is an important one over the soil test method which gives only an index ,of the availability of nutrient and not the actual amount of nutrient that the soil can supply to the plant .It has been observed that the soil having the same soil test values may differ in nutrient supplying capacity which may be due to numerous reasons particularly ,the interaction of nutrients amongst themselves .

Materials and methods

The present study on the conjoint use of fertilizers and manures on the farmers' fields at the village Dangidhana, District Narsinghpur (M.P.) targeted yield concept on Soybean crop in Vertisols under different fertilizer levels and yield targets was undertaken during *kharif* season, 2004.

Experiment details

The experiment was conducted on vertisol, which belonged to kheri-series of fine montmorillonitic, hyperthermic family of Typic Haplusterts, commonly known as "Deep Black soil"
Location – farmers' fields at village Dangidhana District Narsinghpur (M.P)
Crop and variety-soybean (JS 93-05)
Treatments -Eight
Replication-Three (Farmers as replicate)
Design-Randomized Block Design
Total number of plots-Twenty four
Actual plot size - 20×25 m^2 =500 sq.m
Seed rate- 100 Kg ha^{-1}
Date of sowing -27/06/2004
Date of harvesting -04/10/2004

Treatments

T1- Farmers practice (control)
T2- General recommended dose (GRD)
T3-Yield Target 1 (15qha^{-1})
T4-Yield Target 2 (25qha^{-1})
T5-Yield Target 1(15q+5t FYM ha^{-1})
T6-Yield Target 2(25q+5t FYM ha^{-1})
T7-Yield Target 1 (15q+10t FYM ha^{-1})
T8-Yield Target 2(25q+10t FYM ha^{-1})

Physical and chemical properties of the experimental soils

Representative surface (0-23 cm) soil samples were collected from 3 experimental sites before sowing of soybean crop. These soil samples were analyzed for various physical and chemical parameters and results are presented in [Table-1]. Calculations of fertilizer requirements for soybean crop. Fertilizer requirement for soybean crop was calculated by introducing different targets and the soil test values of experimental site in the fertilizer adjustment equations developed by JNKVV Centre under STCR project [2].

Table-1 *Physical and chemical properties of soil at initial stage*

S	Properties	Unit	R1	R 2	R 3	Average value
1	Soil texture	-	clay	Clay	Clay	Clay
2	Soil PH (1:2.5)	-	7.1	7.0	7.1	7.1
3	EC (1:2.5)	Sdm^{-1}	0.32	0.37	0.33	0.34
4	Organic carbon	%	0.25	0.26	0.25	0.25
5	Available nitrogen	Kg ha^{-1}	181	165	189	178
6	Available phosphorus	Kg ha^{-1}	7.9	4.8	7.6	6.8
7	Available potassium	Kg ha^{-1}	248	304	360	304
8	Available sulphur	Mg Kg^{-1}	10.1	11.5	11.6	11.1
9	Available zinc	Mg Kg^{-1}	0.72	0.60	0.62	0.65

Table-2 *Doses of fertilizers and FYM applied to Soybean*

Treatments	Treatment details	Nutrients applied (Kgha^{-1})			FYM (T ha^{-1})	S Kgha^{-1} (through S.S.P)
		N	P_2O_5	K_2O		
T1	Farmers practice (control)	10	25	0	0	18.75
T2	General recommended dose	20	60	20	0	45.0
T3	Yield Target 1(15qha^{-1})	0	50	0	0	37.66
T4	Yield Target 2(25qha)	44	102	31	0	76.6
T5	Yield Target 1(15q+5t FYM ha^{-1})	0	50	0	5	37.66
T6	Yield Target 2(25q+5t FYM ha^{-1})	44	102	31	5	76.6
T7	Yield Target 1(15q+10t FYM ha^{-1})	0	50	0	10	37.66
T8	Yield Target 2 (25q+10t FYM ha^{-1})	44	102	31	10	76.6

Table-3 *Chemical properties of soil after the harvest of crop*

Treatments	Treatment details	Soil PH (1:2.5)	EC (dsm^{-1})	O.C%	Nitrogen (Kgha^{-1})	Phosphorus (Kgha^{-1})	Potassium (Kgha^{-1})	Sulphur (mg Kg^{-1})	Zinc (mg Kg^{-1})
T1	Farmers practice (control)	6.9	0.34	0.25	178	6.8	304	11	0.64
T2	General recommended dose	7	0.37	0.28	183	8	310	13.6	0.68
T3	Yield Target 1(15qha^{-1})	7.1	0.42	0.29	198	8.3	320	15.1	0.71
T4	Yield Target 2(25qha)	7.1	0.42	0.34	198	8.6	340	15.2	0.71
T5	Yield Target 1(15q+5t FYM ha^{-1})	7.2	0.49	0.44	214	8.8	345	15.7	0.72
T6	Yield Target 2(25q+5t FYM ha^{-1})	7.1	0.49	0.67	230	9	348	17.3	0.73
T7	Yield Target 1(15q+10t FYM ha^{-1})	7.2	0.51	0.7	242	9	355	17.3	0.75
T8	Yield Target 2 (25q+10t FYM ha^{-1})	7.2	0.52	0.71	246	9.4	362	17.8	0.79
SEm±					1.49	0.064	1	0.966	0.052
CD (5%)					4.519	0.196	3.036	2.932	NS

Results

The treatment wise data recorded of soybean grain and straw and average contents of N,P,K,Zn and S and their uptake by biological yield and changes in some soil properties and nutrient contents (PH,EC,organiccorbon content ,available nutrients (N,P,K)) due to application of NPK fertilizers and in combination with FYM are elucidated one by one. The findings of the present study on the effect of NPK applied under STCR approach and FYM on growth parameters, yield and nutrient status of soil contents of there in soybean grain and straw, and uptake of nutrients by soybean under rain fed conditions are presented and have been discussed. The PH and fertility status increase with increase in the degree of base saturation. the availability of trace elements is directly related with the pH of the soil. The data presented in [Tables-3] indicate that there was no significant variation in PH due to various treatments. The pH of soils under study (after harvest of crop) ranged from 6.9 to 7.2 Decrease in PH due to continuous use of FYM has also reported [3] and also started [4]. The EC of the soil increase due to the application of NPK fertilizer alone and also in combination with FYM significantly but was within normal limits .The maximum EC was recorded in treatment T8 *i.e.*, target 2 (25q) +10 t $FYMha^{-1}$,which was significantly higher over all other treatments *viz*. GRD ,control,T4 and T3 .The EC was observed due to the application of high amount of FYM .Similar findings were also reported [5]. EC showed that high dose of FYM applied caused increase in EC of soil and in other definite trend of increase in the surface soil over control. The organic carbon status of the plough layer was found to increase due to the application of NPK fertilizers alone as well as in combination with FYM . The maximum organic carbon content was recorded in treatment (T8) *i.e.*, target 2 (25q)+10t FYM ha-1, which was significantly higher over all other treatment *viz*,T5,T4,T3,T2 and T1 (control). The results suggested that organic manures like FYM added more organic carbon as compared to inorganic fertilizer addition [6].

Effect of treatments on available nutrients

[Tables-3] (A) showed that nitrogen increasing trend in soil nitrogen after the harvest of crop with the application of different doses of fertilizers. Addition of FYM with NPK resulted in maximum available soil nitrogen content, The differences in the nitrogen content after harvest of soybean crop in different treatments were significantly different but they maintained higher N status in the soil than lower fertilizer treatment (T1) control. The N content in soil was almost at par in T3 and T4. The increase in N content in treatment (T8) *i.e.*, targent 2 ,(T7) *i.e.*, target 1,(T6) *i.e.*, 2 and (T5) *i.e.*, target 1 , Whereas the decrease of N content in control was 178 Kg ha-1 nearly as compared to initial status (173 Kg ha-1 [7] and [8] also reported the similar results .The data presented in [Tables-3] (A) showed that available phosphorus content increased in the soil after harvest of the crop with the treatment (T8) *i.e.*, target 2(25q)+10t FYM ha-1,and treatment (T7) *i.e.*, target 1 (15q)+10t FYM ha^{-1}, but the latter showed maximum p content which was significantly superior to all other treatments. Treatment (T8) showed significantly higher p than other treatment .The lowest P content was seen in control plot (T1) followed by G.R.D.(T2).The FYM treatment increased nearly 6.8 (T1) to 9.4(T8) Kg ha^{-1} P as compared to its initial increased the available P content to a variable extent over initial level reported by [9] The data showed that maximum K content was observed in treatment (T8) *i.e.*, target 2 which was significantly superior to all other treatments *i.e.*, T2,T1,T4,T3 and T5 .The K content in soil is increased by the application of NPK in combination with FYM was reported by [10] . [11] reported the effect of manures and fertilizers where the addition of phosphorus and nitrogen in soils lead to the grater depletion of potassium from the soil . It is evident from the data given in [Tables-2] (B) that the sulphur status of soil was sufficient .The maximum sulphur content was observed in treatment (T8) *i.e.*, target 2 which was significantly superior to all other treatment T3,T2 and T1.The higher content of sulphur in FYM treated plot due to the reason that mineralization of organic sulphur in soil reached to a maximum as reported [12].

The available soil sulphur improved considerably over the initial level where single super phosphate had been applied over the years [13]. Similar results were reported [14]. The data presented in [Tables-3] (B) indicate that the NPK and FYM treatments showed higher content of Zn in comparison to control and lower fertilizer treatment. The maximum content of Zn was recorded in treatment (T8) *i.e*., target 2 which was found higher than the other treatments. The available soil zinc declined to 0.61 mg kg^{-1} from the initial level of 1.10 mg Kg^{-1}, but incorporation of FYM along with NPK fertilizers maintained the initial level of available Zn in soil [13].

Effect of treatments on yield of soybean

The data in [Tables-4]and depicted in fig .3 revealed that grain and straw yields of soybean were significantly higher in the plots receiving fertilizer (NPK) and FYM as compared to control. Application of treatment (T8) target 2, treatment (T7) *i.e*., target 2 produced lesser grain yield than treatment (T6) *i.e*., target 2, treatment (T5) *i.e*., target 1 respectively. The beneficial effects of the fertilizer application in soybean have also been reported at different locations in the country as reported [15]. Addition of FYM and NPK fertilizers showed an increasing trend in respect of grain and straw, but could not reach to the level of significance. The beneficial effect of FYM can be due to steady supply of all nutrients including the micronutrients and improvement in physical condition of soil providing better aeration and microbial activities. The beneficial effects of FYM with NPK have been reported [3]. [The mean seed yield was highest with the application of 10t FYM+56.25 Kg P_2O_5 ha^{-1} Similar result was also reported [16,17].

Table-4 (A) Grain and straw yield (qha^{-1}) of soybean

Summary

The present investigation were undertaken at the village Dangidhana,Tehshil and District Narsinghpur (M.P) on the farmers field with the crop soybean (J S 93-05) during *kharif* 2004 There were 8 treatments *viz*. (1) Farmers practice (control) 10,25 and 0 Kg ha^{-1} N,P_2O_5 and K_2O ,respectively (ii) General recommended dose 20,60 and 20 Kg ha^{-1} N,P_2O_5 and K_2O,respectively (iii) Yield target 1 (15q ha^{-1}) (iv) Yield target 2 (25q ha^{-1}) (v) Yield target 1 (15q +5 t FYM ha^{-1}) (vi) Yield target 2 (25q +5 t FYM ha^{-1}) (vii) Yield target 1 (15q +10 t FYM ha^{-1}) and (viii) Yield target 2 (25q +10 t FYM ha^{-1}), 44 Kg N,102 Kg P_2O_5,31 Kg K_2O Kg ha^{-1}.The required amount of fertilizers were applied before sowing of the soybean crop . The PH of soil under study ranged from 6.9 to 7.2 (after harvest of crop), decrease in PH was observed due to continuously use of FYM. The maximum EC was recorded in treatment (T8) *i.e*., target 2 (25q) +10 t FYM ha^{-1}, which was significantly higher over all other treatments, general recommended dose, control to T4 and T3. The increase in EC was observed due to the application of high amount of FYM. The maximum organic carbon content was recorded in treatment (T8) *i.e*., target 2 (25q)+10t FYM ha^{-1},which was significantly higher over all other treatment *viz*, T5,T4,T3,T2 and T1 (control) The increase in N content in treatment (T8) *i.e*. target 2 (25g)+10 t FYM ha^{-1},treatment (T7) *i.e*., target 1 (15q) + 10 t FYM ha^{-1} , treatment target (T6) *i.e*., 2 (25g)+5 t FYM ha^{-1},treatment (T5) *i.e*., target 1 (15q) +5 t ha^{-1} were found 246,242,230,and 214 Kg ha^{-1}, respectively .The lowest p content was seen in control plot (T1) followed by G.R.D. (T2) .The FYM treatment increased nearly 8.0 (T) to 17.9 (T8) Kg ha^{-1} p as compared to its initial status (6.8 Kg ha^{-1})

The objectives of the study were to study the effect of different treatment combinations of fertilizer and FYM on-

To introduce the targeted yield concept for fertilizer recommendation for maintaining soil fertility.

To adjudge the performance of conjunctive use of chemical fertilizer and organic manures using targeted yield concept of recommendation.

To compare the efficiency of existing practices pertaining to fertilizer application in the state with targeted yield approach for recommendation based on soil tests.

In the present investigation including nodule study, crop yield and growth parameters, chemical composition of plant and soil and total uptake of different nutrient by the crop were recorded.

Conclusion

Yield attributes of soybean. The influence of NPK and FYM were noticed positively significant on yield attributes like, plant height, number of pods, number of nodules at 45 and 60 days after sowing and their dry weight.

The soil PH was more or less due to application of NPK and FYM .At the initial stage (before sowing of crop) soil PH was 7.1 and slight decrease in PH was seen due to the treatments target 1 (15q+5t FYM ha^{-1}) T5, target 1(15q+10t FYM ha^{-1}) T7, target 2 (25q+10t FYM ha^{-1}) T8, target 2 (25q+5t FYM ha^{-1}) T6, target 2 (25q ha^{-1}) T4.

The increase in the electrical conductivity was observed in all the treatments. This may be due to improper drainage and clayey nature of the experimental soils and application of fertilizer with combination of FYM.

Organic carbon content in soil increased appreciably in treatments target 2 (25q+10t FYM ha^{-1}), target 1 (15q+10t FYM ha^{-1}), target 2 (25q+10t FYM ha^{-1}). In general, the rate of accumulation of organic carbon was more in the treatments which produced higher yields of soybean.

The availability of nitrogen, phosphorus, zinc and sulphur generally increased in all the treatments as compared to their initial status, except in G.R.D.and control where it either decreased or remained at the same level. However, the decrease in available potassium was observed in most of the treatments.

The yield of soybean was significantly higher with the fertilizer treatments than low fertilizer treatment (control).

There was no significant difference in yields between the target 1 (15q+10t FYM ha^{-1}) and target 1 (15q+5t FYM ha^{-1}) treatments.

The target 2 (25q+10t FYM ha^{-1}) gave the highest grain yield and was significantly higher over treatment T4,T2,T7,T5,T3 and T1 however no significant difference were found with the T6. It showed the importance of FYM for the soybean crop.

The sulphur subtraction did not give significant difference in the yield.

FYM also showed its beneficial effect on growth and development of soybean crop due to steady supply of all the major and minor nutrients.

Suggestions for further research work

Experiment is target specific and the data indicated that on applying fixed doses of fertilizer based on soil test base we have achieved the yield target and is better than the traditional method. So, there is a vast scope for the improvement of crop yield and the use efficiency of the applied resources. The applications of FYM (low cast input) seems to be of greater value in the crop production. The investigation should further be carried out through different combination of FYM with green manuring, combinations of fertilizers, use of FYM with Rhizobium culture and with various micronutrients

Application of research: The present study on the Conjoint use of fertilizers and Manures on the farmers' fields at the village Dangidhana, District Narsinghpur (M.P) Vis-à-vis Targeted yield concept on Soybean crop in Vertisols under different fertilizer levels and yield targets was undertaken during *kharif* season, 2004.

Research Category: Soil fertility

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***Research Guide or Chairperson of research: Dr G P Gupta**

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Study area / Sample Collection: Dangidhana Village, Narsinghpur District

Cultivar / Variety name: Soybean (*Glycine max* L. merril)

Conflict of Interest: None declared

Ethical approval: Ethical approval taken from Department of Soil Science and Agriculture Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004, Madhya Pradesh, India.
Ethical Committee Approval Number: Nil

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