

Effect of Integrated Nutrient Management on Soybean production and WUE in Vertisols of MP

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ABSTRACT

Soybean is a major crop for oil and protein consumption by human, animal and fuel. Crop yield influenced with the application of different nutrients along with recommended dose of fertilizers. On an average 7 to 12 lack liters/ha of water is received during rainy season. Over the last one decade, there is a change in rainfall pattern in the Malwa region. A field experiment was conducted at various farmer's fields over the years to assess the productivity of soybean, profitability of technologies and improving water use efficiency. The soil of the experimental site was medium black with pH (7.6-8.1), having low organic carbon (0.31%). Soils, in general, are low in N and P and rich in Potash. The experiment was laid out in randomized block design with five replications. Study revealed that plant height was maximum in T4 treatment [RDF+ Sulphur (Use of sulphur@20 kg/ha as basal application) + Boron (Use of Boron @1.5 kg/ha as basal application)] followed by the rest treatments in the reverse order [T3>T2>T1]. Pods per plant were significantly more in T4 treatment followed by T3, T2 and Farmer's practice [10:23:0 kg/ha N:P:K], although T4 and T3 were found at par statistically. It showed that the 100 seed weight, WUE and B:C ratio was highest in T4. Similarly highest yield was recorded in T4 during both years followed by RDF+ BNF [T3], RDF [T2] and FP [T1]. Results revealed higher WUE and yield in treatments with integrated approach of fertilizers and bio-fertilizers. The SYI was the lowest (64.37) where no manure and bio-fertilizers was added in the soil under FP [T1] whereas it was increasing in order in other treatment and highest in T4 where bio-fertilizers were added with recommended dose of fertilizers along with sulphur. The study revealed highest Net return (Rs/ha: 26697) coupled with highest B:C ratio (2.64) in T4 treatment [RDF+S+Bo] while it was lowest Net return (13059 Rs/ha) and B:C ratio(1.92) was found in Farmers Practice[T1]. The difference in yield between FP [T1] and the succeeding treatments ranged from 350 kg ha⁻¹ to 540.9 kg ha⁻¹. It can be further concluded that INM practices had a better impact on the WUE and together they contributed to higher partial factor productivity.

Keywords: Soybean, RDF, INM, Sulphur, Boron, Bio-fertilizers, plant height, pods per plant, WUE, yield, Net return, B:C ratio.

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INTRODUCTION

Soybean is a major crop for oil and protein consumption by human, animal and fuel. The increased demand for oil and protein stimulated soybean production mainly by land expansion, with very modest growth in its productivity (Imas & Magen, 2007). This Cray covers an area of our 90 million ha. of which 90% area is concentrated in US, Brazil, Argentina, China and India. Contributing 8% of the world area (7.8 million hectares) Our country figures with the lowest productivity (1050 kg ha⁻¹) as against the world average of 2380 kg ha⁻¹ FAC STAT (8-2007), Madhya Pradesh is the leading state in soybean production both in terms of area and productivity, contributing 4.8 million ha and 1120 kg ha⁻¹, respectively. The various production factors, water and balanced nutrition plays a key role in the productivity of the crop. Soybean which is grown as a rainfed crop in M.P. Rainy season (3rd week of June to 2nd week of September) provides sufficient water and 07 to 12 lac liters/ha of water is received averagely during rainy season. Over the last one decade, there is a change in rainfall pattern in the Malwa region. Due to lack of appropriate water management most of rainfall water is lost through surface run-off, leading to moisture stress in the standing crop affecting the crop yields adversely.

MATERIALS AND METHODS

A field experiment comprising four treatments of different nutrients was conducted over the years at various farmer's field of Ujjain district adopting cluster approach to improve the productivity of crop, enhancement of farmers socially and environmentally sustainable growth, poverty reduction and to assess increasing water use efficiency in favours of yield enhancement in soybean, a rainfed crop in Malwa region of the Madhya Pradesh. The soil of the experimental site was medium black with pH (7.6-8.1), having low organic carbon (0.31%). Sustainable Yield Index (SYI) was therefore, used as an approach to evaluate the minimum yield likely to be achieved in relation to changes in Soil Organic

Carbon(SOC) and available N, P and K status of soil. The experiment was laid out in randomized block design with five replications. There were four different treatments namely –

T1; Farmers practice, compressing of using untreated and un-inoculated seed, with imbalanced fertilizer dose 10:23:0 kg/ha N:P:K, and sowing seeds mixed with fertilizers.

T2; Recommended dose of fertilizer [20:60-80:40 kg N: P: K Kg/ ha.]

T3; RDF + Bio-fertilizers @ 1.5 kg/ha *Rhizobium* and 3 kg/ha PSB applied in the soil prior to sowing.

T4; RDF+ Sulphur [Use of sulphur@20 kg/ha as basal application] + Boron [Use of Boron @1.5 kg/ha as basal application].

The soybean variety which matures in 92-95 days with good yield potential was utilized for the purpose. Crop was sown in the last week of June and harvested on 1st to 2nd week of October, respectively. Rainfall pattern of the district showed differences drastically over the years with an average rainfall of 892 mm.

RESULTS AND DISCUSSIONS

Perusal of data in table 1 revealed not significant differences for plant height in both the years. However, the pooled data revealed that plant height was maximum in T4 followed by the rest of treatments in the reverse order. Pods per plant were significantly more in T4 and T3 followed by T2 and T1, although T4 and T3 were at par. Similarly highest yield was recorded in T4 during both years followed by T3,T2 and T1. Pooled figures of yield showed at par statistically in T4 and T3. The above results are in conformity with that of Malik and Khurshid, 2007.

Lower yields in 1st year may be attributed due to high rainfall during reproductive phase *i.e.* the month of July, August and September which might have hampered the photosynthetic efficiency coupled with excess moisture level in the root zone. During the 2nd year although the total rainfall was less but the soybean variety which is of comparatively early in maturity did not

face any dearth of moisture during the critical growth periods as seen from the data of total rainy days which were 28 out of the total growth period of 95 days [As per depicted in the table 2].

Pooled Data in table 3 revealed that the 100 seed weight and WUE was highest in T4. This was probably due to the favorable metrological parameters which indicates that during the entire crop growth period the total rainfall received was distributed mainly

between the seed emergence stage to seed development. This led to the better utilization of the inputs used particularly fertilizers as a result of which the fertilizer use efficiency and the WUE in treated plots accounted to 17.62 Kg grain/cm of water and 17.00 Kg grain/cm of water. These results are in conformity with the earlier study of Ghosh *et al* 2003. The total increase in WUE owing to better moisture condition over control was 37.43 per cent.

Title 1: Effect of various treatments on growth and yield of soybean

Treatment	Plant height (cm)			Pods / plant(Nos)			Yield (Kg/ha)		
	1 st yr	IInd Yr	Mean	1 st yr	IInd Yr	Mean	1 st yr	IInd Yr	Mean
T1	48.66	60.95	54.80	22.00	44.50	33.25	923.20	960.00	941.60
T2	51.16	62.15	56.66	31.00	62.50	46.75	1233.20	1350.00	1291.60
T3	54.50	64.20	59.40	36.00	67.25	51.63	1383.20	1490.00	1436.60
T4	56.16	64.75	60.45	36.83	68.00	52.42	1410.00	1555.00	1482.50
SEM _+	1.88	1.17		0.90	1.87		22.20	47.70	
CD=0.05	N.S	N.S		2.68	5.93		66.20	151.00	

Table2. Distribution of rainfall (mm) and number of rainy days during crop period

Month	Rain fall (mm)		Rainy days(Nos)	
	Ist year	IInd Year	Ist year	IInd Year
June	133	29.7	5	1
July	535	283.22	14	11
August	550	147.69	17	6
September	175	149.55	10	9
October	0	8.89	0	1

Table3. Test weight and Water Use Efficiency as affected by various treatments

Treatment	100 seed Weight (g)	WUE (Kg grain/cm of water used)
T1	11.50	11.07
T2	12.10	15.33
T3	13.40	17.00
T4	13.50	17.62

Sustainable Yield Index (SYI) was therefore, used as an approach to evaluate the minimum yield likely to be achieved in relation to changes in SOC and available N, P and K status of soil. The SYI was the lowest (64.37) where no manure and bio-fertilizers was added in the soil under FP [T1] whereas it was increasing in order in other treatment and

highest in T4 where bio-fertilizers were added with recommended dose of fertilizers along with sulphur. These results are in conformity with the earlier study of Wanjari *et al*. 2004. The economy of crop cultivation is major point of adoption the technology which is reflected through Net return received by the farmers. An another point of decision factor

for spreading or adoption of a particular technology is their B:C ratio. In the present study table 4 revealed that highest Net return (Rs/ha: 26697) coupled with highest B:C ratio

(2.64) was achieved in T4 treatment [RDF+S+Bo] while it was lowest Net return (13059 Rs/ha) and B:C ratio (1.92) was found in Farmers Practice [T1].

Table 4: Effect of different nutrients on yield and its economy on soybean crop

SN	Treatment	Yield (Q./ha)	Yield Potential (Max) (Q./ha)	Mean yield (Q./ha)	SYI (Kg grain/cm)	Cost Of Cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C ratio
1	T1(FP)	9.42	24.92	17.17	64.37	14259	27318	13059	1.92
2	T2 (RDF;20:60:40; N:P:K)	12.92	24.92	18.92	71.39	14522	37468	22946	2.58
3	T3(RDF+BNF)	14.37	24.92	19.65	74.30	19550	41673	22123	2.13
4	T4(RDF+S+Bo)	14.83	24.92	19.88	75.22	16310	43007	26697	2.64

CONCLUSIONS

Soybean productivity enhancement is dependent fully on the use of balanced nutrition through N,P,K and the most essential being deficient nutrients namely Sulphur and Boron coupled with the integration of bio-fertilizers(Rhizobium and PSB) and organic matter. The use of balanced N,P,K [20:60:80:40] along with other nutrients like sulphur, boron and bio-fertilizers, yield and yield contributing parameters responded positively. The difference in yield between T1 and the succeeding treatments ranged from 350 kg ha⁻¹ to 540.9 kg ha⁻¹. It can be further concluded that Integrated Nutrient Management practices had a better impact on the WUE, SYI, pods per plant, plant height, 100 seeds weight and together they contributed to higher partial factor productivity with sustainability through high Net return coupled with high B:C ratio.

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