

Impact of Different Nutrient Management Practices on Physico-Chemical Properties of Soil and Economics of Soybean under Kymore Plateau and Satpura Hills Agro-Climatic Zone

ABSTRACT

The field trial was conducted at Krishi Nagar Farm, Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India, during the *kharif* season of 2021. The field experiment consisted with six treatments and they were tested in randomized block design (RBD) with four replications. The study revealed that from the results, soil pH slightly reduced in 100 % Organic NM, 50 % Organic NM +NF inputs B₁G, 50% Organic+50% Inorganic NM and 25% Organic + NF inputs B₁G +25% Inorganic NM and increased in T₅ and T₆ as compared to initial status of soil. While in case of EC and OC of soil under different treatments did not found any remarkable changes but in case of available N, P and K of soil showed significant difference under different treatments with increased values from initial soil status. Whereas, maximum cost of cultivation (Rs.31624), gross monetary return (Rs 58605/ha), net monetary return (Rs. 26982/ha) and B:C ratio (1.85) was recorded under the treatment 100% Organic NM which was followed by 50 % Organic NM + NF inputs respectively.

Keywords: Soybean; natural farming; Beejamrit; Jeevamrit; Ghanjeevamrit; organic; inorganic; nutrient management; pH; organic Carbon; soil fertility.

1. INTRODUCTION

Soybean (*Glycine max* L Merill) is the world's most important seed legume; it is a native of North-eastern China belongs to family *Fabaceae*. Soybean is extensively grown in all over India especially in Madhya Pradesh because of its wide adaptability to agro-climatic conditions and better market value. It has great nutritive value and very high protein content (42-43%) and oil (18-20%) with major essential fatty acids and vitamins (A and D). It also having high carbohydrate (30%) and fiber (4%) content. Therefore, it also known as golden bean, wonder crop and man-made meat [1]. According to USDA, world soybean production in 2021-22 is estimated 372.5 million tons from total area of 120.50

million hectare. Area under soybean in India is 11.34 million hectare and productions are estimated 11.99 million tons [2] in 2021-22. Madhya Pradesh stood first with 5.51 million hectares area and production of 5.56 million tons in 2021-22. Application of organic manure in conjunction with inorganic fertilizers in an integrated manner, proved to be the best alternative. Integrating chemical fertilizer with organic manures has been proven to be highly promising in terms of not only preserving higher output but also increasing crop production stability. When used with lower dosages of inorganic fertilizers, farmyard manure or vermicompost enhanced soil fertility, crop growth, and yield. Chemical fertilizers, on the other hand, have a negative impact on

soil fertility leading to unsustainable yields, while integration of chemical fertilizers with organic manures and bio-fertilizers would be able to maintain soil fertility and sustain crop productivity. Nutrient supply plays an important role in the crop production but under intensive cultivation, use of chemical fertilizers alone for a longer period would result in deterioration of soil fertility and quality of produce [3]. The microorganisms which are present in the soil are responsible for increasing the fertility of the soil and the productivity of the crops. In order to increase the microbial activity in the soil Jeevamrit is used. Jeevamrit can be applied in two forms i.e., solid and liquid. Solid form is generally called as “Ghanjeevamrit” [4]. The quality of the soil has been damaged and the microorganisms in the soil have been impacted by the ongoing use of synthetic fertilizers in the soil and crop. Chemical fertilizers cost more than natural fertilizers, they may include substances that are harmful to the skin or respiratory system, which can lead to sickness in both humans and plants, contaminate the environment, and they are more expensive. The INM is made up of components, which possess great diversity in terms of chemical and physical properties, nutrient release efficiencies, positional availability, and crop specificity and farmers acceptability. Only organic manures cannot meet the total nutrient needs of modern agriculture, integrated use of nutrients from fertilizers and an organic resource seems to be a need of the time. The complementary use of chemical fertilizers and organic manures may increase the efficiency of chemical fertilizers in order to maintain a high level of

crop productivity [5]. Integrated nutrient management (INM) is an integral part of the sustainable agriculture which requires the management of resources in a way to fulfill the changing human needs without deteriorating the quality of environment and conserving vital natural resources. It comprises of application of organic manures, green manures, blue-green algae, bio-fertilizers and crop rotation with legumes along with minimum use of chemical fertilizers to produce optimum crop yield without deteriorating the soil health.

2. MATERIAL AND METHODS

A field experiment entitled “Studies on the effect of varying nutrient management practices on growth and yield of soybean (*Glycine max* L Merill)” was conducted during *kharif* 2021. The field trial was conducted at Krishi Nagar Farm, Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India, during the *kharif* season of 2021. The district Jabalpur is located in Madhya Pradesh, India, and is located between 23°18' N latitude and 79°98' E longitude, with an average altitude of approximately 411.78 meters (1387.73 ft) above mean sea level with a total area of 5198 km². According to the National Agricultural Research Program's criteria, Jabalpur is located in the "Kymore Plateau and Satpura Hills" agro-climatic zone. According to a new concept established by National Bureau of Soil Survey and Land Use Planning, Nagpur, this area is part of agro-ecological sub region No. 10.1, which is a sub-humid (dry) eco-region (Malwa

plateau, Vindhyan Scarp Land and Narmada Valley). Temperatures range from a low of 5°C in December and January to a high of 46°C in May and June. In terms of maximum weekly temperature ranges from 26.8°C to 37.7°C and minimum weekly temperature ranges from 21.6°C to 26.7°C, maximum and minimum relative humidity during morning ranges from 74.0 to 94.6% and evening 31.7 to 85.1%, the crop was exposed to a total of 63.2 hours of sunlight throughout the crop growing season, with sunshine hours ranging from 0.2 to 8.2 hours and total seasonal rainfall of 652.4 mm with 45 wet days. As a result, it encouraged crop establishment, followed by crop growth, development, and yield. These conditions were also quite congenial at this stage. Entire weather conditions were almost favorable for proper growth, development

and yield of crops. The current study, as previously stated, was a long-term investigation. As a result, data on the initial status of numerous soil physico-chemical properties were evaluated. Soil samples were collected from each plot at a depth of 0-15 cm before sowing. Soil analysis findings from various plots were recorded. The data on the original status of the soil and the values of its chemical properties are presented below: The Physico-chemical properties of experimental field were shown in Table 1. The soil in the experimental field had a Sandy Clay Loam texture, neutral in reaction (pH 7.20) with a medium OC content (0.59 percent), and EC (0.30 dS/m), and analyzed low in available nitrogen (216.50 kg/ha N), medium in available phosphorus (12.42 kg/ha P), and medium in available potassium (240.51 kg/ha K).

Table 1: Physico-chemical properties of experimental location

Texture	Sandy clay loam (Sand:54.5%, Silt:23.51%, and Clay:21.99%)
Soil reaction	7.20
Electrical conductivity (dS/m)	0.30
Soil organic carbon (%)	0.59
Available Nitrogen kg ha ⁻¹	216.50
Available Phosphorus kg ha ⁻¹	12.42
Available potassium kg ha ⁻¹	240.51

2.1 Experimental techniques

The field experiment consisted with six treatments and they were tested in

randomized block design with four replications. The details of the treatments are given below:

Table 2: Treatments Details of Experiments

S. No	Treatments
T ₁	100% Organic nutrient management
T ₂	50% Organic NM +NF inputs Beejamrit+ Jeevamrit+Ghanjeevamrit
T ₃	50% Organic NM + 50% Inorganic NM
T ₄	25% Organic +NF inputs Beejamrit+Jeevamrit+Ghanjeevamrit 25% Inorganic NM
T ₅	Farmer practices
T ₆	100% Inorganic nutrient management

2.2 Statistical analysis of treatment

Data recorded on various observations were tabulated and subjected to their statistical analysis by using techniques of the analysis of variance [7]. The significance of the treatments was tested by using 'F' test and

when 'F' best shown the significance, of the difference between the treatments was further tested with critical difference (C. D.) at 5% level of significance.

Table 3: Skeleton for analysis of variance (ANOVA)

Source of variance	d.f.	SS	MSS	'F' Value		
				Calculated	Tabulated	
					5%	1%
Replication	(r-1) = 3	RSS	RMSr	RMSe		
		d.f.		EMSe		
Treatment	(t-1) = 5	TSS	TMS _t	TMS _t		
		d.f.		EMSe		
Error	(r-1) (t-1) = 15	ESS	EMSe			
		d.f.				
Total	(rt-1) = 23	Total SS				

The significant differences between different treatments were judged by using critical **Critical difference (CD) = t. x SE (d)**

differences (C.D.) which was calculated as follows:

$$SE(d) = \frac{\sqrt{2EMS}}{\sqrt{EMSS}}$$

$$SEm \pm = \frac{\sqrt{2EMS}}{\text{Mean}}$$

$$C.V. = \frac{\sqrt{2EMS}}{\text{Mean}}$$

3. RESULTS AND DISCUSSION

3.1 Impact of different nutrient management practices on physico-chemical properties of soil:

Data pertaining to various soil chemical properties viz., pH, EC, OC and available N, P and K contents were determined before sowing and after harvest of crop under different treatments presented in Table 4 and depicted in Fig 1 & 2 respectively. It is clear from the results that soil pH slightly reduced in T₁, T₂, T₃ and T₄ and increased in T₅ and T₆ as compared to initial status of soil. While in case of EC and OC of soil under different treatments did not found any remarkable changes but in case of available

N, P and K of soil showed significant difference under different treatments with increased values from initial soil status indicated that the maximum pH was observed under 100% Inorganic NM (7.18) followed by Farmer practices (7.17), whereas lowest pH was recorded under the treatment of 100 % Organic NM (7.11). The available N, P and K was influenced statistically significantly by different treatments and maximum nitrogen was registered under treatment of 100% organic nutrient management (244 kg ha⁻¹), phosphorus (12.70 kg ha⁻¹) and potassium (270 kg ha⁻¹) followed by 50 % Organic NM +NF inputs BJK. Whereas lowest value of N, P and K was recorded under the

treatments of Farmer Practice 227.75, 12.47 and 247 kg ha⁻¹, respectively. However, in case of EC and OC was not affected significantly by various treatments. It may be due to the significant increase in available N content of soil was due to increased mineralization of organic N by active microorganisms and the regular dynamics of

biomass carbon. The higher soluble P in the organic systems is mainly attributed to the release of inorganic P from added organics, inhibition of P adsorption by organic molecules released from the organics. These results are in agreement with the findings [8, 9, 10 & 11].

Table 4: Impact of different nutrient management practices on physico-chemical properties of soil

Treatment No.	pH	EC (dS/m)	OC (%)	Available nutrients (kg/ha)		
				N	P	K
T ₁ 100 % Organic NM	7.11	0.32	0.63	244.00	12.70	267.00
T ₂ 50 % Organic NM +NF inputs BJJ	7.12	0.31	0.62	238.75	12.53	260.50
T ₃ 50% Organic+50% Inorganic NM	7.12	0.29	0.61	238.50	12.50	256.75
T ₄ 25% Organic + NF inputs BJJ +25% Inorganic NM	7.14	0.30	0.62	230.00	12.67	252.00
T ₅ Farmer Practice	7.17	0.29	0.61	227.75	12.47	247.00
T ₆ 100 % Inorganic NM	7.18	0.30	0.60	234.25	12.62	263.50
Initial status of soil	7.20	0.28	0.59	216.50	12.41	240.50
SEm ±	0.01	0.01	0.01	1.57	0.02	1.88
CD (5%)	0.02	NS	NS	4.44	0.07	5.67

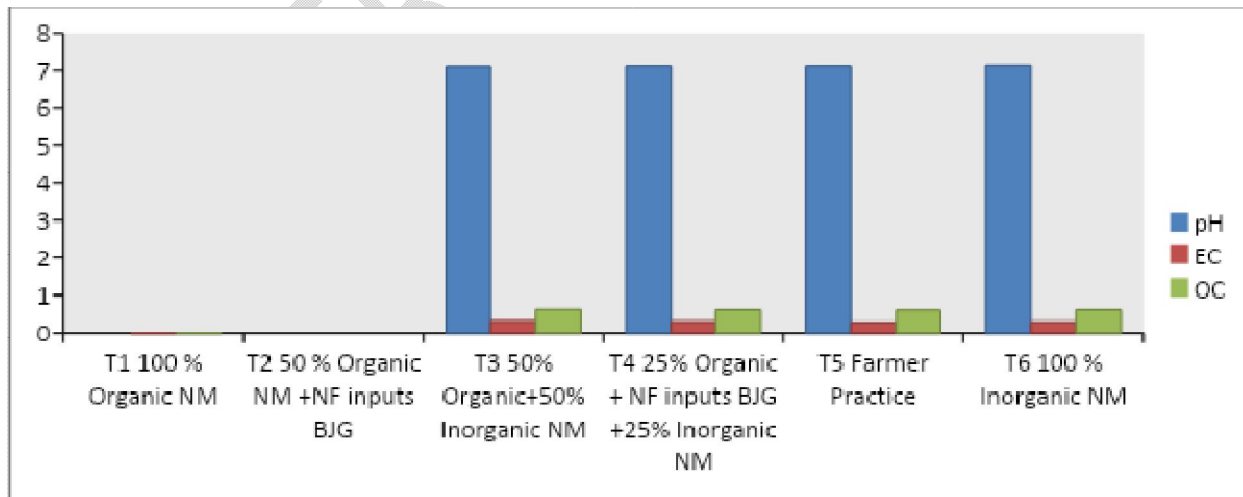


Fig. 1: Impact of different nutrient management practices on pH, EC and OC of soil

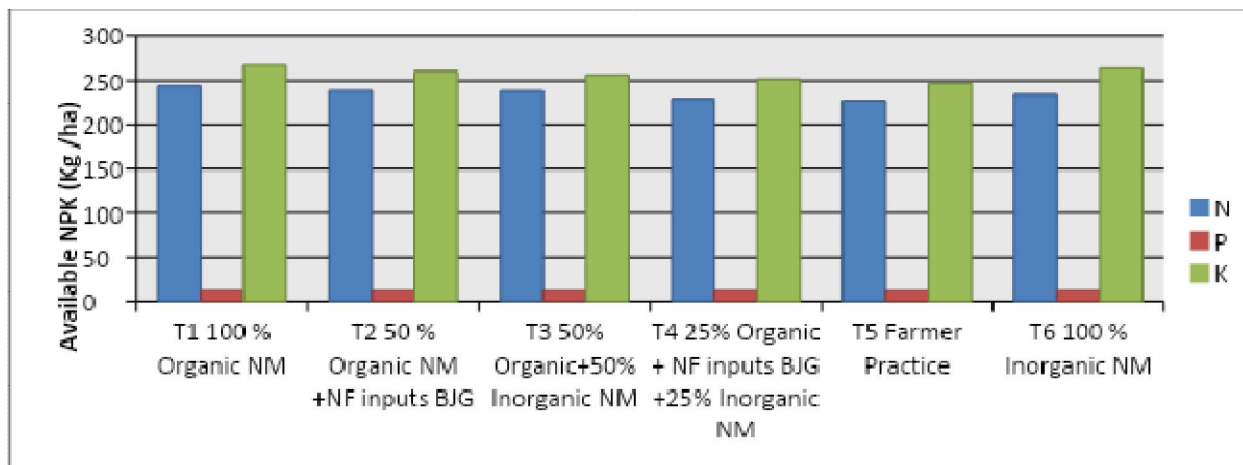


Fig. 2: Impact of different nutrient management practices on Available N, P and K of soil (kg/ha)

3.2 Impact of different nutrient management practices on economics:

Economic analysis of treatments was determined on per hectare area basis, which includes cost of cultivation, gross monetary return, net monetary return and benefit-cost ratio as affected by various treatments are given in Table 5.

3.2.1 Cost of cultivation (Rs/ha)

Data on cost of cultivation showed variations among the different treatments

represent in Table 5 and depicted in Fig 3. On an average the highest cost of cultivation was found under the treatment of 100% organic nutrient management (Rs. 31624/ha) followed by T₂ (50% organic+ NF inputs (beejamrit +jeevamrit+ ghanjeevamrit) + 50% inorganic NM (Rs.31128/ha) and lowest cost of cultivation was recorded under the treatment of T₅ farmer practice (Rs.20800/ha). These findings are in close conformity with the results of [12, & 13].

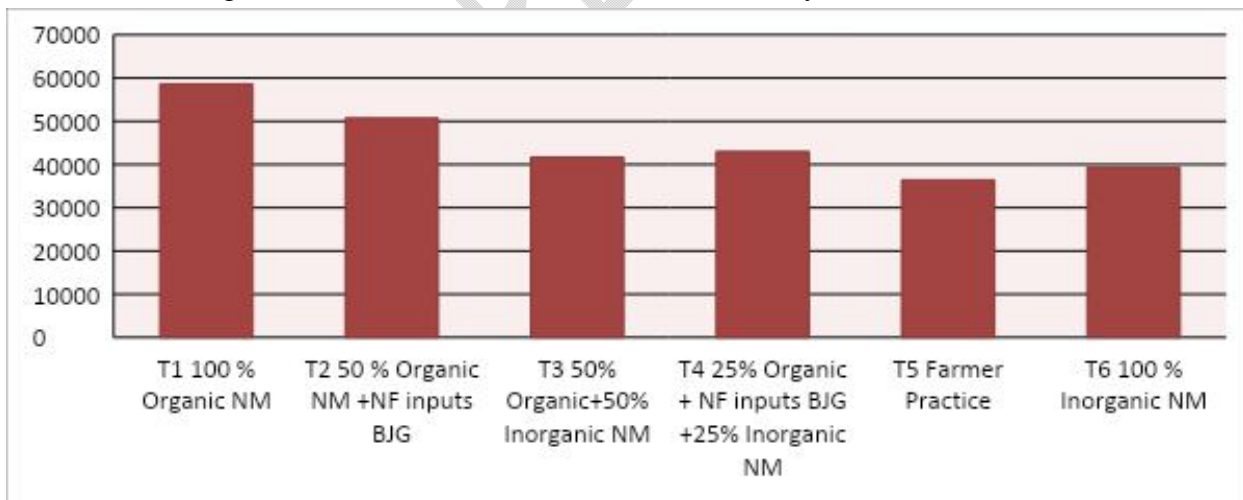


Fig. 3: Impact of different nutrient management practices on cost of cultivation of soybean under different treatments

3.2.2 Gross monetary returns (Rs/ha)

Data on gross monetary returns showed variations among the different treatments represent in Table 5 and depicted in Fig 4.

On an average highest gross monetary returns was obtained from T₁ (100% organic nutrient management) (Rs.58606/ha) followed by T₂ (50% organic+ NF inputs

(beejamrit+jeevamrit+ ghanjeevamrit) + 50% inorganic NM) (Rs.50712/ha) however, lowest gross monetary returns obtained from

(T₅ farmer practice)(Rs.36419/ha) These findings are in close conformity with the results of [14, 15 & 16].

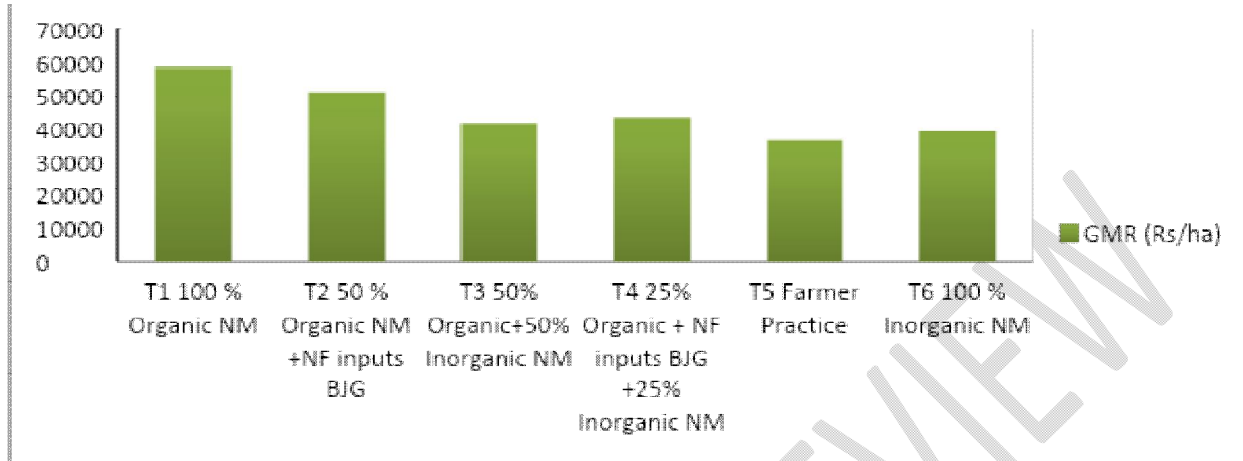


Fig. 4: Impact of different nutrient management practices on gross monetary returns of soybean under different treatments

3.2.3 Net monetary returns (Rs/ha)

Data on net monetary returns showed variations among the different treatments represent in Table 5 and depicted in Fig 5. The highest net monetary returns were found in T₁ (100% organic nutrient management) (Rs. 26982/ha) followed by T₂ (50%

organic+ NF inputs (beejamrit +jeevamrit + ghanjeevamrit) + 50% inorganic NM) (Rs.19584/ha) however, lowest net monetary returns were found in T₅ (farmer practice) (Rs.15619/ha). These results are with close agreement [17, 18 &19].

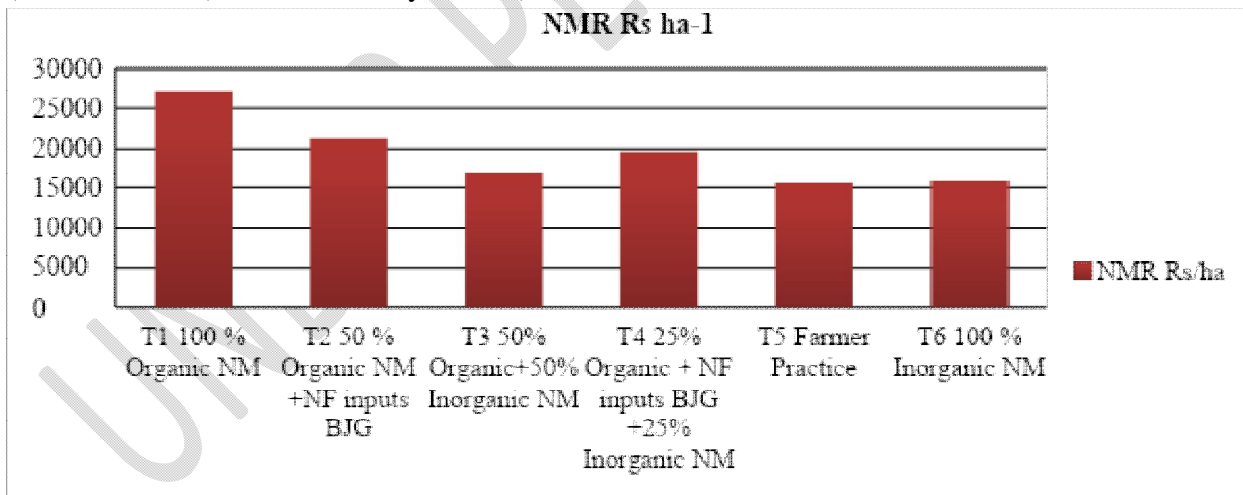


Fig. 5: Impact of different nutrient management practices on net monetary returns of soybean under different treatments

3.2.4 Benefit-cost ratio

Data on B: C ratio showed variation among the different treatments represent in Table 5 and depicted in Fig 6. The highest average

benefit cost ratio was found in T₁ (100% organic nutrient management) (1.85) followed by T₅ (Farmer practice) (1.75) and lowest benefit cost ratio was recorded in T₂

(50 % Organic NM +NF inputs BJJ) (1.62).

[20,

21

&

22].

These results are in with close agreement

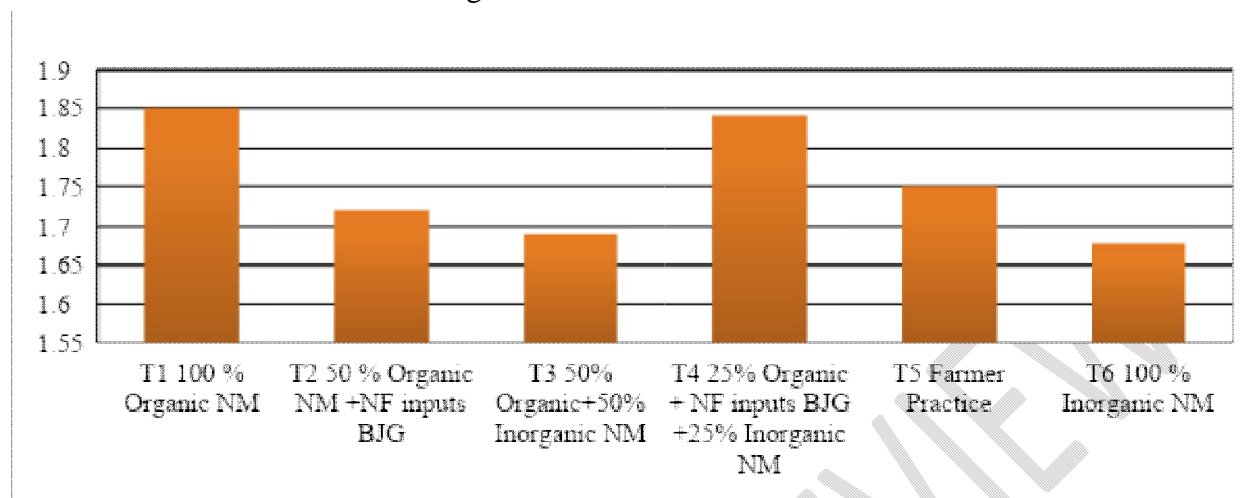


Fig. 6: Impact of different nutrient management practices on B: C Ratio of soybean under different treatments

Table 5: Economic analysis of soybean under different treatments

Treatment No.	Cost of Cultivation (Rs/ha)	GMR (Rs/ha)	NMR (Rs/ha)	B:C Ratio
T ₁ 100 % Organic NM	31624	58606	26982	1.85
T ₂ 50 % Organic NM +NF inputs BJJ	31128	50712	19584	1.62
T ₃ 50% Organic+50% Inorganic NM	24704	41686	16982	1.68
T ₄ 25% Organic + NF inputs BJJ +25% Inorganic NM	24840	42962	18122	1.72
T ₅ Farmer Practice	20800	36419	15619	1.75
T ₆ 100 % Inorganic NM	23484	39349	15865	1.67

4. CONCLUSION

Based on foregoing results and discussion it can be concluded that among different nutrient management practices treatments (100% organic nutrient management) have shown positively impact on soil health with the post-harvest values of available N (244 kg/ha), P (12.70 kg/ha), K (267 kg/ha), pH (7.11), EC (0.32ds/m) and organic carbon

(0.63%) where the initial values were available N (216.50 kg/ha), P (12.41 kg/ha), K (240.50 kg/ha), pH (7.20), EC (0.28 dS/m) and organic carbon (0.59 %). Whereas the higher Gross monetary returns (Rs.58606/ha), Net monetary returns (Rs.26982/ha) and in terms of per rupees investment (1.85) were obtained under the

treatment (100% organic nutrient management).

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