The Pharma Innovation Journal 2021; 10(10): 2502-2507

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 2502-2507

www.thepharmajournal.com
Received: 10-07-2021
Accepted: 24-09-2021

Vivek Kumar
Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Sushil Dimree
Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

US Tiwari
Department of Soil Science and Agricultural Chemistry, C. S. Azad University of agriculture and technology, Kanpur, Uttar Pradesh, India

RK Pathak
Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

SD Dubey
Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
Vivek Kumar
Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Effect of different levels of sulphur and zinc on economics of hybrid rice (*Oryza sativa* L.) in central Uttar Pradesh

Vivek Kumar, Sushil Dimree, US Tiwari, RK Pathak and SD Dubey

Abstract
A field experiment was conducted at student's instructional farm Chandra Shekhar Azad University of Agriculture & Technology, Kanpur during *Kharif* season of 2019 and 2020. The experiment was carried out in Factorial Randomized Block Design (RBD) having three replications and sixteen treatments T_1 (control), T_2 (Zn_0+S_{15}), T_3 (Zn_0+S_{30}), T_4 (Zn_0+S_{45}), T_5 ($Zn_{2.5}$+S_0), T_6 ($Zn_{2.5}$+S_{15}), T_7 ($Zn_{2.5}$+S_{30}), T_8 ($Zn_{2.5}$+S_{45}), T_9 (Zn_5+S_0), T_{10} (Zn_5+S_{15}), T_{11} (Zn_5+S_{30}), T_{12} (Zn_5+S_{45}), T_{13} ($Zn_{7.5}$+S_0), T_{14} ($Zn_{7.5}$+S_{15}), T_{15} ($Zn_{7.5}$+S_{30}) and T_{16} ($Zn_{7.5}$+S_{45}) for hybrid rice. The test variety PHB-71 of hybrid rice was raised with different treatment combinations of sulfur and zinc. The highest cost of cultivation (55316 rupees ha^{-1}) was recorded with application of S@45 kg ha^{-1} and Zn @7.5 kg ha^{-1} while it was noted minimum (47536 rupees ha$^{-1)}$ under control (T_1) during both the years. Maximum gross return (141329 and 150509 rupees ha^{-1}) was recorded with the application of application of 100% RDF + S@30kg and Zn@5 kg ha^{-1} followed by 100% RDF + S@30 kg ha^{-1} and Zn@7.5 kg ha^{-1} during both years. The net realization (87075 and 96255 rupees ha^{-1}) and BCR (2.60 and 2.69) was found maximum with the application of 100% RDF + S@30kg and Zn@5 kg ha^{-1} during both the years of experimentation.

Keywords: Experiment**,** factorial randomized block design, replication, treatment, gross return, net return and b:c ratio

1. Introduction
Rice (*Oryza sativa* L.) is one of the most important staple foods for nearly half of the world's population, most of them living in developing countries. Rice occupies about 11% of world's agricultural land and ranks second in terms of cultivated area (Tumrani *et al*. 2015) [9]. Rice is the second most widely consumed cereal in the world next to wheat. India ranks first in respect of area 437.80 lakh ha. and second in production 118.40 million tonne ha^{-1}. It is higher by 8.67 million tonnes than the five years' average production of 109.76 million tonnes and obtained 2705 kg yield per hectare during 2019-2020. (Ministry of Agriculture & Farmers Welfare 2020-21) [1]. Rice is grown in tropical and sub-tropical areas and occupies an area of 40 million ha^{-1} to 43 million ha^{-1} in the country, only 42 per cent of which is grown under irrigated condition. Rice provide food for more than 70% of the population and source of livelihood for 120-155 million rural house holders and also a back bone of Indian Agriculture. India alone produce nearly one fourth of the rice globally. Rice is one of the chief grains and dominant crop of the country. Moreover, this country has the largest area under rice cultivation, as it is one of the principal food crops. Rice is a high energy or high calorie cereal crop. Rice protein, though small in amount, is of high nutritional value. Chaudhary and Tran, (2001) [3]. Sulphur involve in chlorophyll production, protein synthesis and plant function and structure. It forms an important constituent of straw and plant stalks. Sulphur application increased the microbial biomass carbon and arylsulphatase activity. It is a building block for protein and a key ingredient in the formation of chlorophyll Duke and Reisenaue, (1986) [5]. Zinc is essential for the transformation of carbohydrates and regulates consumption of sugars. The function of zinc in plants is as a metal activator of enzymes. Deficiency of zinc in lowland rice occurs in near neutral to alkaline soils, particularly in calcareous soils. Zinc deficiencies are widely spread throughout the world, especially in the rice lands of Asia and deficiencies occur in neutral and calcareous soils Tisdale *et al*., (1997) [8].
Waikhom Jiten Singh *et al*. (2018) [10] Reported that treatments consisted of four levels of suphur (0, 15, 20 and 25 kg/ha) and four levels of zinc (0, 5, 10 and 15 kg Zn/ha) laid out in factorial randomise block design and which were replicated thrice.
Regarding the net return highest value was observed at S_{20} Zn_{15} (Rs 29278.38), however highest B: C ratio was recorded with the treatment combination of S_{20} and Zn_5 (0.63).

2. Materials and Methods

2.1 Experimental Site and Location

The experiment was conducted at Students' Instructional Farm, Department of Agronomy Chandra Shekhar Azad University of Agriculture & Technology, Kanpur and it was in the alluvial tract of Indo - Gangetic plains in central part of Uttar Pradesh between 25 ^{0}26' to 26 ^{0}58' North latitude and 79 ^{0}31' to 80 ^{0}34' East longitude at an elevation of 125.9 m above mean sea level. The region falls under agro-climatic zone V (Central Plain Zone) of Uttar Pradesh.

Treatment combination and symbols

Sr. No.	Treatment Symbol	Treatment combination
1.	T_1	Control ($Zn_0 + S_0$)
2.	T_2	$Zn_0 + S_{15}$
3.	T_3	$Zn_0 + S_{30}$
4.	T_4	$Zn_0 + S_{45}$
5.	T_5	$Zn_{2.5} + S_0$
6.	T_6	$Zn_{2.5} + S_{15}$
7.	T_7	$Zn_{2.5} + S_{30}$
8.	T_8	$Zn_{2.5} + S_{45}$
9.	T_9	$Zn_5 + S_0$
10.	T^{10}	$Zn_5 + S_{15}$
11	T_{11}	$Zn_5 + S_{30}$
12	T_{12}	$Zn_5 + S_{45}$
13	T_{13}	$Zn_{7.5} + S_0$
14.	T_{14}	$Zn_{7.5} + S_{15}$
15.	T_{15}	$Zn_{7.5} + S_{30}$
16.	T_{16}	$Zn_{7.5} + S_{45}$

Note: RDF of NPK was given @ 150: 75: 60 kg ha^{-1} in all the plots except control whereas Sulphur and Zinc was applied in all the plots of hybrid rice as per treatment @ 0, 15, 30, 45 kg ha^{-1} and 0, 2.5, 5.0, 7.5 kg ha^{-1}, respectively

2.2 Field preparation

The experimental field was ploughed once with soil turning plough. In first week of June, irrigation was applied and at proper soil moisture, field was ploughed with tractor drawn disc harrow followed by planking. Layout was made by marking of plots.

2.3 Transplanting

The nursery was given a light irrigation before uprooting the seedlings at 25 days of sowing. Transplanting was done by manual labours using two seedlings per at the spacing of 20 10 cm on 15 July 2019 and 17 July 2020.

2.4 Application of Fertilizer

The Urea, di-ammonium phosphate, muriate of potash, elemental sulfur and zinc oxide were used as source of N, P, K, S and Zn. In paddy, half dose of N, full doses of P_2O_5, K_2O, S and Zn were applied as basal and remaining amount of nitrogen was top dressed in equal two splits. RDF of N:P:K (@ 150:75:60) will be applied in all the treatments except control by Urea, DAP and MOP, respectively while different doses of Sulphur (0, 15,30 45 kg/ha) and Zinc (0, 2.5, 5.0, 7.5 kg/ha) given by elemental sulphur and zinc oxide as per treatment composition.

2.5 Cultural operations

In order to protect, the crop from adverse effects of weeds and to pulverize the soil, the weeding operations were performed by manual labors with the help of *khurpi* during both the years of experimentation in the crops.

2.6 Economic studies

2.6.1 Cost of cultivation

Cost of cultivation for different treatments was worked out by adding variable cost of various treatments to common cost of cultivation.

2.6.2 Gross return

Gross return was worked out by multiplying grain and by-product yield separately under various treatment combinations with their existing minimum support price declared by the central government/prevailing market prices. The money values of both, grain and straw were added together in order to achieve gross return.

Gross return = Total income from grain and straw yields.

2.6.3 Net return

Net return was calculated by subtracting the cost of cultivation from the gross return of the individual treatment combination. Net return was worked out for hybrid rice by subtracting treatment wise total cost of cultivation from their gross monetary return.

Net return = Gross return - Cost of cultivation

2.6.4 Benefit-Cost ratio

Benefit-cost ratio was calculated as gross return (GR) accrued divided by total cost of cultivation (TC) of the individual treatment combination.

Benefit: Cost = Gross return ÷ Total cost of cultivation

3. Results

3.1 Effect of treatments on cost of cultivation

Data presented in table no. 1 showed that highest cost of cultivation (55316) was recorded with application of S@45 kg ha^{-1} and Zn @7.5 kg ha^{-1} while it was noted minimum (47536) under control S_0Zn_0 during both the years.

Table 1: Effect of treatments on Cost of cultivation of hybrid rice during 2019 and 2020

Factors	2019 and 2020			
	S_0	S_{15}	S_{30}	S_{45}
Zn_0	47536	52745	53357	53970
$Zn_{2.5}$	52582	53195	53807	54419
$Zn_{5.0}$	53030	53643	54255	54867
$Zn_{7.5}$	53480	54092	54704	55316

3.2 Effect of treatments on Gross return

The data pertaining to effect of levels of sulphur and zinc on gross return has been summarized in table 2.0 and fig no 1.0

Effect of Sulphur

It was obvious from the table that the applied sulphur had considerable influence on gross return during both the years. The maximum and highly significant gross realization (136559 and 145647 rupees ha^{-1}) was computed with the treatment receiving 30 kg sulphur ha^{-1} followed by treatment where sulphur was given @ 45 kg ha^{-1} during first and second year respectively. Whereas, the minimum gross realization was obtained with the treatment of no sulphur application.

Effect of zinc

A cursory glance of the data showed that the application of zinc significantly increased the gross realization of the produce after harvest. The maximum gross realization (136827 and 146048 rupees ha^{-1}) was computed with the application of zinc @ 5.0 kg ha^{-1} which was close similar to the treatment of zinc @ 7.5 kg ha^{-1} during first and second years, respectively. Whilst, the lowest one was registered in treatment of no zinc application.

Effect of Sulphur and zinc

It was obvious from the data presented in table and fig that the interactive effect of applied sulphur and zinc had profound influence on gross realization of produce. The maximum gross realization (141329 and150509 rupees ha^{-1}) was obtained with the treatment receiving sulphur and zinc @ 30 and 5.0 kg ha^{-1} during first and second years of experimentation.

Table 2: Effect of treatments on Gross return during 2019 and 2020

Factors	2019					2020				
	S_0	S_{15}	S_{30}	S_{45}	Mean	S_0	S_{15}	S_{30}	S_{45}	Mean
Zn_0	101281	126319	131234	128977	121953	101675	134752	140060	137386	128468
$Zn_{2.5}$	126150	130000	134654	131044	130462	134743	138720	143939	140127	139382
$Zn_{5.0}$	131875	135600	141329	138505	136827	141174	144711	150509	147799	146048
$Zn_{7.5}$	128977	134381	139019	135740	134529	137293	143058	148079	145376	143452
Mean	122071	131575	136559	133567	130943	128721	140310	145647	142672	139338

	2019		2020	
Factors	S.E.(m)	C.D. (at 5%)	S.E.(m)	C.D. (at 5%)
S	217.139	627.318	179.505	518.591
Zn	217.139	627.318	179.505	518.591
S x Zn	434.279	1254.637	359.009	1037.182

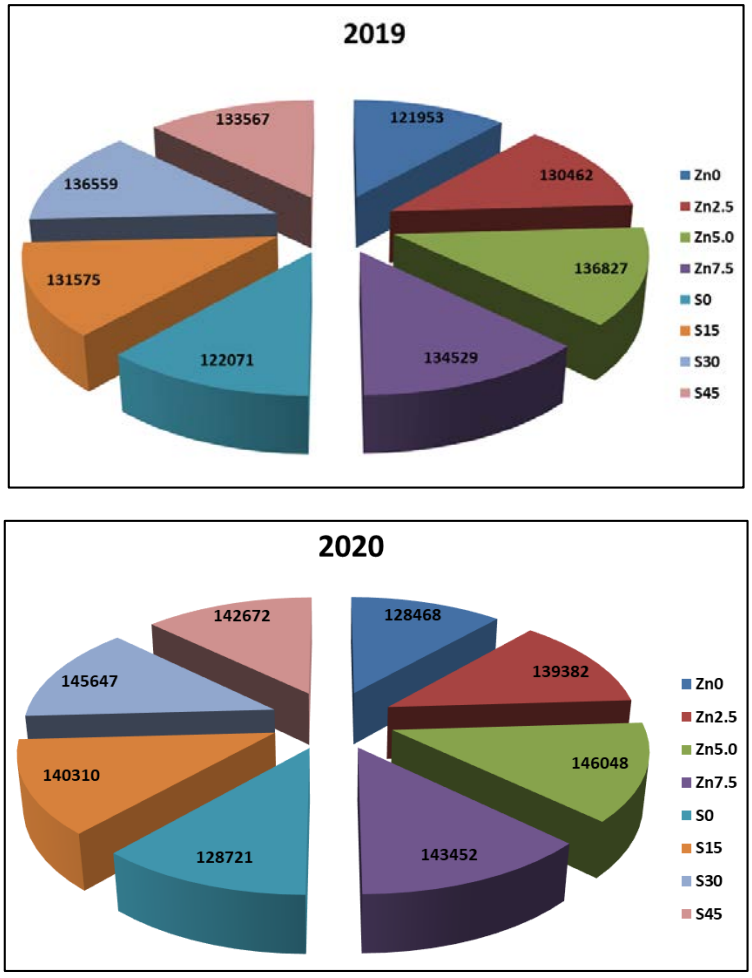

Fig 1: Effect of treatments on Gross return

3.3 Effect of treatments on net return

The data in relation to effect of levels of sulphur and zinc on net return has been given in table no. 3 and fig no 2.

Effect of Sulphur

It clearly indicated that the applied sulphur had profound influence on net return during both the years. The maximum and highly significant net realization (82529 and 91616 rupees ha^{-1}) was computed with the treatment receiving 30 kg sulphur ha corresponding to the treatment where sulphur was given @ 45 kg ha^{-1} and significantly superior to control during first and second year respectively. Whereas, the

minimum net realization (70414 and 77064 rupees ha^{-1}) was obtained with the treatment of no sulphur application.

Effect of zinc

An appraisal of the data showed that the application of zinc significantly increased the net realization of the produce after harvest. The maximum gross realization (82879 and 92100 rupees ha^{-1}) was computed with the application of zinc @ 5.0 kg ha which was close similar to the treatment of zinc @ 7.5 kg ha^{-1} and significantly superior to control during first and second years, respectively. Whilst, the lowest was registered in treatment of no zinc application.

Effect of Sulphur and zinc

It was obvious from the data that the interactive effect of applied sulphur and zinc brought profound influence on net realization of produce. The maximum net realization (87075 and 96255 rupees ha^{-1}) was obtained with the treatment receiving sulphur and zinc @ 30 and 5.0 kg ha^{-1} during first and second years of experimentation.

Table 3: Effect of treatments on net return during 2019 and 2020

Factors	2019					2020				
	S_0	S_{15}	S_{30}	S_{45}	Mean	S_0	S_{15}	S_{30}	S_{45}	Mean
Zn_0	53745	73574	77877	75007	70051	54139	82007	86703	83417	76567
$Zn_{2.5}$	73568	76806	80848	76625	76962	82161	85525	90132	85708	85882
$Zn_{5.0}$	78845	81958	87075	83638	82879	88144	91068	96255	92932	92100
$Zn_{7.5}$	75497	80289	84315	80424	80131	83814	88966	93375	90060	89054
Mean	70414	78157	82529	78924	77506	77064	86891	91616	88029	85900

	2019		2020	
Factors	S.E.(m)	C.D. (at 5%)	S.E.(m)	C.D. (at 5%)
S	143.426	414.360	95.943	191.885
Zn	143.426	414.360	95.943	271.326
S x Zn	286.852	828.719	191.885	542.651

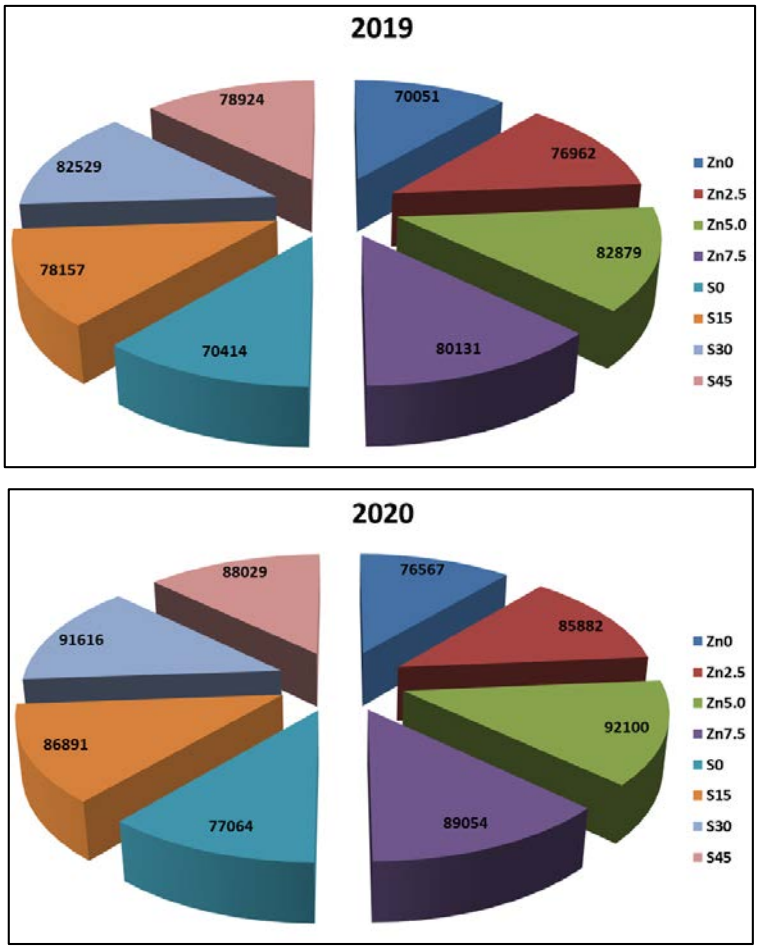

Fig 2: Effect of treatments on net return

3.4 Effect of treatments on BCR

The data pertaining to effect of levels of sulphur and zinc on BCR has been given in table no. 4 and fig no 3.

Effect of Sulphur

It was noticed that the applied levels of sulphur had profound influence on BCR during both the years. The maximum and highly significant BCR (2.53 and 2.70) was computed with the treatment receiving 30 kg sulphur ha^{-1} followed by the treatment wherein sulphur was given @ 45 kg ha^{-1} however, significantly superior to control during first and second year respectively. Whereas, the minimum BCR (2.36 and 2.48)

was computed with the treatment of no sulphur application.

Effect of zinc

A visualisation of the data showed that the application of zinc significantly increased the value respective to BCR of the produce. The maximum BCR (2.54 and 2.71) was computed with the application of zinc @ 5.0 kg ha^{-1} followed by the treatment of zinc @ 7.5 kg ha^{-1} and significantly superior to control during first and second years, respectively. Whilst, the lowest BCR was registered in treatment of no zinc application.

Effect of Sulphur and zinc

It was obvious from the data that the interactive effect of applied sulphur and zinc brought significant influence on BCR of produce. The maximum BCR (2.60 and 2.69) was obtained with the treatment receiving sulphur and zinc @ 30 and 5.0 kg ha^{-1} during first and second years of experimentation.

Table 4: Effect of treatments on BCR during 2019 and 2020

Factors	2019					2020				
	S_0	S_{15}	S_{30}	S_{45}	Mean	S_0	S_{15}	S_{30}	S_{45}	Mean
Zn_0	2.13	2.39	2.46	2.39	2.34	2.14	2.55	2.62	2.55	2.47
$Zn_{2.5}$	2.4	2.44	2.50	2.41	2.44	2.56	2.61	2.68	2.57	2.61
$Zn_{5.0}$	2.49	2.53	2.60	2.52	2.54	2.66	2.7	2.77	2.69	2.71
$Zn_{7.5}$	2.41	2.48	2.54	2.45	2.47	2.57	2.64	2.71	2.63	2.64
Mean	2.36	2.46	2.53	2.44	2.45	2.48	2.63	2.70	2.61	2.60

	2019		2020	
Factors	S.E.(m)	C.D. (at 5%)	S.E.(m)	C.D. (at 5%)
S	0.022	0.063	0.025	0.073
Zn	0.022	0.063	0.025	0.073
S x Zn	0.043	0.125	0.050	0.146

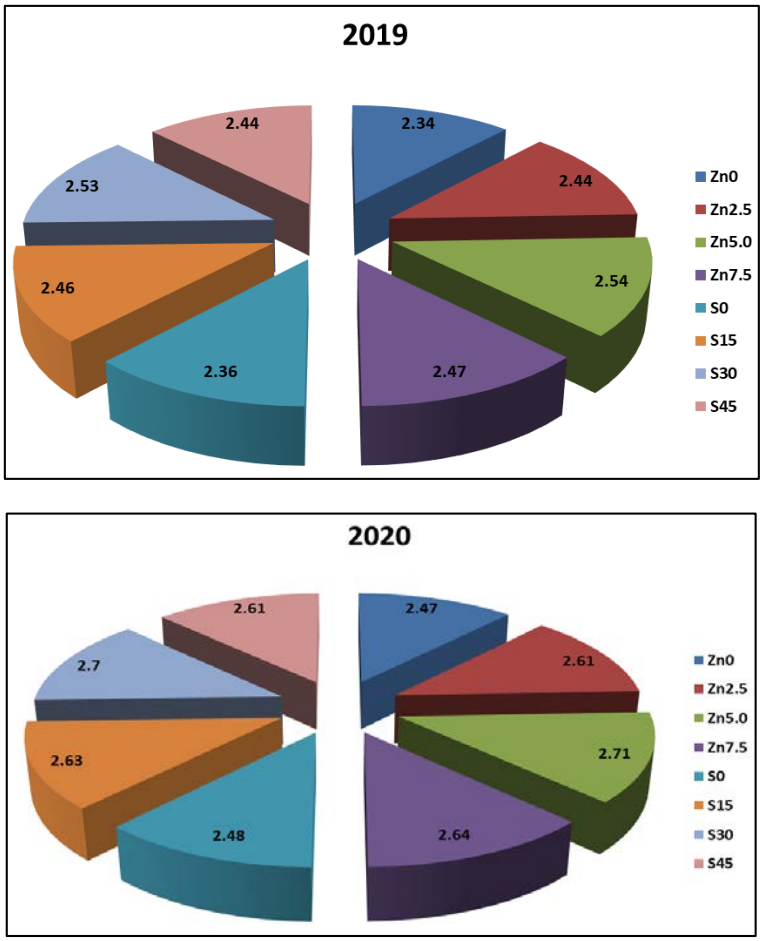

Fig 3: Effect of treatments on BCR

4. Discussion

It was obvious from the results that the applied sulfur had considerable influence on cost of cultivation, gross return, net return and BCR during both the years. The maximum and highly significant cost of cultivation, gross realization, net realization and BCR were computed with the treatment receiving 30 kg sulfur ha followed by treatment where sulfur was given @ 45 kg ha during first and second year respectively. Whereas, the minimum cost of cultivation, gross realization, net realization and BCR was obtained with the treatment of no sulfur application. Similar to sulfur application, the data showed that the application of zinc

significantly increased the cost of cultivation, gross realization, net realization and BCR of the produce after harvest. The maximum gross realization was computed with the application of zinc @ 5.0 kg ha which was followed by the treatment of zinc @ 7.5 kg ha and minimum at its control during first and second years, respectively. Bahera *et al.* (2018) [2] reported that the application of recommended fertilizer dose(RFD) @ 80-40-40 kg N-P2O5-K2O ha-^{1}+ZnSO4 @ 25 kg ha^{-1}+B @ 1 kg ha^{-1} recorded higher gross return, net return and B: C ratio than other management practices. It was also observed that likewise sulfur and zinc their interactions also showed positive impact on cost of cultivation, gross realization, net realization and BCR during both the years of experimentation. It is interesting to report here that the maximum cost of cultivation, gross realization, net realization and BCR were recorded with the treatment receiving sulfur and zinc @ 30 and 5.0 kg ha and minimum at its control. Waikhom Jiten Singh *et al*. (2018) [10] reported that highest B: C ratio was recorded with the treatment combination of S20 and Zn5 (0.63). This might be due to less cost incurred and obtained maximum gross return. These findings are in accordance with results obtained by (Mauriya *et al*. 2013; Das *et al.* 2010 and Rakesh Kumar *et al*. 2014) [6, 4, 7].

5. Conclusion

From above results, it may be inferred that the maximum gross return, net return and B;C ratio was found with the application of 100% RDF + soil application of S@30kg and Zn@5 kg ha^{-1} followed by 100% + soil application of S@30kg and Zn@7.5 kg ha^{-1} during the experimentation year of 2019 and 2020.

6. References

1. Anonymous. Ministry of Agriculture and Farmers Welfare, Government of India 2020-21.
2. Bahera MP, Saahoo J, Mishra GC, Mahapatra A. Sulfur Zinc and Boron nutrition on yield and economics in wet season rice (*Oryza sativa* L) under rainfed ecosystem of Odisha, India International Journal of Chemical Studies 2018;6(4):3296-3299
3. Chaudhary RC, Tran DV. editors. (eds.). Specialty rices of the world a prologue in Specialty Rice of the World: Breeding, Production, and Marketing (Rome; New Delhi: FAO; Oxford & IBH Publishing Co. Pvt. Ltd.) 2001, 3-14.
4. Das A, Tomar JMS, Ramesh T, Munda GC, Ghosh PK, Patel DP. Productivity and economics of lowland rice as influenced by N-fixing tree leaves under mid-altitude subtropical Meghalaya. Nutrient Cycling in Agroecosystem 2010;87:9-19.
5. Duke SH, Reisenaue HM. Roles and requirements of sulphur in plant nutrition. In: Tabatabai, M. A. (ed.), Sulphur in Agriculture. Agronomy American Society of Agronomy, Madison, Wisconsin, USA, 1986;27:124-168
6. Mauriya AK, Maurya VK, Tripathi HP, Verma RK, Radhey Shyam. Effect of site- specific nutrient management on productivity and economics of rice (*Oryza sativa*)-wheat (*Tritucum aestivum*) system. Indian Journal of Agronomy 2013;58(3):282-287.
7. Rakesh Kumar, Lal JK, Arvind Kumar, Agrawal BK, Karmakar S. Effect of Different Sources and Protein Content in Rice and Pea Grown in Sequence on an acid Alfisol. Journal of the Indian Society of Soil Science 2014;62(2):140-143.
8. Tisdale LS, Nelson LW, Beaton DJ, Havlin LJ. Soil Fertility and Fertilizers. Prentice Hall of India. 5th edn. 1997, 319-346.
9. Tumrani SA, Pathan PA, Suleman BM. Economic contribution of rice production and food security in Indonesia. Asia Pacific Res. J. 2015;33:63-74.
10. Waikhom Jiten Singh, Mahua Banerjee, Nabachandra Singh L. Effect of Sulphur and Zinc on Yield Attributes, Yield and Economics of Rice, International Journal of Current Microbiology and Applied Sciences 2018. ISSN: 2319-7706.