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Influence of Fungicide and Different *Rhizobium* Inoculants on Growth, Yield and Economics of Soybean (*Glycine max* (L.) Merrill)

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A B S T R A C T

An experiment was carried out at in *Kharif* season at student research field, College of Agriculture, Indore (M.P.) to study the Effect of fungicide and different *Rhizobium* inoculants on growth and yield of soybean (*Glycine max* (L.) Merrill). The soil of the experimental field was medium black in texture, neutral in reaction (pH 7.70) with normal EC (0.23 dS/m) and medium organic carbon contents (0.56 %) and analysing low in available N (225 kg/ha), medium in available P (9.60 kg/ha) and high in available K (508 kg/ha) contents. A field experiment was consisted of 15 treatments replicated four times in randomized block design (RBD). As per treatment, the seed of soybean cv. JS 335 treated or not treated with fungicides and inoculated with *Rhizobium* culture before 15, 10, 05, 01 days of planting and on the day of sowing. Among the treatments, seed treatment with Thiram + Carbendazim 50 WP – inoculation with Premax+ Rizo-liq (ODS)] (T_{10}) recorded the maximum plant height (66.75 cm) at harvest, branches per plant (4.02), fresh weight (35.83 g) per plant at 75 DAS, dry matter per plant (23.14g) at 75 DAS, leaf area index (12.87) at 60 DAS, number of pods (39.18) per plant, number of seeds (2.84) per pod while minimum was recorded in T_{15} absolute control (No fungicide, No culture). The maximum yield (2147 kg/ha) was recorded under [Thiram + Carbendazim 50 WP - Premax+ Rizo-liq (ODS)] (T_{10}) treatment and the minimum (1509 kg/ha) was recorded in absolute control (T_{15}) treatment. The application of *Rhizobium* with or without fungicides showed a synergic effect in increasing the seed yield of soybean per hectare. The maximum net return (Rs.16030/ha) as well as the benefit; cost ratio (2.72) were obtained from T_{10} having [Thiram + Carbendazim 50 WP - Premax + Rizo-liq (ODS)] treatment as compared to absolute control (T_{15}) treatment whereas minimum net return (Rs.9035/ha) and the benefit; cost ratio (2.03) were obtained.

Introduction

Soybean (*Glycine max* (L.) Merrill) is a major legume crop recognized as the efficient producer of the two scarce quality characters *i.e.* the protein and oil, which are not only the major components in the diet of vegetarians mass but a boon to the developing countries as well. Soybean contains 40 per cent protein, 20 per cent oil, 85 per cent PUFA and 25-30 per cent, carbohydrates, minerals, antioxidants, beta-carotene and iso-flavanoids. Soybean plays a vital role in the agricultural economy of India. Soybean [*Glycine max* (L.) Merrill] is one of the major economically predominant oilseed crops.

It is recognized as the most important versatile and fascinating crop of the world. Hence it is known as a "Wonder crop" and "Golden bean" of the 21st century. Soybean is rich in a lysine an amino acid in which most of the cereals are deficit.

In Madhya Pradesh, Farmers generally apply unbalanced under dose of fertilizers and less use of FYM and bacterial cultures which lead to low production. Indiscriminate use of chemical fertilizers deteriorates the soil health with environmental pollution. Biofertilizers are the substitute or supplementary materials in addition to the chemical fertilizers. Biofertilizers are economically viable lever for realizing the ultimate goal of increasing productivity.

These microbial systems siphon out appreciable amount of nitrogen from the atmospheric reservoir and enrich the soil with these important but scare nutrients. Culture inoculation of legume seeds at the time of sowing was found helpful in increasing the *Rhizobia* population in the soil which resulted into increased number of root nodules and ultimately gave 20-70% more yield of the legume (Dadson and Acquash, 1984)

The limitation of using the *Rhizobia* are that they cannot apply well in advance and in the other hand there is narrow window of soybean planting in India as it is rainy season crop. Soybean is becoming popular in Madhya Pradesh particularly in 'Malwa region' and hence efforts should be made to boost up the production of soybean by adopting modern techniques of crop production. The genuine problems limiting the production of soybean are poor germination and low seed viability. Micro-organisms play major role on quality of seed, of which fungi are in predominant quantity. These fungi are harmful as they minimize the vigour of seed and diminish the growth of plant at its initial stages. Fungicides or microbial antagonists act as a barrier for seed infection and seed treating with these save the seed from infection by seed borne and soil borne pathogens. Seed treatment is therefore a routine practice to ensure good emergence and better crop stand. These treatments allow the seed to germinate rapidly in to a healthy seedling. The present study was aimed to know the effect of seed treatment along with fungicides and bio-inoculants on growth and seed yield parameters of soybean.

Materials and Methods

An experiment was carried out at in *Kharif* season at student research field, College of Agriculture, Indore (M.P.) to study the Effect of fungicide and different *Rhizobium* inoculants on growth and yield of soybean (*Glycine max* (L.) Merrill). The soil of the experimental field was medium black in texture, neutral in reaction (pH 7.70) with normal EC (0.23 dS/m) and medium organic carbon contents (0.56 %) and analysing low in available N (225 kg/ha), medium in available P (9.60 kg/ha) and high in available K (508 kg/ha) contents. Due to dominance of montmorillonite clay content it has high capacity to swell and shrink and high CEC. A field experiment was consisted of 15 treatments replicated four times in randomized block design (RBD). It is located on latitude of 22.43^{o}N and longitude of 75.66^{o}E. It has subtropical climate having a temperature range of 23^{o}C to 41^{o}C and 4^{o}C to 29^{o}C in summer and winter season, respectively. The rainfall in the region is mostly inadequate and erratic. Late commencement, early withdrawal and two to three dry spells are the main features. The average rain is 964 mm and it was below normal (803 mm). The maximum temperature ranged from 25.7°C to 40.8°C while minimum temperature accelerated between 14.9°C to 28.8°C during the season.

Properties of fungicides and Bio-fertilizers

Thiram

Thiram is contact fungicide, most effective seed protectant, least phytotoxic and used for the control of many seed-borne or soil-borne diseases.

Carbendazim 50 WP (Bavistin)

Carbendazim is systemic with prophylactic and curative action and also non-phytotoxic. It is used for the control of many internally and externally seed borne diseases. Besides the disease control, beneficial side effects like stimulation of growth, flowering and yield of plants on the treated hosts have been reported.

Premax (protector)

Premax protects Rhizobial population from the adverse effects of fungicides.

Rizo-liq

Rizo-liq (*Bradyrhizobium japonicum* Strain) is a liquid biofertilizer which is used well in advance to inoculate the seed and recommended for soybean crop.

Rhizobium cultures (Rh_1, Rh_2, Rh_3)

Rhizobium cultures (*Rhizobium japonicum* strain) are solid biofertilizers which are used to inoculate the seed of soybean.

Pre harvest studies

Plant population

The plant population was taken initially and finally at 15 DAS and before harvesting, respectively. Plant population was counted per meter row length at three random rows within each net plot and the mean thus obtained was used to estimate plant population for statistical analysis.

Number of branches per plant

The primary branches were counted on five tagged plants at 45, 60 DAS and at harvesting of crop in all the plots.

Post-harvest Studies

Number of pods per plant

The number of pods per plant was counted from five already tagged plants and mean per plant was calculated for analysis. The observation taken from all the plots.

Number of seeds per pod

The number of grains per pod was counted from 20 randomly selected pods of 5 tagged plants for each plot.

Seed index

100 seeds are drawn from finally cleaned produce of each plot and weighed on balance.

Seed yield per plant

The seed yield per plant was recorded from randomly selected five plants from each plot and averages were worked out.

Seed yield (tone per hectare)

The seed yield per net plot was recorded after drying the seed. The plot yield was later on converted into kg per hectare by multiplying it by conversion factor.

Stover yield (tone per hectare)

The stover yield per plot was obtained by subtracting grain yield from bundle weight of

each plot. This was later on converted into kg per hectare.

Economics of the treatments

It was calculated as per existing market prices by method described by Yang (1956) and Dhondyal (1971).

Results and Discussion

Growth parameters

Plant population

The mean data showed that there was very small variation among different treatments with regard to plant population at 15 DAS and at harvest and it was statistically non-significant.

Number of branches per plant

Maximum number of branches per plant (4.02) was recorded in T_{10} [Thiram + Carbendazim 50 WP- Premax+Rizo-liq (ODS)] treatment and minimum (2.95) was recorded under T_{15} (Absolute control) treatment. The data revealed that *Rhizobium* inoculation with or without fungicide on the day of sowing increased the number of branches per plant as compared to control and uninoculated seed treatment at all the growth stages. However rest of the treatments produced more number of branches per plant than absolute control.

Yield attributing characters

Number of pods per plant

The maximum (39.18 pods / plant) number of pods in entire experiment was recorded in T_{10} [Thiram+Carbendazim 50 WP - Premax+ Rizo-liq (ODS)] treatment, which was significantly superior to treatment T_{14} (Uninoculated seed), T_{15} (Absolute control) and at par with rest of the treatments. Minimum pods (24.53/plant) were recorded in T_{15} (Absolute control) treatment. It is evident from the data (Table 6) that *Rhizobium* inoculation with or without fungicides resulted in significant increase in number of pods per plant as compared to the control and uninoculated seed treatment.

Number of seeds per pod

Data showed that the there was a variation in seeds per pod but statistically it was non significant. However, the maximum (2.84 seeds per pod) number of seeds per pod in entire experiment was recorded in T_{10} [Thiram+Carbendazim 50 WP - Premax+ Rizo-liq (ODS)] treatment. Minimum seeds (2.45/pod) were recorded in T_{15} (Absolute control) treatment.

Seed index

Amongst the different yield contributing characters the test weight is important which influences the grain yield directly. The data revealed that T_{10} comprising [Thiram+Carbendazim 50 WP - Premax+ Rizo-liq (ODS)] recorded maximum seed index (12.03 g), closely followed by T_{13} [Thiram + Carbendazim 50 WP - Rh_3 (ODS)] *i.e*, 11.9 g. The third best treatment was T_{11} [Thiram+ Carbendazim 50 WP - Rh_1 (ODS)], which gave seed index upto 11.83g while the treatment T_{15} recorded the lowest seed index (10.45g).

Seed yield per plant (g)

Seed yield per plant is one important yield parameters besides plant population that influenced much on final yield performance of a crop as influenced by different treatments. The maximum seed yield per plant (10g) in entire experiment was recorded in T_{10}

[Thiram+Carbendazim 50 WP - Premax+ Rizo-liq (ODS)] treatment while the minimum seed yield per plant (6.05g) was recorded in T_{15} (Absolute control) treatment.

It is evident from the data that *Rhizobium* inoculated treatments with or without fungicides except T_1 and T_{14} resulted in significant increase in seed yield per plant (g) as compared to the control treatment.

Stover yield per plant (g)

Data showed that maximum (12.79g) stover yield per plant in entire experiment was recorded in T_{10} [Thiram+ carbendazim 50 WP - Premax + Rizo-liq (ODS)] treatment, though it was at par with T_5, T_{11}, T_9, T_{12}, and T_4. But it was significantly higher as compared to control. Minimum (8.83g) stover yield per plant was recorded in T_{15} (Absolute control).

Seed yield per hectare

Yield of the crop is the result of the various biotic and environmental factors, which are responsible for changes brought about in the productivity. Effectiveness of any treatment could be judged by the magnitude of changes in the productivity brought about by that particular treatment.

The seed yield was recorded per net plot and then it was converted into kg/ha. Perusal of data in Table 6 revealed that the maximum (2147 kg/ha) seed yield of soybean in entire experiment was recorded in T_{10} [Thiram+carbendazim 50 WP - Premax+ Rizo-liq (ODS)] treatment which was appreciably higher than all other treatments, immediately followed by T_{13} [Thiram + Carbendazim 50 WP - Rh_3 (ODS)] (2115 kg/ha) treatment. Minimum (1509 kg/ha) seed yield was recorded in T_{15} (Absolute control) treatment.

Stover yield per hectare

The stover yield obtained was statistically analysed in order to find out the effect of different treatments. The stover yield was calculated by subtracting the seed yield from the biological yield. The maximum (2846 kg/ha) stover yield in entire experiment was recorded in T_{10} [Thiram+Carbendazim 50 WP- Premax+ Rizo-liq (ODS)] treatment. T_{10} [Thiram+Carbendazim 50 WP- Premax+ Rizo-liq (ODS)] was found to be at par with all the treatments except T_1, T_2, T_{14}, and T_{15} (Absolute control). The lowest stover yield (2080 kg/ha) was noted in T_{15} (Absolute control) treatment.

Harvest index (%)

Data revealed that all the treatments increased the harvest index of soybean as compared to T_{15} (Absolute control) treatment. The differences in harvest index among the treatments were non-significant.

The maximum harvest index up to 43.62% equally found inT_{11} [Thiram + Carbendazim 50 WP - Rh_1 (ODS)] and T_1 [Premax+Rizo-liq (15 DPS)] treatments whereas the minimum harvest index (39.56%) was recorded in T_{15} (Absolute control).

Economics of treatments under study

Gross monetary returns

The maximum gross return of Rs. 25325 per hectare was recorded from T_{10} [Thiram+Carbendazim 50 WP-Premax+ Rizo-liq (ODS)] treatment followed by T_{13} (Rs.24923). However, the minimum gross return Rs. 17847/ha was obtained from T_{15} (Absolute control) treatment.

Table.1 Effect of different treatments on plant population

Treatment No.	Treatments	Plants per meter row length	
		15 DAS	Harvest
T_1	Premax + Rizo-liq (15 DPS)	26.75	17.25
T_2	Premax + Rizo-liq (10 DPS)	27.75	18.75
T_3	Premax + Rizo-liq (05 DPS)	26.84	18.34
T_4	Premax + Rizo-liq (01 DPS)	26.75	18.84
T_5	Premax + Rizo-liq (ODS)	28.00	17.67
T_6	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (15 DPS)	27.75	18.33
T_7	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (10 DPS)	27.25	17.25
T_8	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (05 DPS)	26.50	18.00
T_9	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (01 DPS)	27.59	17.75
T_{10}	Thiram+Carbendazim 50 WP - Premax + Rizo-liq (ODS)	27.84	16.92
T_{11}	Thiram + Carbendazim 50 WP - Rh_1 (ODS)	28.25	17.33
T_{12}	Thiram + Carbendazim 50 WP - Rh_2 (ODS)	27.92	17.00
T_{13}	Thiram + Carbendazim 50 WP - Rh_3 (ODS)	27.58	17.00
T_{14}	Uninoculated seed (but fungicidal treatment)	27.09	17.33
T_{15}	Absolute control (No fungicidal treatment and no inoculation)	26.25	17.67
SEm ±		0.46	0.48
CD at 5%		NS	NS

Table.2 Number of branches per plant as affected by various treatments at successive stages of plant growth

Treatment No.	Treatments	Number of branches per plant		
		45 DAS	60 DAS	At Harvest
T_1	Premax + Rizo-liq (15 DPS)	1.65	3.10	3.10
T_2	Premax + Rizo-liq (10 DPS)	1.80	3.20	3.20
T_3	Premax + Rizo-liq (05 DPS)	1.85	3.20	3.20
T_4	Premax + Rizo-liq (01 DPS)	1.90	3.80	3.80
T_5	Premax + Rizo-liq (ODS)	2.15	3.95	3.95
T_6	Thiram + Carbendazim 50 WP - Premax + Rizo-liq (15 DPS)	1.85	3.15	3.15
T_7	Thiram + Carbendazim 50 WP - Premax + Rizo-liq (10 DPS)	1.90	3.25	3.25
T_8	Thiram + Carbendazim 50 WP - Premax + Rizo-liq (05 DPS)	1.95	3.30	3.30
T_9	Thiram + Carbendazim 50 WP - Premax + Rizo-liq (01 DPS)	2.10	3.80	3.80
T_{10}	Thiram + Carbendazim 50 WP - Premax + Rizo-liq (ODS)	2.60	4.02	4.02
T_{11}	Thiram + Carbendazim 50 WP - Rh_1 (ODS)	2.20	3.85	3.85
T_{12}	Thiram + Carbendazim 50 WP - Rh_2 (ODS)	2.25	3.80	3.80
T_{13}	Thiram + Carbendazim 50 WP - Rh_3 (ODS)	2.55	3.95	3.95
T_{14}	Uninoculated seed (but fungicidal treatment)	1.60	3.05	3.05
T_{15}	Absolute control (No fungicidal treatment and no inoculation)	1.55	2.95	2.95
SEm ±		0.23	0.31	0.31
CD at 5%		NS	NS	NS

DPS: Days prior sowing, ODS: On days of sowing, DAS: Days after sowing

Table.3 Average number of pods per plant and seeds per pod as influenced by different treatments

Treatment No.	Treatments	Number of pods per plant	Number of seeds per pod
T_1	Premax + Rizo-liq (15 DPS)	34.20	2.63
T_2	Premax + Rizo-liq (10 DPS)	34.43	2.65
T_3	Premax + Rizo-liq (05 DPS)	34.63	2.68
T_4	Premax + Rizo-liq (01 DPS)	35.70	2.69
T_5	Premax + Rizo-liq (ODS)	36.80	2.74
T_6	Thiram +Carbendazim 50 WP - Premax + Rizo-liq (15 DPS)	34.55	2.66
T_7	Thiram +Carbendazim 50 WP - Premax + Rizo-liq (10 DPS)	35.43	2.68
T_8	Thiram +Carbendazim 50 WP - Premax + Rizo-liq (05 DPS)	35.48	2.7
T_9	Thiram +Carbendazim 50 WP - Premax + Rizo-liq (01 DPS)	36.23	2.7
T_{10}	Thiram +Carbendazim 50 WP - Premax + Rizo-liq (ODS)	39.18	2.84
T_{11}	Thiram + Carbendazim 50 WP - Rh_1 (ODS)	37.23	2.76
T_{12}	Thiram + Carbendazim 50 WP - Rh_2 (ODS)	36.55	2.74
T_{13}	Thiram + Carbendazim 50 WP - Rh_3 (ODS)	39.00	2.78
T_{14}	Uninoculated seed (but fungicidal treatment)	31.13	2.6
T_{15}	Absolute control (No fungicidal treatment and no inoculation)	24.53	2.45
SEm ±		1.96	0.07
CD at 5%		5.59	NS

Table.4 Seed index as influenced by different treatments

Treatment No.	Treatments	Seed index (weight of 100 seeds in gm)
T_1	Premax + Rizo-liq (15 DPS)	11.18
T_2	Premax + Rizo-liq (10 DPS)	11.28
T_3	Premax + Rizo-liq (05 DPS)	11.53
T_4	Premax + Rizo-liq (01 DPS)	11.60
T_5	Premax + Rizo-liq (ODS)	11.73
T_6	Thiram+Carbendazim 50 WP- Premax+Rizo-liq (15 DPS)	11.20
T_7	Thiram+Carbendazim 50 WP - Premax + Rizo-liq (10 DPS)	11.50
T_8	Thiram+Carbendazim 50 WP - Premax + Rizo-liq (05 DPS)	11.58
T_9	Thiram+Carbendazim 50 WP - Premax + Rizo-liq (01 DPS)	11.60
T_{10}	Thiram+Carbendazim 50 WP - Premax + Rizo-liq (ODS)	12.03
T_{11}	Thiram + Carbendazim 50 WP - Rh_1 (ODS)	11.83
T_{12}	Thiram + Carbendazim 50 WP - Rh_2 (ODS)	11.63
T_{13}	Thiram + Carbendazim 50 WP - Rh_3 (ODS)	11.90
T_{14}	Uninoculated seed (but fungicidal treatment)	10.95
T_{15}	Absolute control (No fungicidal treatment and no inoculation)	10.45
SEm ±		0.22
CD at 5%		0.62

Table.5 Seed and stover yield per plant (g) as influenced by different treatments

Tr. No.	Treatments	Seed yield per plant (g)	Stover yield per plant (g)
T_1	Premax + Rizo-liq (15 DPS)	6.81	10.20
T_2	Premax + Rizo-liq (10 DPS)	8.23	10.20
T_3	Premax + Rizo-liq (05 DPS)	8.31	10.50
T_4	Premax + Rizo-liq (01 DPS)	8.61	11.02
T_5	Premax + Rizo-liq (ODS)	9.14	11.70
T_6	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (15 DPS)	8.26	10.21
T_7	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (10 DPS)	8.41	10.41
T_8	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (05 DPS)	9.00	10.55
T_9	Thiram+Carbendazim 50 WP-Premax+Rizo-liq (01 DPS)	9.06	11.41
T_{10}	Thiram + Carbendazim 50 WP-Premax+Rizo-liq (ODS)	10.00	12.79
T_{11}	Thiram + Carbendazim 50 WP - Rh_1 (ODS)	9.21	11.60
T_{12}	Thiram + Carbendazim 50 WP - Rh_2 (ODS)	8.82	11.30
T_{13}	Thiram + Carbendazim 50 WP - Rh_3 (ODS)	9.58	12.00
T_{14}	Uninoculated seed (but fungicidal treatment)	6.75	9.08
T_{15}	Absolute control (No fungicidal treatment and no inoculation)	6.05	8.83
SEm ±		0.64	0.69
CD at 5%		1.84	1.96

Table.6 Seed yield, stover yield (kg/ha) and harvest index (%) as affected by different treatments

Treatment No.	Treatments	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index (%)
T_1	Premax + Rizo-liq (15 DPS)	1845	2388	43.61
T_2	Premax + Rizo-liq (10 DPS)	1845	2417	43.33
T_3	Premax + Rizo-liq (05 DPS)	1898	2539	42.84
T_4	Premax + Rizo-liq (01 DPS)	1995	2606	43.43
T_5	Premax + Rizo-liq (ODS)	2065	2728	43.32
T_6	Thiram+Carbendazim 50 WP-Premax + Rizo-liq (15 DPS)	1904	2528	43.00
T_7	Thiram+Carbendazim 50 WP-Premax + Rizo-liq (10 DPS)	1935	2646	42.15
T_8	Thiram+Carbendazim 50 WP-Premax + Rizo-liq (05 DPS)	1979	2652	42.69
T_9	Thiram+Carbendazim 50 WP-Premax + Rizo-liq (01 DPS)	2022	2672	43.37
T_{10}	Thiram+Carbendazim50 WP-Premax + Rizo-liq (ODS)	2147	2846	43.20
T_{11}	Thiram + Carbendazim 50 WP - Rh_1 (ODS)	2025	2622	43.62
T_{12}	Thiram + Carbendazim 50 WP - Rh_2 (ODS)	1925	2722	41.42
T_{13}	Thiram + Carbendazim 50 WP - Rh_3 (ODS)	2115	2763	43.36
T_{14}	Uninoculated seed (but fungicidal treatment)	1635	2174	43.03
T_{15}	Absolute control (No fungicidal treatment and no inoculation)	1509	2080	39.56
SEm ±		71.73	127.11	1.67
CD at 5%		204.60	362.56	NS

DPS: Days prior sowing, ODS: On days of sowing, DAS: Days after sowing

Table.7 Economic evaluation of different treatments

Treatment No.	Expenditure		Cost of production (Rs.)	Yield (kg/ha)		Income		B:C ratio
	Common (Rs.)	Extra (Rs.)		*Seed*	Stover	Gross C = A+B (Rs.)	Net Return (Rs.)	
T_1	8512	543	9055	1845	2388	21728	12673	2.40
T_2	8512	588	9100	1845	2417	21745	12645	2.39
T_3	8512	668	9180	1898	2539	22401	13221	2.44
T_4	8512	688	9200	1995	2606	23509	14309	2.56
T_5	8512	688	9200	2065	2728	24352	15152	2.65
T_6	8512	753	9265	1904	2528	22461	13196	2.42
T_7	8512	768	9280	1935	2646	22873	13593	2.46
T_8	8512	738	9250	1979	2652	23360	14110	2.53
T_9	8512	763	9275	2022	2672	23845	14570	2.57
T_{10}	8512	783	9295	2147	2846	25325	16030	2.72
T_{11}	8512	518	9030	2025	2622	23848	14818	2.64
T_{12}	8512	518	9030	1925	2722	22808	13778	2.53
T_{13}	8512	672	9184	2115	2763	24923	15899	2.71
T_{14}	8512	396	8908	1635	2174	19289	10381	2.17
T_{15}	8512	300	8812	1509	2080	17847	9035	2.03

Net monetary returns

The maximum (Rs.16030/ha) net return was obtained in T_{10} [Thiram+Carbendazim 50 WP- Premax+ Rizo-liq (ODS)] treatment followed by (Rs. 15899/ha) in T_{13} [Thiram + Carbendazim 50 WP - Rh_3 (ODS)] and (Rs. 15152/ha) in T_5 (Premax+ Rizo-liq (ODS) treatments. The lowest net return (Rs. 9035/ha) was obtained under T_{15} (Absolute control) treatment.

Benefit cost ratio

It is evident from the data that the *Rhizobium* inoculation with or without fungicides were found to be profitable than uninocualted seed and absolute control. The maximum (1:2.72) BCR was observed under treatment T_{10} [Thiram+Carbendazim 50 WP- Premax+ Rizo-liq (ODS)], followed by (2.71) T_{13} [Thiram + Carbendazim 50 WP - Rh_3 (ODS)], T_5 (Premax+ Rizo-liq (ODS) and T_{11} [Thiram + Carbendazim 50 WP - Rh_1 (ODS)] (2.64) treatments. The lowest BCR (2.03) was recorded in T_{15} (Absolute control) treatment.

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