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# Effects of seed treatment on termite damage in Wheat crop

## Laishram Bikash Singh and Vikrant

**Abstract**
The research experiment was conducted at Rajawala field which is located near ICFAI University during Rabi season of 2020-21. The experiment consisted of eight treatments (($T_1$) RDF 100%, ($T_2$) Seed treatment with *Azotobacter* and 100% RDF, ($T_3$) Seed treatment with PSB and 100% RDF, ($T_4$) Seed treatment with *Azotobacter* + PSB and 100% RDF, ($T_5$) Seed treatment with *Azotobacter* + PSB and 75% RDF, ($T_6$) Seed treatment with *Azotobacter* + PSB and 50% RDF, ($T_7$) Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100% RDF, ($T_8$) Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) arranged in a Randomized Block Design with three replications. The wheat variety used in the experiment was "PBW 226". Total termite infested plants were counted at weekly interval. It was found that treatments have significant effect on termite damage in plants. $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100% RDF) showed minimum termite damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) and the maximum termite damage were observed in $T_1$ (RDF 100%) followed by $T_3$ (Seed treatment with PSB and 100% RDF).

**Keywords:** Insecticides, efficacy, wheat, termite, seed treatment

## Introduction

Wheat (*Triticum aestivum* L.) ranks first among world food crops. Wheat is the second most important staple food of India after rice. Its importance comes from using grain as a main source for human and straw as feed for livestock. In India wheat crop is cultivated in Rabi season. It is normally sown during November and harvested between March and April. It is the most important staple food of about billion people (36% of the world population) and it is the most significant cereal food crop in the world.) Wheat crop is India's prime most staple harvest, placed second only to rice. It is mostly consumed in the north and north-west parts of the country. Being rich in protein, vitamin and carbohydrates, it provides a balanced food to millions of people each day. Wheat grown in central and western India is typically hard, with high protein and high gluten content. Having a significant share in consumption of food basket with a 36% share in the total food grains produced from India and ensuring not only food security but also nutrition security, wheat is extensively procured by the government and distributed to a majority of the population; it ensures not only food security but also nutrition security. The cereal is one of the cheapest sources of energy, provides a major share of protein (20%) and calorie intake (19%) from consumption. Wheat is often considered primarily as a source of energy (carbohydrate) and it is certainly important in this respect. However, it also contains significant amounts of other important nutrients including proteins, fiber, and minor components including lipids, vitamins, minerals, and phytochemicals which may contribute to a healthy diet.

Globally, it occupy total 221.1 million hectare area with an annual production of 697.8 million tonnes and average productivity of 3101kg/ha. It is considered one of the most important cereals not only in India but also in the world. India has largest area under wheat (29.58 m ha), but stands second position in production (99.70 MT) after China with the average productivity of 3371 kg / ha. (Anonymous, 2017-18) [1]. Uttar Pradesh, Punjab, Madhya Pradesh, Haryana, Rajasthan, Bihar, Gujarat, and Maharashtra are the states in which wheat is mainly cultivated. Among the different state of India, Uttar Pradesh has first position in area and production. Wheat crop in Uttarakhand state is cultivated on 358 thousand ha area with annual production of 858 thousand tonnes and productivity of 2.39 tonnes / ha during 2012-2013 (Anonymous, 2012-13) [2].

Bio-fertilizers can be defined as preparation containing living cells of microorganisms that when inoculated on seed, applied on plant surface or on soil have the capacity to improve the soil fertility and promote growth by converting major nutrients (nitrogen, phosphorus) from unavailable to available form through biological nitrogen fixation and phosphorus solubilizing microorganisms (Rokhzadi *et al.,* 2008) [3]. They help in improving soil fertility by the way of biological nitrogen fixation from atmosphere, solubilization of insoluble nutrients already present in the soil, decomposing soil residues stimulating plant growth and production. The process is slow, consumes less energy and provides cheap nutrients to plants without polluting the nature. They are low cost, renewable and eco-friendly sources of plant nutrients which supplement chemical fertilizer. They can be used either in seed treatment or soil application. They are also ideal inputs for reducing the cost of cultivation and for practicing organic farming.

The carrier based inoculants and currently being produced in India by most manufactures using the charcoal, lignite and coal as carriers. The cost of production of carrier based inoculants is high as it is energy and labor intensive process involving processes such as transportation, mining, drying, milling, sieving, sterilization, and correcting pH (Somasegaran and Hoben, 1994) [4]. Other constraints for poor adoption of bio-fertilizer technology include shorter shelf life, poor storage facility, high contamination, inconsistent field response and lack of awareness among farmers. Survival of microorganisms in carrier soil is affected by various abiotic stress factors such as drought (Mahler and Wollum, 1981) [5] osmotic shock, high temperature (La Favre and Eaglesham, 1986) [6] and starvation (Throne and Williams, 1997) [7]. Liquid inoculant formulation provided a solution to some of these problems associated with the carrier based inoculants. Liquid inoculants are special formulations of viable cells of desired microorganisms in an appropriate nutrient medium containing certain cell protectant chemicals. These chemicals provide protection to microbial cells under extreme conditions such as high temperature, desiccation and presence of toxic seed exudates (Mugnier and Jung, 1985). Major insect pests of wheat are termite. It is calculated the loss due to termite up to 230 million rupees for all the agricultural crops (Mehta and Verma, 1968) [9]. Out of these pests, termite ranks first as a pest of wheat not only in India but South Asia too (Geddes and Iles, 1991) [10]. Gadhiya and Board (2012) [11] also evaluated nine insecticides as seed treatment of Fipronil 5 SC @ 5 ml/kg, Imidacloprid 600 FS @ 3 ml/kg and Bifenthrin 10 EC @ 2 ml/kg seed was found highly effective in suppression of the termite population among all the tested insecticides against termite.

## Materials and Methods

A field experiment was conducted during Rabi seasons of the year 2020-21. The materials and methods adopted during the experiment have been described in this chapter under different heads and sub-heads.

**Experimental site:** The experiment was conducted at Rajawala field which is located near ICFAI University during Rabi season of 2020-21.

### Area description

According to census 2011 information the location code or village code of Rajawala village is 045064. Rajawala village is located in Vikasnagar Tehsil of Dehradun district in Uttarkhand, India. It is situated 27 km away from sub district headquarter Vikasnagar and 26 km away from district headquarter Dehradun.

The total geographical area of village is 201.53 hectares.

### Climate and weather conditions

The climate condition is warm and temperate. When compared with winter, summer have much more rainfall. The climate is considered to be Cwa according to the köppen-Geiger climate classification. The average annual temperature is 20.4ºC. About 1441 mm/56.7 inch precipitation falls annually. And during this experiment season we can see the driest month is December with precipitation/ rainfall of 0.96 mm. The precipitation is highest in the month of February with a rainfall of 2.6 which is more than the month compared to others. May is the warmest month out of all the month mention below with maximum temperature reaching till 33.9ºC and the coldest is January with minimum temperature of 4.1ºC.The highest number of daily hour of sunshine is seen in the month of May. There is an average of 11.9 hour of sunshine a day. And the minimum can be seen in the month of January with an average of 8.86 hour per day. The highest humidity can be seen in January with 73% humidity.

### Soil Characteristics

To assess the general nature and composition soil sample from 0-15

cm depth was collected and analyzed for important physical - chemical characteristics. The soil pH value of experimental site was5.8, which indicates the property of the soil slightly acidic in nature and the soil was medium in nitrogen (345.38 kg/ha), low in phosphorus (6.96kg/ha) and medium in available potassium (225.7 kg/ha) with medium (0.70) organic carbon status.

### Field preparation

The experimental field was thoroughly ploughed with the help of tractor. Stones, pebbles and residue of the previous crop were removed from the field manually. Then the ridges and furrows were prepared.

### Treatments

There were 8 treatments used in the experiment carried out which comprises of different doses of bio-fertilizers of *Azotobacter* 8g/kg and PSB 8g/kg, Thiamethoxam 35 FS (insecticides) 3ml/kg, Chlorpyrifos 20 EC (pesticides) 5 ml/kg and recommended dose of N,P,K in the ratio (120:60:20) respectively.

The details of the treatments used are as follows:

### Details of treatments

$T_{1=}$ RDF 100%

$T_{2=}$ Seed treatment with *Azotobacter* and 100% RDF

$T_{3=}$ Seed treatment with PSB and 100% RDF

$T_{4=}$ Seed treatment with *Azotobacter* +PSB and 100% RDF

$T_5$= Seed treatment with *Azotobacter* + PSB and 75% RDF

$T_{6=}$ Seed treatment with *Azotobacter* + PSB and 50% RDF

$T_{7=}$ Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100% RDF

$T_{8=}$ Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and100%RDF

**Materials**

**Bio-fertilizers**

The bio-fertilizers *Azotobacter* and PSB were obtained from college laboratory respectively.

**Insecticides and pesticides**

The insecticides and pesticides used in the experiment field were all provided by the college. The name of insecticides and pesticides are Thaimethoxam and Chlorpyriphos

**Glassware**

The glass wares used in the treatment of seed were being well sterilized before use to avoid contamination.

**Seed**

Healthy wheat variety (PBW 226) was being used in the experiment carried out which was provided by our college.

**Inorganic fertilizer**

The chemical fertilizers used in the experiment was urea, Di – ammonium phosphate (DAP), and muriate of Potash (MOP) respectively which was obtained from our college.

**Urea**

Urea is the most widely used N fertilizer and is produced by heating ammonia with $CO_2$ under high temperature (160-170ºC). Urea contains the highest percentage of nitrogen (46.6%) among solid fertilizers. It contains nitrogen in the amide form. This organic fertilizer is cheaper than any other solid nitrogenous fertilizer in India.

**Di-ammonium phosphate (DAP)**

Di-ammonium phosphate is the most commonly used phosphatic fertilizer and is produced by reacting calcium nitrate with mono-calcium phosphate and finally to di-ammonium phosphate and it contain 18% N and 46% $P_2O_5$

**Muriate of potash (MOP)**

Muriate of potash or potassium chloride is the most common and cheapest fertilizer among the potassium fertilizers. It contains 58-60% $K_20$.

**Observation**

**Number of plants germinated per meter of row length**

The number of plants germinated in a meter row was recorded after 10 and 15 DAS after sowing.

**Termite damage**

For recording observations on termite incidence, infested and healthy plants was counted at weekly interval (each of 1 m) of each plot starting from one week of germination till the harvest of the crop.

$$\text{Plant damage} = \frac{\text{number of plant damaged per meter row}}{\text{Total number of plant per meter row}} \times 100$$

**Economic analysis**

The cost of cultivation was calculated by taking into account the cost of seed, fertilizers, herbicide and the hiring charges of labor and machines for land preparation, irrigation, fertilizer application, plant protection, harvesting and threshing and the time required per hectare to complete an individual field operation. Cost of irrigation was calculated by multiplying time (h) required to irrigate a particular plot, consumption of diesel by the pump (l $h^{-1}$) and cost of diesel. Gross income is the minimum support price offered by the Government of India for wheat. Net income was calculated as the difference between gross income and total cost.

**Cost of cultivation**

The cost of cultivation means the expenditure incurred on the production of any crop, it includes from land preparation to harvesting and threshing of the crop. Cost of cultivation was measured in area term and cost of production was measured in quantity term. Cost of cultivation and cost of production was used as synonyms for the purpose of cost study.

**Gross returns**

Gross returns mean the total income earned from sale of main product and by product. The output prices prevailing in local market at the time of harvest was taken in to consideration for computing gross return.

**Net returns**

The net profit was computed by subtracting respective values of cost of cultivation from the gross return as follows:

NR = R – C

**Benefit: Cost ratio:** Benefit: cost ratio was calculated by dividing net returns with the cost of cultivation of particular treatment

$$\text{B: C} = \frac{\text{Net Return (Rs.ha}-1)}{\text{Cost of Cultivation (Rs.ha}-1)}$$

**Statistical Analysis**

All the experimental data for various growth parameters and yield attributes, will be statistically analyses by the analysis of variance (ANOVA). The significance of treatment effects was computed with the help of 'F' (Variation ratio) test and to judge the significance of difference between means of two treatments, critical difference (CD) was worked out as described by (Gomez and Gomez (1984) [12].

**Standard error of mean**

Standard error of mean will be calculated as follows:

$$\text{Standard error of mean} = \frac{\sqrt{\text{EMSS}}}{\text{R}}$$

Where,

SE m ± = Standard error of mean

EMSS = Error mean sum of square

R = Number of replication on which the observation is based.

**Critical difference**

The data obtained would be subjected to statistical analysis as outlined by Gomez and Gomez (1984) [12]. The treatment means will be compared using transformed means. The treatment differences will be tested by least significant difference at 5 per cent of probability calculated by the following formula:

$$\text{CD} = \frac{\sqrt{2 \text{ x Error mean square}}}{\text{r}} \text{ x t 0.05}$$

Where,

CD = Critical difference

r = Number of replications of the factor for which C.D. is to be calculated.
t 0.05 = Value of percentage point of‘t’ distribution for error degree of freedom at 5 per cent level of significance.

**Results and Discussion**

Total termite infested plants were counted at weekly interval. It was found that treatments have significant effect on termite damage in plants. $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) and the maximum termite damage were observed in $T_1$ (RDF 100%) followed by $T_3$ (Seed treatment with PSB and 100% RDF).

On the 5th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100% RDF) showed minimum termite damage with 0.84 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 0.94 and the maximum termite damage was observed in $T_1$ (RDF 100%) with termite damage of 3.01followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 2.16.

On the 6th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 1.02 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 1.37 and the maximum termite damage was observed in $T_1$ (RDF 100%) with 3.98 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 3.11.

On the 7th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 1.24 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with 1.83 and the maximum termite damage was observed in $T_1$ (RDF 100%) with termite damage of 5.25followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 4.36.

On the 8th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 1.59 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 2.36 and the maximum termite damage was observed in $T_1$ (RDF 100%) with7.04 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 5.56.

On the 9th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 1.84 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 3.17 and the maximum termite damage was observed in $T_1$ (RDF 100%) with 8.34followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 6.52.

On the 10th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 2.26 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 4.55 and the maximum termite damage was observed in $T_1$ (RDF 100%) with 10.21followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 8.49.

On the 11th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 3.52 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 5.66 and the maximum termite damage was observed in $T_1$ (RDF 100%) with termite damage of 14.80 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with 13.09.

On the 12th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 4.17 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 6.56 and the maximum termite damage was observed in $T_1$ (RDF 100%) with 18.73 followed termite damage of by $T_3$ (Seed treatment with PSB and 100% RDF) with 17.70.

On the 13th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 4.02 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with 7.62 and the maximum termite damage was observed in $T_1$ (RDF 100%) with termite damage of termite damage of 19.80 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with 19.75.

On the 14th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 6.63 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100% RDF) with termite damage of 9.64 and the maximum termite damage was observed in $T_1$ (RDF 100%) with 20.71 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with termite damage of 20.58.

On the 15th week, $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) showed minimum termite damage with 6.64 damage followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with termite damage of 11.39 and the maximum termite damage was observed in $T_1$ (RDF 100%) with termite damage of 21.13 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with 20.83. Singh *et al.* (2004) [13] also reported that seed treatment with Bifenthrin 10% EC @ 2 ml/kg seeds was found effective and economical followed by Endosulfan 35 EC @ 7 ml and Chlorpyriphos 20 EC @ 1.5 ml for the management of termites in wheat also supported the present findings. The above results are also agreement with findings of Mishra *et al.,* (2007) [14] who evaluated the effect of insecticides (Endosulfan, Monocrotophos, Chlorpyriphos, Imidacloprid, Carbaryl, Quinalphos and Methyl-parathion) as seed treatments @ 2.5, 2.5, 5.0, 2.0, 4.0, 2.5 and 2.5 ml/kg seeds, respectively, for the control of *O. obesus* and *M. obesi* infesting wheat in Uttar Pradesh. The maximum plant stand (77.7 plants/m2) and minimum infested tillers (5 tillers/plot) due to termites and maximum grain yield (42.2 q/ha) was obtained in Imidacloprid @ 2.0 ml/kg followed by Chlorpyriphos @ 5 ml/kg seed, whereas carbaryl found least effective. Apart from wheat, it also causes damage to maize, bajra, rice, barley and sorghum. Loss of 15–25 per cent of maize yield and about 1478 million rupees was estimated in India (Joshi *et al.,* 2005) [15] In wheat, yield losses of 80% (Roonwal, 1979) [16], 43% (Sattar and Salihah, 2001) [17] and 60% (Kakde *et al*., 2006) [18] was reported due to termite infestation.

**Economic analysis:** The maximum cost of cultivation was observed in $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) with cost of cultivation of Rs26503/ha followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF) with cost of cultivation of Rs26453/ha and the minimum cost of cultivation was observed in $T_1$ (RDF 100%) with cost of cultivation of Rs25300/ha followed by $T_3$ (Seed treatment with PSB and 100% RDF) with cost of cultivation of Rs25620/ha.

The maximum gross monetary returns was observed in $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) with gross monetary returns of Rs108037.1/ha followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF with gross monetary returns of Rs100527.1/ha and the minimum gross monetary returns was observed in $T_1$ (RDF 100%) with Rs5104695/ha followed by $T_3$ (Seed treatment with PSB and 100% RDF) with gross monetary returns of Rs61167.4/ha.

The maximum net returns was observed in $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100%RDF) with net returns of Rs 81534.05/ha followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF with net returns of Rs 74074.1/ha and the minimum was observed in $T_1$ (RDF 100%) with net returns of Rs 25746.95/ha followed by $T_3$ (Seed treatment with PSB and 100% RDF) with net returns of Rs 35547.4/ha.

The maximum Benefit: Cost ratio was observed in $T_8$ (Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100% RDF) with Benefit: Cost ratio of 3.076 followed by $T_7$ (Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100%RDF with 2.8 and the minimum was observed in $T_1$ (RDF 100%) with Benefit: Cost ratio of 1.017 followed by $T_3$ (Seed treatment with PSB and 100% RDF) with Benefit: Cost ratio of 1.38. Chand *et al.* (2014) [19] studied the effect of application of bio-fertilizers (*Azotobacter* + PSB) to wheat and reported that highest net returns (Rs. 50,390 $ha^{-1}$) was found with seed treatment of *Azotobacter* @ 20g/kg seed and PSB @ 2.5 kg mixed with 60 kg FYM applied in soil before sowing as compared to farmers practice of Rs. 43,650. The highest B: C ratio was recorded in seed treatment of *Azotobacter* and soil application of PSB (3.30) as compared to control (2.65).

**Table 1:** Effect of different seed treatment on termite damage percentage of wheat crop**.**

| SN | Treatments | Termite damaged plants (%) week after sowing | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1 | $T_1$ | 3.01 | 3.98 | 5.25 | 7.04 | 8.34 | 10.21 | 14.8 | 18.73 | 19.8 | 20.71 | 21.13 |
| 2 | $T_2$ | 2.03 | 3.11 | 4.32 | 5.44 | 6.28 | 8.27 | 12.75 | 16.44 | 17.87 | 17.91 | 17.97 |
| 3 | $T_3$ | 2.16 | 3.13 | 4.36 | 5.56 | 6.52 | 8.49 | 13.09 | 17.7 | 19.75 | 20.58 | 20.83 |
| 4 | $T_4$ | 1.15 | 1.88 | 2.41 | 3.55 | 4.29 | 5.82 | 7.55 | 7.48 | 11.19 | 13.78 | 15.68 |
| 5 | $T_5$ | 1.41 | 2.02 | 2.77 | 3.59 | 4.78 | 5.97 | 8.15 | 9.74 | 11.71 | 14.74 | 16.91 |
| 6 | $T_6$ | 1.87 | 2.14 | 3.1 | 3.78 | 5.08 | 8.17 | 8.52 | 10.80 | 13.07 | 16.75 | 17.63 |
| 7 | $T_7$ | 0.94 | 1.37 | 1.83 | 2.36 | 3.17 | 4.55 | 5.66 | 6.56 | 7.62 | 9.64 | 11.39 |
| 8 | $T_8$ | 0.84 | 1.02 | 1.24 | 1.59 | 1.84 | 2.26 | 3.52 | 4.17 | 4.02 | 6.63 | 6.64 |
| SE m± | | 0.43 | 0.33 | 0.79 | 0.68 | 0.74 | 0.79 | 1.09 | 1.09 | 0.97 | 1.3 | 0.99 |
| C.D | | 1.32 | 1.02 | 2.44 | 2.09 | 2.27 | 2.28 | 3.34 | 3.35 | 2.97 | 4 | 3.03 |

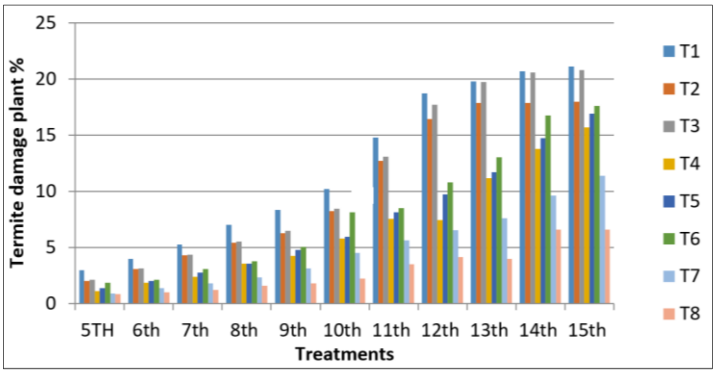


**Fig 1:** Effect of different seed treatment on termite damage percentage of wheat crop.

**Table 2:** Effect of different seed treatment on economics returns of wheat crop

| SN | Treatments | Cost of cultivation (Rs/ha) | Gross returns (Rs/ha) | Net returns (Rs/ha) | Benefit: Cost ratio |
|---|---|---|---|---|---|
| 1 | ($T_1$)RDF 100% | 25300 | 51046.95 | 25746.95 | 1.01 |
| 2 | ($T_2$)Seed treatment with *Azotobacter* and 100% RDF | 25833 | 65226.6 | 39393.6 | 1.52 |
| 3 | ($T_3$)Seed treatment with PSB and 100% RDF | 25620 | 61167.4 | 35547.4 | 1.38 |
| 4 | ($T_4$)Seed treatment with *Azotobacter* +PSB and 100% RDF | 26153 | 90030.6 | 63877.6 | 2.44 |
| 5 | ($T_5$)Seed treatment with *Azotobacter* + PSB and 75% RDF | 26058 | 87001.4 | 60943.4 | 2.33 |
| 6 | ($T_6$)Seed treatment with *Azotobacter* + PSB and 50% RDF | 25858 | 75791 | 49933 | 1.93 |
| 7 | ($T_7$)Seed treatment with *Azotobacter* + PSB + Thaimethoxam 35 FS and 100% RDF | 26453 | 100527.1 | 74074.1 | 2.8 |
| 8 | ($T_8$)Seed treatment with *Azotobacter* + PSB + Chlorpyriphos 20 EC and 100% RDF | 26503 | 108037.1 | 81534.05 | 3.07 |

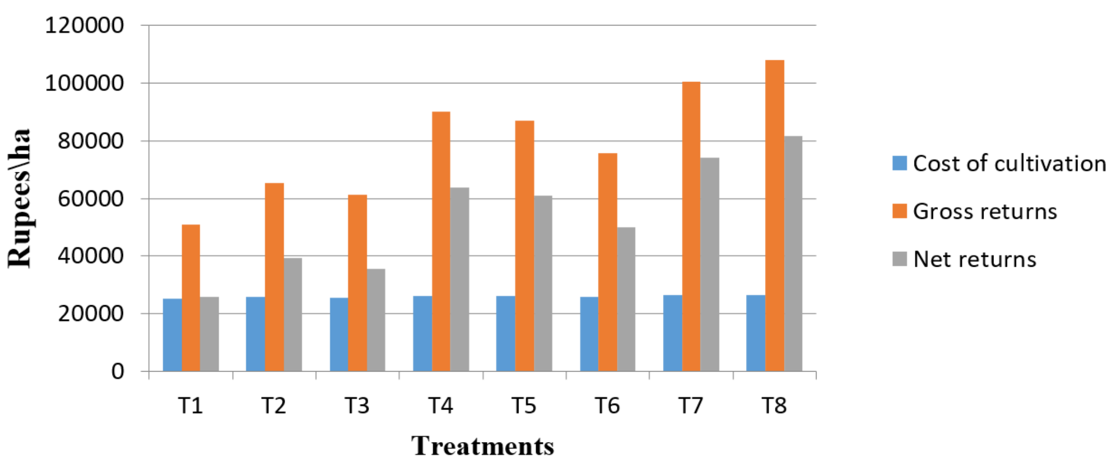


**Fig 2:** Effect of different seed treatment on economic returns of wheat crop

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