**RESEARCH ARTICLE**

# INTEGRATED PEST AND DISEASE MANAGEMENT THROUGH ORGANIC FARMING APPROACHES IN MUSTARD

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**Abstract:** Field experiment was conducted to study the effect of the different organic modules for management of *Alternaria blight* and *Powdery mildew* diseases of Indian Mustard (Brassica juneca)(L.) Czern &Coss) Efficacy of different organic modules were also tested against aphid management in successful growing of organic mustard.Treatment module comprising of seed treatment with *Trichoderma viride*@8g/kg seed +foliar spray of Azadirachtin @3ml/lit.at 5-10DAS+Neem oil spray@2% at 10-20DAS+NSKE spray@5% at 30-40 DAS+cow urine spray@10% at 50-60DAS+milk whey spray @10% at 60-75 DAS was found significantly superior over control and gave maximum seed yield of mustard 13.65q/ha. in comparison to control which gave only 10.16q/ha. mustard seed yield.This organic module was found superior in respect to disease control also,and effectively controlled both the diseases and record minimum disease intensity of *Alternaria blight(*15.94%) and *Powdery mildew* 17.67%. Where as in control 38.32% and 48.15% disease intensity was observed respectively. This module gave the highest net return of Rs.23294/over control with maximum B:C ratio of 1.88,1.83 and 1.84 in year 2012-13 & 2013-14 &2014-15respectively.

**Keywords:** Mustard, *Alternaria blight*, *Powdery mildew*, Aphids *Trichoderma viride*, Milk whey, *Azedirachtin*

## INTRODUCTION

Mustard is one of the most important oil seed crops of India and state of Rajasthan dominates in production of mustard in India. Being a cash crop, there is a great demand of organic mustard (Sahota, 13) Organic mustard in Rajasthan represent a very negligible part of our total oil production. The one of the constraints in increasing the area under organic mustard production is look of suitable organic production practices for different agro climate regions. The present investigation was aimed to study the influence of certain bioagent, organic manures bio pesticides on diseases control and yield of mustard in southern Rajasthan

Organic farming is gaining gradual momentum across the world. In India about 528171 hectare area is under organic farming with 44926 numbers of certified organic farms (willer, 2011)

Among various annual oil seeds crop cultivated in India, the rapeseed mustard is accounted for 25 percent total area and 1/3 of total oil production in the country after groundnut.India ranked third after Canada and China in Area (19.3%) and production (11.1%).In India rapeseed mustard is being cultivated in seven ststes viz Rajasthan, Madhya Pradesh, Utter Pradesh, Haryana, West Bengal, Assam and Gujarat, which contributes maximum to its production and productivity. Among the states, Rajasthan owns the share of almost 50 to total production and acreage in the country with productivity of 1046 Kg/ha. during 2014-15.

*Alternaria blight* and *Powdery mildew* disease are most important diseases of mustard in India.The diseases causes heavy lossess depending upon the stage of infection. Chemical management of both diseases and sucking pest aphids by fungicides and insectisides is un economical and environmentally hazardous. Therefore, there is a need to look for non hazardous and eco friendly control measures for plant diseases and pest management. In this context an investigation was planned to evaluate the efficacy of organic module against *Alternaria brassicae* and *Erysiphae poligoni* pathogens causing *Alternaria blight* and *Powdery mildew* diseases in mustard respectively.

## MATERIAL AND METHOD

The efficacy of eight different modules were tested against Alternaria blight&Powdery mildew diseases and sucking pest Aphids in mustard at Dryland Farming Research Station Arjia, Bhilwara during 2012-13,2013-14&2014-15. Mustard variety Laxmi was sown in Randomized Block Design with three replications The unit plot size was 5.0x3.6 m and mustard seed were sown in first fortnight of October during both years. Prior to sowing mustard seeds were treated with *Trichoderma viride @8g/kg seed* . In control plot seeds were sown without any treatment. Treatment details are as follows:

$T_1$- Seed treatment with *Trichoderma viride*@ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10 -20DAS+30-40DAS+ 50-60 DAS + 60-75 DAS

$T_2$- Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @ 0.2% at 5-10 DAS + 10 -20 DAS +30-40DAS+50- 60 DAS+ 60-75 DAS

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$T_3$- Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS + 10 -20 DAS + 30-40DAS+50-60 DAS+ 60-75 DAS.

$T_4$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS +cow urine @ 10 ml / lit. at 30-40DAS+ 50-60DAS+ 60-75 DAS.

$T_5$- Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS+ Oak leaves extract spray @ 10% at 20-30 DAS+ Neem oil spray @2% at30-40 DAS+Cow urine spray@10% at 50-60 DAS+ *Azedirachtin* spray @ 3 ml/lit.at60-75 DAS

$T_6$- Seed treatment with *Trichoderma viride* @8g/kg seed +Spray of *Azadirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at10-20 DAS+NSKE spray @5% at 30-40 DAS+cow urine spray @10% at 50-60 DAS+Milk whey spray @10% at 60-75 DAS.

$T_7$- Seed treatment with *Trichoderma viride* @8 g/kg seed +Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at10-20 DAS+ Neem oil spray @2% at30-40 DAS + Milk whey spray @10% at 50-60DAS+ Oak leaves Extract spray @ 10% at 60-75DAS.

$T_8$- Control (Without any treatment)

- NSKE = Neem seed kernel extract
  * DAS = Days after sowing

**Preparation and application of the treatments**

Mustard field was given. Farm Yard Mannure @2 ton/ha. prior to sowing crop. Sowing was done using seed treatment with *Trichoderma viride* @ 6g/Kg seed of mustard. Beside a pre sowing irrigation, crop was given four irrigations. For organic amendment in soil Neem cake @ 200 Kg/ha. were given at the time of field preparation, as a cultural practice summer sloughing was also done after the harvesting of previous crop in summer.

In order of preparation of two pesticides NSKE was prepared using 1.0 kg of Neem kernels. The kernels were dried and grounded in a grinding machine as course powder and added one lit. of water and kept it for overnight. Extracts was filtered through muslin cloth to get 100% stock solution of NSKE. 5ml of this solution adding in 100 ml of water will be treated as 5% NSKE solution. Oak leaves extracts was also prepared by using this method fresh 100 gm oak leaves were grounded in 100 ml of water and then filtered it by using muslin cloth. Obtained extracts (2ml) was added to 100 ml. water that is, it was of 2% oak leaves extract. Milk whey also applied this way in which we used 100 ml milk whey added in 1 lit. water then it becomes 10% milk whey spray solution. All bio pesticides were exercised as per scheduled, at initiation of the disease on the standing crop at 10-15 days interval according to the treatments,while control plots were sprayed with plain water. The experiment was irrigated four times and other inter cultural operations were done when necessary. The crop was harvested offer 125-130 days. The data were recorded farm randomly selected 10 plants/Plot for disease severity of *Alternaria blight* & *Powdery mildew* of mustard started from just before first spray of bio pesticide. Mustard yield (q/ha-1) and disease scoring data were recorded on, whole plot basis and then diseases score data converted in to disease severity. (PDJ) The efficacy of bio pesticides were measured by scoring the disease (PDI) in the individual plot on the basis of a standard score scale (Anonymous 1994) Where O= Leaf and pods free from in infection 1= 1-5% leaves are infected, 2=6-20% leaves are infected, 3 = 21-40% leaves & pods are infected 4=41-70% leaves & fruits are infected. The disease data were converted in to percent disease index (PDI) suggested by Sharma (1984) & Rahman et al (1986) Data were analyzed following the statistical procedure followed by Gomez & Gomez (1983)

## RESULT AND DISCUSSION

All the bio pesticides used in trial significantly reduced the severity of *Alternaria blight* & *Powdery mildew* diseases in mustard. A significant variation among the bio pesticide treatment was observed. Data presented in Table No. 1,2 &3 revealed that treatment module comprising of seed treatment with *Trichoderma viride* @ 8g/Kg seed + spray & Azedirechtin @ 3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at 10-20 DAS + NSKE spray @ 5% at 30-40 DAS + cow urine spray @ 10% at 50-60 DAS + Milk whey spray @ 10% at 60-75 DAS was found significant superior over control and gave maximum seed yield of mustard 13.65q/ha., in comparison to control which gave only10.16 q/ha mustard seed yield with highest (38.32%) PDI of *Alternaria blight* and 48.15% *Powdery mildew* diseases respectively in organic mustard. This module effectively controlled disease as well as Aphid population and showed least PDI of *Alternaria blight* (15.94%) and 17.67% Powdery mildew. Minimum aphid population 93.67/10cm of per plant were also recorded at 3 days after sowing under this module. This module showed effectively control of pest & disease management in organic mustard.

Above results clearly indicated that among plant extracts Neem cake, NSKE Neem oil, Azerachtin, cow urine, milk whey can be selected for further integration with *T. viride* as they showed satisfactory controlled the *Alternaria blight & Powdery mildew* as well as aphid population also. They all showed synergetic effect with each other it may be due to suitability of constituents present in bio pesticides & leaf extracts. Ravi Chander (1987) reported that growth of *Rhizoctonia solani* was completely inbihited with the leaf extract of subabul, but its efficacy was not tested against fungal antagonist by any worker earlier. Neem and Akven leaf extracts reduced the viability of *sclerotia* of *R.solani*

(Laxman and Nair 1984) and mycelia growth considerably *in vitro* (Mani Bhusan Rao et al. 1988)It has suggested that treatment with biocontrol agents initiated in the plants anumber of biochemical changes which can be considerd to be a part of plant defence responses(Sharma et al 2010) In Present finding Neem seed kernel and neem based formulations were found inhibitory nature against pathogen as well as antagonist effect against aphid population, therefore it can used for further investgation.

**Economics**

The study also indicate that initially organic farming attributed lower productivity and yield losses but there was an overall improvement in soil quality parameters indicating better soil health.It is economically feasible to practice organic farming when the farmers are able to get premium price for their produce and with the reduced cost of cultivation by not depending upon the purchased off farm inputs. On an average of three years productivity of mustard yield was found lower by 20-22% in comparison to conventional farming. However due to availability of premium price (20-40%) for organic mustard the average net profit was 25-30% higher in organic farming compared to the conventional farming (Table no. 3.)

The economics of organic mustard cultivation over a period of three years indicated that there is a reduction in cost of cultivation and increased gross and net returns compared to conventional mustard cultivation at research station.Three years pooled analysis data on pest and disease management and yield attributes are depicted in Table no. 3 revealed that application of organic treatments viz. seed treatment with *Trichoderma viride*@8g/kg seed +foliar spray of Azedirachtin @3ml/lit.+Neem oil spray @2% Foliar spray of Neem seed kernel Extract (NSKE)@5%+cow urine @10%+Milk whey spray @10% found significant superior over control plot during cropping period. All the organic treatments showed effective control of *Alternaria blight* and recorded minimum PDI (15.94%) while in control Maximum PDI Of *Alternaria blight* 38.32% was observed. Similar trends were observed in case of *Powdery mildew* disease and showed minimum infection (17.67%) of powdery mildew was observed in experimental trial of organic mustard.

The above treatment was found best in controlling sucking pest population also. This organic module also effectively controlled Aphid population and record minimum Aphid (114) population at per plant while in control 244 Aphids were found at every 10 cm terminal growth of mustard plants at seven days after sowing. All organic treatments effectively controlled pest and disease in organic mustard amongst eight treatments .The best treatment gave highest gross return and net return over control of Rs 50,552/&23,294/ respectively while Maximum B:C ratio of 1:1.88 was also recorded under best treatment in organic mustard cultivation during experimentation.

**Table 1.** Efficacy of different organic modules for Disease management in organic mustard(2012-13, 2013-14 & 2014-15)

| Treatments | PDI of A.blight | | | |
|---|---|---|---|---|
| | 2012-13 | 2013-14 | 2014-15 | mean |
| $T_{1}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10-20 DAS+30-40 DAS+ 50-60 DAS + 60-75 DAS | **20.20 (26.65)** | **25.10 (30.07)** | **28.34 (32.15)** | **24.54 (29.68)** |
| $T_{2}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @2% at 5-10 DAS + 10 -20 DAS + 30-40 DAS + 50-60 DAS+ 60-75 DAS | **26.50 (30.72)** | **30.28 (33.40)** | **35.41 (36.51)** | **30.73 (33.65)** |
| $T_{3}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS+10-20 DAS+30-40 DAS+50-60DAS+ 60-75 DAS | **15.24 (22.94)** | **20.43 (26.85)** | **25.32 (30.20)** | **20.33 (26.78)** |
| $T_{4}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS +cow urine@10ml/lit.at30-40 DAS+50-60 DAS+ 60-75 DAS | **17.70 (24.88)** | **22.50 (28.32)** | **24.23 (28.47)** | **21.47 (27.56)** |
| $T_{5}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS + Oak leaves extract spray @ 10% at 20-30 DAS+ Neem oil spray @ 2% at 30-40 DAS + Cow urine spray@10% at 50-60 DAS + *Azedirachtin* spray @ 3 ml/lit.at60-75 DAS | **20.18 (26.67)** | **25.58 (30.40)** | **29.25 (32.75)** | **25.00 (30.00)** |
| $T_{6}$ - Seed treatment with *Trichoderma viride* @ 8g/kg seed +Spray of *Azedirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at10-20 DAS+NSKE spray @5% at 30-40 DAS+cow urine spray @10% at 50-60 DAS+Milk whey spray @10% at 60-75 DAS | 11.25 (19.55) | 16.45 (23.93) | 20.14 (26.66) | 15.94 (23.50) |

| | | | | |
|---|---|---|---|---|
| $T_{7}$ - Seed treatment with *Trichoderma viride* @8 g/kg seed+Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at 10-20 DAS+ Neem oil spray @ 0.2% at 30-40 DAS + Milk whey spray @10% at 50-60 DAS + Oak leaves Extract spray @ 10% at 60-75DAS | 18.35 (25.35) | 25.20 (30.13) | 32.22 (34.57) | 25.25 (30.13) |
| $T_{8}$ - Control | 29.38 (32.76) | 40.34 (39.43) | 45.26 (42.25) | 38.32 (38.23) |
| SEM ± | 1.09 | 1.10 | 1.12 | |
| CD (0.05%) | 3.21 | 3.29 | 3.35 | |
| CV | 8.33 | 10.40 | 10.94 | |

**Table 2.** Efficacy of different organic modules for Disease management against Powdery mildew in organic mustard(2012-13, 2013-14 & 2014-15)

| **Treatments** | **PDI of Powdery mildew** | | | |
|---|---|---|---|---|
| | **2012-13** | **2013-14** | **2014-15** | **mean** |
| $T_{1}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10-20 DAS+30-40 DAS+ 50-60 DAS + 60-75 DAS | 36.20 (37.41) | 40.86 (39.73) | 42.36 (40.57) | 38.53 (38.57) |
| $T_{2}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @2% at 5-10 DAS + 10 -20 DAS + 30-40 DAS + 50-60 DAS+ 60-75 DAS | 35.30 (36.46) | 40.44 (35.92) | 45.25 (42.27) | 37.87 (36.19) |
| $T_{3}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS+10-20 DAS+30-40 DAS+50-60DAS+ 60-75 DAS | 20.12 (26.63) | 28.32 (32.15) | 29.25 (32.75) | 24.22 (29.39) |
| $T_{4}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS +cow urine@10ml/lit.at30-40 DAS+50-60 DAS+ 60-75 DAS | 30.32 (33.38) | 36.56 (37.20) | 39.32 (38.82) | 33.44 (35.29) |
| $T_{5}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS + Oak leaves extract spray @ 10% at 20-30 DAS+ Neem oil spray @ 2% at 30-40 DAS + Cow urine spray@10% at 50-60 DAS + *Azedirachtin* spray @ 3 ml/lit.at60-75 DAS | 33.36 (35.50) | 35.50 (36.57) | 38.48 (38.32) | 34.43 (36.03) |
| $T_{6}$ - Seed treatment with *Trichoderma viride* @ 8g/kg seed +Spray of *Azedirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at10-20 DAS+NSKE spray @5% at 30-40 DAS+cow urine spray @10% at 50-60 DAS+Milk whey spray @10% at 60-75 DAS | 15.22 (22.89) | 20.12 (26.65) | 25.32 (30.20) | 17.67 (24.77) |
| $T_{7}$ - Seed treatment with *Trichoderma viride* @8 g/kg seed+Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at 10-20 DAS+ Neem oil spray @ 0.2% at 30-40 DAS + Milk whey spray @10% at 50-60 DAS + Oak leaves Extract spray @ 10% at 60-75DAS | 26.79 (31.09) | 29.87 (33.09) | 33.36 (35.27) | 28.33 (32.09) |
| $T_{8}$ - Control | 45.55 (42.44) | 50.76 (45.42) | 52.47 (46.43) | 48.15 (43.93) |
| SEM ± | 1.08 | 1.12 | 1.10 | |
| CD (0.05%) | 3.17 | 3.35 | 3.30 | |
| CV | 6.49 | 9.80 | 9.80 | |

**Table 3.** Efficacy of different organic modules for Disease management and yield attributes in organic mustard (2012-13, 2013-14 & 2014-15)

| **Treatments** | **Yield (q/ha)** | | | |
|---|---|---|---|---|
| | **2012-13** | **2013-14** | **2014-15** | **mean** |
| $T_{1}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10-20 DAS+30-40 DAS+ 50-60 DAS + 60-75 DAS | 10.32 | 11.40 | 12 .40 | 11.37 |
| $T_{2}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @2% at 5-10 DAS + 10 -20 DAS + 30-40 DAS + 50-60 DAS+ 60-75 DAS | 10.15 | 11.68 | 11.69 | 11.17 |
| $T_{3}$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS+10-20 DAS+30-40 DAS+50-60DAS+ 60-75 DAS | 12.54 | 13.30 | 13.55 | 13.13 |

| | | | | |
|---|---|---|---|---|
| $T_4$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS +cow urine@10ml/lit.at30-40 DAS+50-60 DAS+ 60-75 DAS | 11.43 | 12.28 | 13.50 | 12.40 |
| $T_5$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS + Oak leaves extract spray @ 10% at 20-30 DAS+ Neem oil spray @ 2% at 30-40 DAS + Cow urine spray@10% at 50-60 DAS + *Azedirachtin* spray @ 3 ml/lit.at60-75 DAS | 11.21 | 11.88 | 12.51 | 11.86 |
| $T_6$ - Seed treatment with *Trichoderma viride* @ 8g/kg seed +Spray of *Azedirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at10-20 DAS+NSKE spray @5% at 30-40 DAS+cow urine spray @10% at 50-60 DAS+Milk whey spray @10% at 60-75 DAS | 13.16 | 13.84 | 13.96 | 13.65 |
| $T_7$ - Seed treatment with *Trichoderma viride* @8 g/kg seed+Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at 10-20 DAS+ Neem oil spray @ 0.2% at 30-40 DAS + Milk whey spray @10% at 50-60 DAS + Oak leaves Extract spray @ 10% at 60-75DAS | 12.26 | 12.88 | 13.52 | 12.88 |
| $T_8$ - Control | 9.49 | 10.14 | 10.86 | 10.16 |
| SEM ± | 0.68 | 0.73 | 0.83 | |
| CD (0.05%) | 2.00 | 2.18 | 2.49 | |
| CV | 12.01 | 13.34 | 13.34 | |

**Table 4.** Efficacy of different organic modules for Aphid management in organic mustard (2012-13&2013-14 &2014-15)

| **Treatments** | **Mean no. of Aphids at 10cm/per plant(3DAS)** | | | | **Mean no. of Aphids at 10cm/per plant(7DAS)** | | | |
|---|---|---|---|---|---|---|---|---|
| | **2012-13** | **2013-** | **2014-15** | **Mean** | **2012-** | **2013-** | **2014-15** | **Mean** |
| $T_1$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10-20 DAS+30-40 DAS+ 50-60 DAS + 60-75 DAS | 125 *(11.20) | 127 (11.29) | 118 (10.88) | 123.33 (11.12) | 135 (11.64) | 168 (12.98) | 125 (11.20) | 142.67 (11.96) |
| $T_2$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @2% at 5-10 DAS + 10 -20 DAS + 30-40 DAS + 50-60 DAS+ 60-75 DAS. | 134 (11.59) | 144 (12.02) | 122 (11.06) | 133.33 (11.56) | 139 (11.81) | 131 (11.46) | 142 (11.93) | 137.33 (11.74) |
| $T_3$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS+10-20 DAS+30-40 DAS+50- | 143 (11.97) | 149 (12.22) | 125 (11.20) | 139 (11.81) | 115 (10.95) | 150 (12.26) | 135 (11.64) | 133.33 (11.56) |
| $T_4$- Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS+cowurine@10ml/lit.at30-40DAS+50-60DAS+60-75 DAS | 105 (12.27) | 170 (13.06) | 115 (10.74) | 130 (11.42) | 120 (10.97) | 126 (11.24) | 117 (10.83) | 121 (11.02) |
| $T_5$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS + Oak leaves extract spray @ 10% at 20-30 DAS s+ Neem oil spray @ 2% at 30-40 DAS + Cow urine spray@10% at 50-60 DAS + *Azadirachtin* spray | 110 (10.51) | 114 (10.70) | 109 (10.46) | 111 (10.55) | 131 (11.46) | 146 (12.10) | 115 (10.74) | 130.67 (11.45) |
| $T_6$ - Seed treatment with *Trichoderma viride* @ 8g/kg seed +Spray of *Azadirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at 10-20 DAS + NSKE spray @5% at 30-40 DAS + cow urine | 95 (9.77) | 96 (9.82) | 90 (9.51) | 93.67 (9.70) | 119 (10.93) | 121 (11.02 | 102 (10.12) | 114 (10.70) |
| $T_7$ - Seed treatment with *Trichoderma viride* @8 g/kg seed+Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at 10-20 DAS+ Neem oil spray @ 0.2% at 30-40 DAS + Milk whey spray @10% at 50-60 DAS + Oak leaves Extract spray @ 10% at 60-75DAS | 102 (10.12) | 102 (10.12) | 108 (10.41) | 104 (10.22) | 125 (11.20) | 137 (11.72) | 110 (10.51) | 124 (11.15) |
| $T_8$ - Control | 250 (15.82) | 252 (15.85) | 175 (13.24) | 225.66 (15.03) | 263 (16.23) | 266 (16.32) | 205 (14.33) | 244 (15.63) |
| SEM ± | 0.23 | 0.62 | 0.53 | | 0.19 | 0.62 | 0.52 | |
| CD (0.05%) | 0.66 | 1.82 | 1.49 | | 0.57 | 1.81 | 1.45 | |
| CV | 3.93 | 9.04 | 9.45 | | 3.24 | 8.60 | 9.23 | |

*Figures in The parentheses are square root transformed value
DAS=Days after spraying

**Table 5.** Economics of Oeganic Musrard (2012-13&2013-14 &2014-15)

| Treatments | ( Gross return) | | | | ( Net return) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2012-13 | 2013- | 2014- | Mean | 2012- | 2013- | 2014-15 | Mean |
| $T_1$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10-20 DAS+30-40 DAS+ 50-60 DAS + 60-75 DAS | 37152 | 39900 | 49600 | 42211 | 12172 | 13671 | 19400 | 15081 |
| $T_2$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @2% at 5-10 DAS + 10 -20 DAS + 30-40 DAS + 50-60 DAS+ 60-75 DAS. | 36540 | 40880 | 46760 | 41393 | 10900 | 13958 | 14219 | 13025 |
| $T_3$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS+10-20 | 45144 | 46550 | 53200 | 48298 | 18064 | 28116 | 21955 | 22711 |
| $T_4$- Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS+cowurine@10ml/lit.at30-40DAS+50-60DAS+60-75 | 41148 | 42980 | 54000 | 46042 | 17338 | 17980 | 21311 | 18873 |
| $T_5$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS + Oak leaves extract spray @ 10% at 20-30 DAS s+ Neem oil spray @ 2% at 30-40 DAS + Cow urine spray@10% at 50-60 DAS + | 40356 | 41580 | 50040 | 43992 | 15436 | 15414 | 20382 | 17071 |
| $T_6$ - Seed treatment with *Trichoderma viride* @ 8g/kg seed +Spray of *Azadirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at 10-20 DAS + NSKE spray @5% at 30-40 DAS + cow urine spray @10% at 50-60 DAS + | 47376 | 48440 | 55840 | 50552 | 22246 | 22054 | 25582 | 23294 |
| $T_7$ - Seed treatment with *Trichoderma viride* @8 g/kg seed+Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at 10-20 DAS+ Neem oil spray @ 0.2% at 30-40 DAS + Milk whey spray @10% at 50-60 DAS + Oak leaves Extract spray @ 10% at 60-75DAS | 44136 | 45080 | 54080 | 47765 | 19696 | 19418 | 23859 | 20991 |
| $T_8$ - Control | 34164 | 35490 | 43440 | 37698 | 11994 | 12212 | 15856 | 13330 |

**Table 6.** Economics of Oeganic Musrard (2012-13&2013-14 &2014-15)

| Treatments | (B:C Ratio) | | |
|---|---|---|---|
| | 2012-13 | 2013-14 | 2014-15 |
| $T_1$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *NSKE* @ 5% spray at 5-10 DAS + 10-20 DAS+30-40 DAS+ 50-60 DAS + 60-75 DAS | 1.49 | 1.52 | 1.64 |
| $T_2$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed +Neem oil @2% at 5-10 DAS + 10 -20 DAS + 30-40 DAS + 50-60 DAS+ 60-75 DAS. | 1.43 | 1.51 | 1.43 |
| $T_3$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + *Azedirachtin* @3 ml/ lit. at 5-10 DAS+10-20 DAS+30-40 DAS+50-60DAS+ 60-75 DAS | 1.66 | 1.63 | 1.70 |
| $T_4$- Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of milk whey @ 10% at 5-10 DAS + 10-20 DAS+cowurine@10ml/lit.at30-40DAS+50-60DAS+60-75 DAS | 1.72 | 1.71 | 1.65 |
| $T_5$ - Seed treatment with *Trichoderma viride* @ 8 g/kg seed + spray of NSKE @ 5% at 5-10 DAS + Oak leaves extract spray @ 10% at 20-30 DAS s+ Neem oil spray @ 2% at 30-40 DAS | 1.61 | 1.58 | 1.68 |
| $T_6$ - Seed treatment with *Trichoderma viride* @ 8g/kg seed +Spray of *Azadirachtin* @3 ml/lit at 5-10 DAS + Neem oil spray @ 2% at 10-20 DAS + NSKE spray @5% at 30-40 DAS + cow | 1.88 | 1.83 | 1.84 |
| $T_7$ - Seed treatment with *Trichoderma viride* @8 g/kg seed+Spray of NSKE @ 5% at 5-10 DAS+cow urine @10% at 10-20 DAS+ Neem oil spray @ 0.2% at 30-40 DAS + Milk whey spray @10% at 50-60 DAS + Oak leaves Extract spray @ 10% at 60-75DAS | 1.80 | 1.75 | 1.78 |
| $T_8$ - Control | 1.54 | 1.52 | 1.57 |


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