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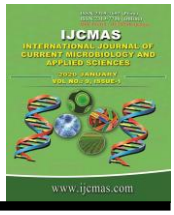

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Assessment of Four Newly Evolved Fungicidal Combinations in Laboratory Conditions Against *Rhizoctonia Solani* Isolates Predominantly in Paddy Fields of Nadia and Bardhhaman Districts of West Bengal, India

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A B S T R A C T

Rice (*Oryza sativa* L.) being a significant food crop feeding millions of people globally. Among many malignancies of rice, the disease known as "Sheath blight of rice" is caused by *Rhizoctonia solani.* which evolved as the threat to rice production and its yield losses ranges from 5.2-50 % in distinct environmental conditions. The preliminary infection on leaf sheath gave the name as “sheath blight”. Many fungicides with diverse modes of action were available in the market. Ten isolates of *R. solani* were collected from Nadia & Bardhhaman districts of West Bengal. The current study was undertaken to determine the best and most economical fungicides to obliterate this disease in *in-vitro* condition. The assessment of efficiency for four fungicides against *R. solani viz.*, Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC and Hexaconazole 4% + Zineb 68 %, Mancozeb 75% WP at 100ppm,250 ppm,500 ppm,1000 ppm concentrations respectively. This study revealed that Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC and Hexaconazole 4% + Zineb 68 % was effective against *R. solani* besides Mancozeb was least under *in vitro* conditions.

Introduction

Rice one of the major significant grain crop consumed by the most of the global population. It is followed by maize and wheat, which together provide 20% of the world's nutritional energy. By 2035, an additional 114 Mt of milled rice will be produced to meet world demand, representing a 26% increase over the next 25 years. Rice is farmed on every continent except Antarctica, spanning about 150 million hectares, with Asia being the largest producer. Yield loss caused by the disease differs based on factors like plant age, time of infection, and disease severity. According to Venkat Rao et al., (1990) and

Naidu (1992), this loss can range from 5.9 to 69 percent. In India, rice cultivation spans across a 43.5 million hectares of land, yielding an overall 112.9 million tonnes, resulting in a productivity rate of 2.56 tonnes per hectare. Specifically, in West Bengal, rice is grown on 5.15 million hectares, producing 15.09 million tonnes, and achieving a productivity of 2933 kg per hectare (Indiastat, 2018). In the realm of rice agriculture, Sheath Blight, caused by R. solani Kuhn, emerges as one of the most pernicious and widespread diseases (Shahram Naeimi et al., 2010). The sheath blight was initially identified in Japan in 1910 and has since spread throughout Asia, giving it the labels "Oriental leaf and sheath blight," "sheath blight," "Pellicularia sheath blight," "sclerotial blight," and "banded blight of rice" (Dath and A.P, 1990).

Most systemic fungicides are presently used to combat *R.solani* disease (Pal et al., 2005). The majority of chemicals show effectiveness against sheath blight disease. However, to prevent the development of fungicidal resistance, it is recommended to rotate the application of fungicides. This approach helps maintain their efficacy in managing the disease. Due to the tolerance of fungicide in the fungus population, it is crucial to look for novel fungicide types with distinct modes of action. Only then can farmers use these new diversified fungicides. In this context, we conducted laboratory tests to assess the effectiveness of four different fungicides, each exhibiting a distinct mechanism of action.

Materials and Methods

Collecting sheath blight disease sample isolates from different locations of West Bengal

The illnesses and symptoms that were seen in nature were examined and recorded. The samples of infected paddy plants with noticeable typical sheath blight symptoms were collected from different regions of Nadia & Bardhhaman districts of West Bengal. The collected samples were brought into laboratory and dried in blotter paper and then preserved for further investigation. The occurrence and intensity of the disease were determined using the formula and scale provided below.

$$\text{Disease incidence: } = \frac{\text{number infected tillers}}{\text{total number of tillers}} \text{X } 100$$

Ten disease samples were collected and taken to the laboratory. These samples were then washed under running tap water to eliminate any dirt or impurities. Plant disease samples were separated into 0.5m sections, 1% sodium hypochlorite solution was used to surface-sterilize for 30 seconds and was cleaned for three or more with different sterile distilled water for each time and blotter dry. Then, plant tissue samples measuring 0.5 cm in length were excised from the lesions and subsequently transferred to an isolation medium, specifically, 2 percent PDA media. Subsequently, the plates were kept at 28±2 °C for 1 to 2 days. Fresh culture hyphal pieces were transferred to PDA-containing petri plates after 72 hours, where they were then kept at 28±2°C. Every 24 hours, the mycelial progress of these plates were recorded.

Microscopic observation revealed that all ten isolates were recognized as *R. solani* based on the presence of right-angle branching. Koch's postulates were successfully proved for ten isolates. Isolates were assigned with name like RS-1 (Chakdah, var. Swarna MTU 7029), RS-2 (Kalyani block-A, var.Ajit), RS-3 (Gayeshpur, var. Swarna MTU 7029), RS-4 (Gayeshpur, var.Pratiksha), RS-5 (Gopalpur, Bardhhaman, var. Swarna MTU 7029), RS-6 (Jaguli, var. Swarna MTU 7029), RS-7 (Balindi, var. Swarna MTU 7029), RS-8 (Balindi, var. Pratiksha), RS-9 (Galsi block-A,Bardhaman, var. Swarna MTU 7029), RS-

10 (Jaguli, var. Satabdi) for deigned experimental purpose.

The assessment of efficiency for four fungicides against *R. solani viz.,* Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC and Hexaconazole 4% + Zineb 68 %, Mancozeb 75% WP at 100ppm,250 ppm,500 ppm,1000 ppm concentrations respectively in lab conditions.

The upshot of different fungicidal components on the pathogen radial growth was experimented with antagonistic activity. The needed amount of test fungicides was taken in conical flask and diluted with PDA medium (autoclaved). To facilitate uniform mixture, the medium was shaken vigorously and 20 ml well mixed PDA with each treatment was poured into each sterile Petri plate.

A sterile cork-borer was used to cut an inoculum disc (5 mm) from a pure culture five days old and placed in the middle of a Petri plate that contained a solidified fungicidal medium. Each treatment was maintained with five replications.

The medium which lacks fungicide is considered as control. The incubation of inoculated petri-plates was done at room temperature. The five replications record of fungus colony diameter was taken periodically. The growth inhibition percentage against the control was determined using the formula provided by Vincent in 1947.

$$I = \frac{C - T}{C} \times 100$$

Whereas,

I = mycelial growth reduction % of *R.solani*,
C = control radial growth (mm)
T= treatments radial growth (mm)

Results and Discussion

Effect of different newly evolved fungicides on growth of different isolates of R. solani in-vitro condition

Effect of four newly evolved fungicides *viz.*, Mancozeb 52.6% + Hexaconazole 2.4%, Hexaconazole 5% EC, Hexaconazole 4% + Zinab 68%, Mancozeb 75% WP were recorded the growth of *Rhizoctonia solani* the fungicides were tested with four concentrations 100ppm, 250ppm, 500ppm, 1000 ppms. The observations are presented in the Figures (1 to 10). It is evident from the Figures that (1 to 10).

Mancozeb 52.6% + Hexaconazole 2.4% was found to be most effective giving complete inhibition of growth at 500ppm and 1000ppm against isolate RS1, RS2, RS3, RS6, RS9, RS10 respectively. This was followed by Hexaconazole 5% EC and Hexaconazole 4% + Zinab 68%.

These results corroborated the earlier findings of Akter *et al*. (2001), Sudakar *et al.* (2005), Agarwal and Sundar. (2012), Raj *et al*., 2016; Raji *etal*., 2016 and Pramesh *et al*., 2017; who revealed that cent percent inhibition of *R.solani* by Hexaconazole 5% EC and Propiconazole 25% EC at concentration.

In conclusion, Fungicidal screening was led in vitro to determine the vulnerability of Rhizoctonia solani by poisoned food technique at different concentrations. The inhibition percent of mycelium was recorded maximum (100%) by fungicidal combinations viz. Mancozeb 52.6% + Hexaconazole 2.4% (100,250,500,1000), Hexaconazole 5% EC (100,250,500,1000), Hexaconazole 4% + Zineb 68% (100,250,500,1000) at all the concentrations tested. Followed by Mancozeb 75% WP (100, 250, 500, 1000), concentrations respectively.

Fig.1 *Invitro* effect of fungicides against *R.solani* isolate of Swarna MTU 7029, chandah

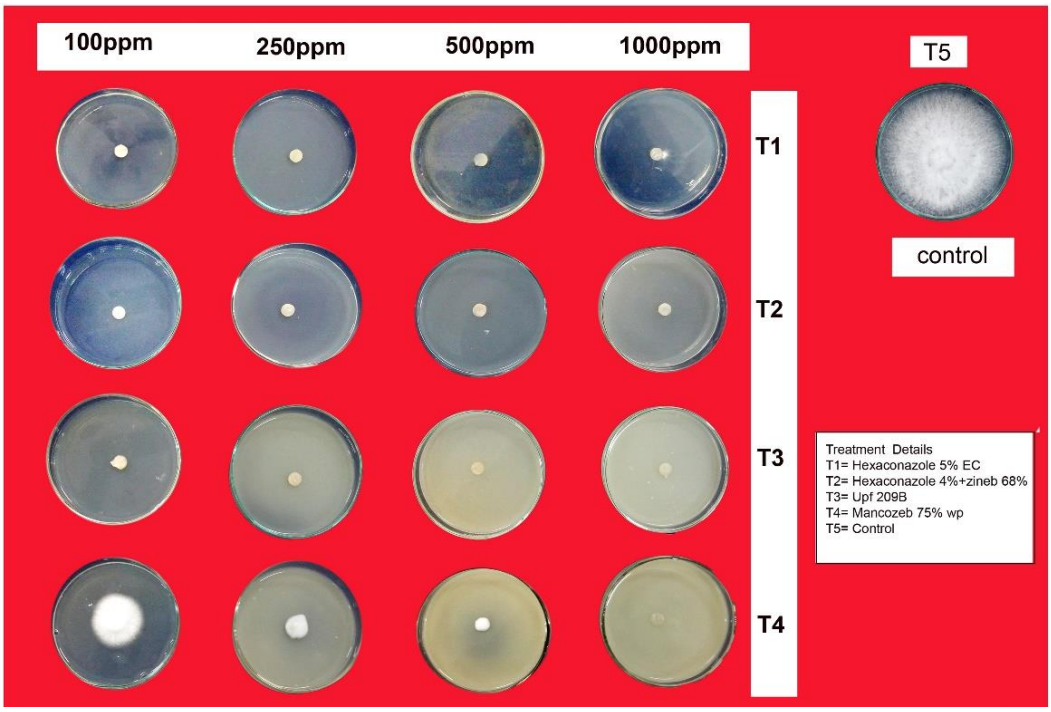


Fig.2 Effect of newly evolved fungicidal combinations on the mycelial growth of R. solani of RS-1 culture

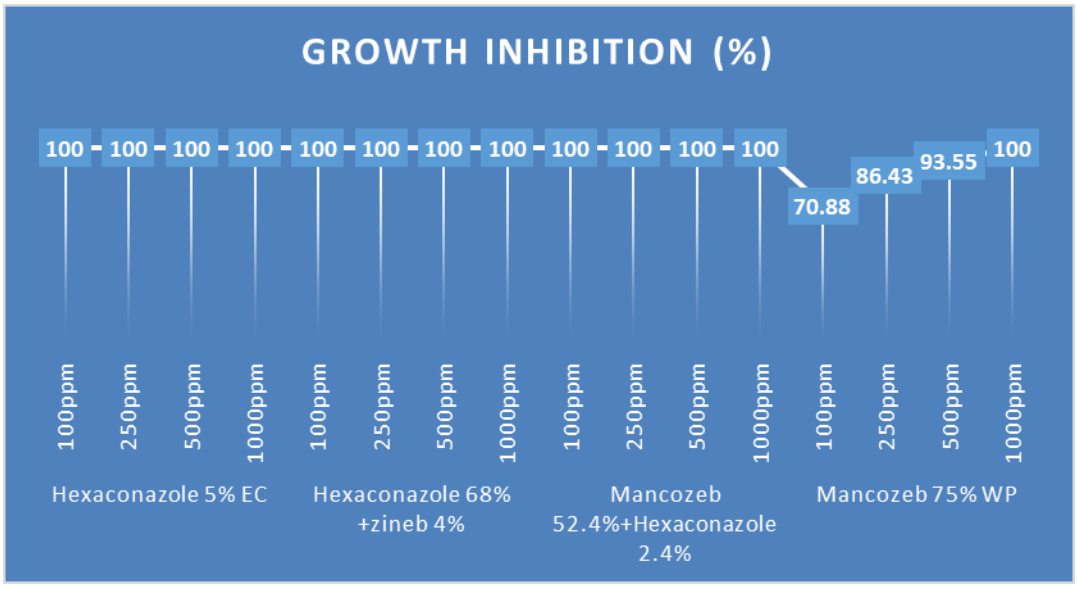


Fig.3 *Invitro* effect of fungicides against *R.solani* isolate of Ajith, Kalyani, A Block

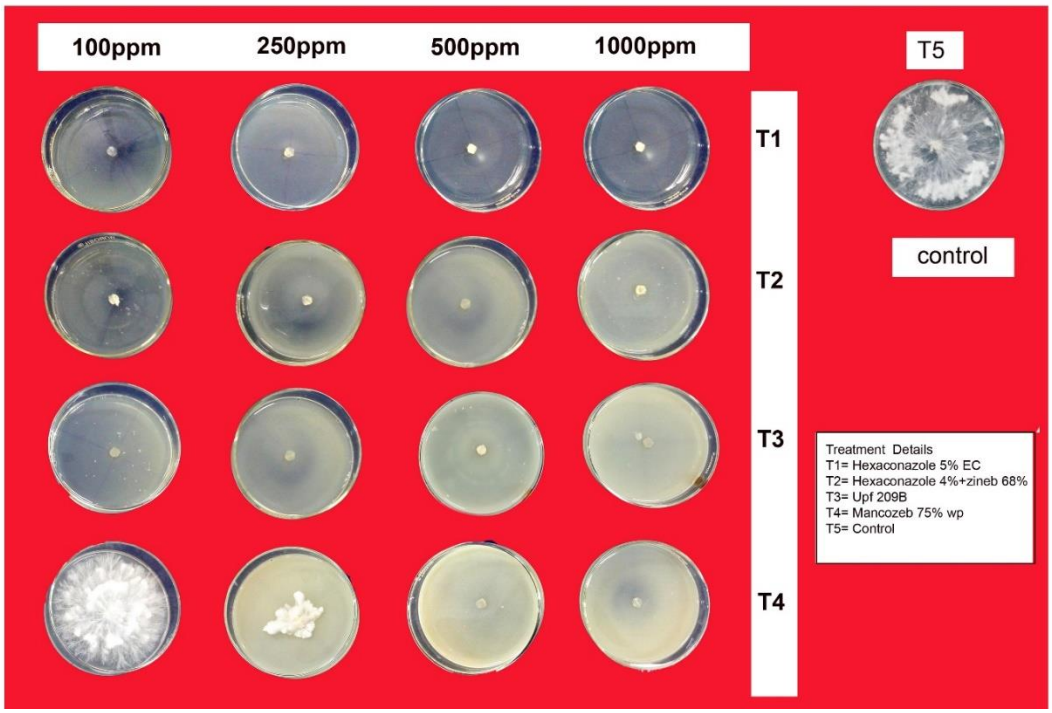


Fig.4 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-2 culture

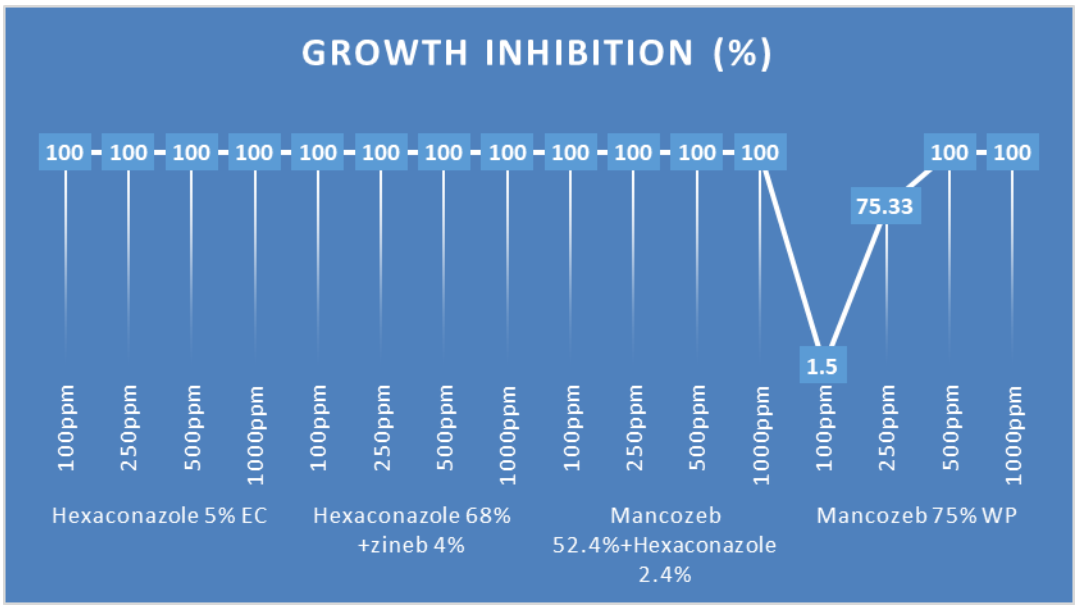


Fig.5 *Invitro* effect of fungicides against *R.solani* isolate of Swarna-7, Gayeeshpur

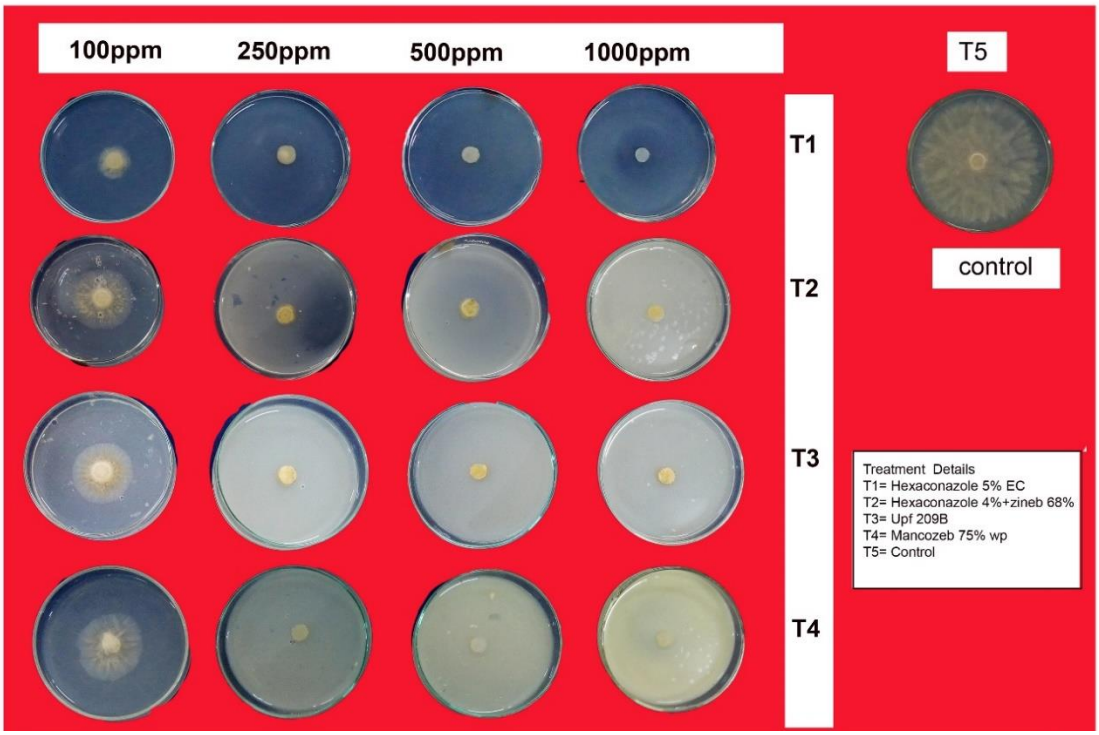


Fig.6 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-3 culture

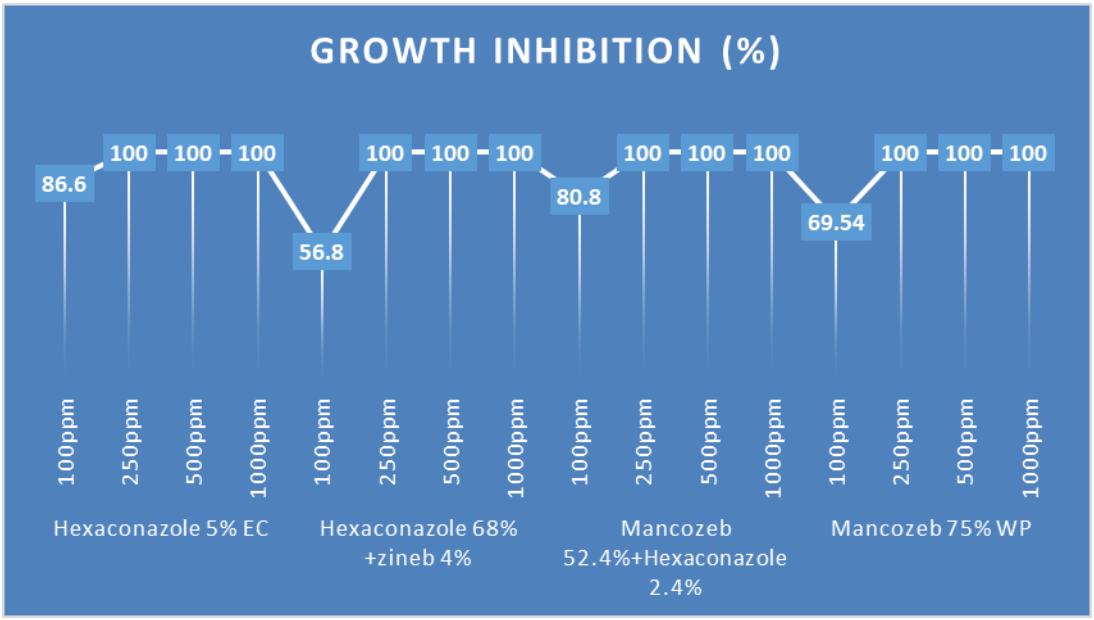


Fig.7 *Invitro* effect of fungicides against *R.solani* isolate of Pathika, Gayeeshpur

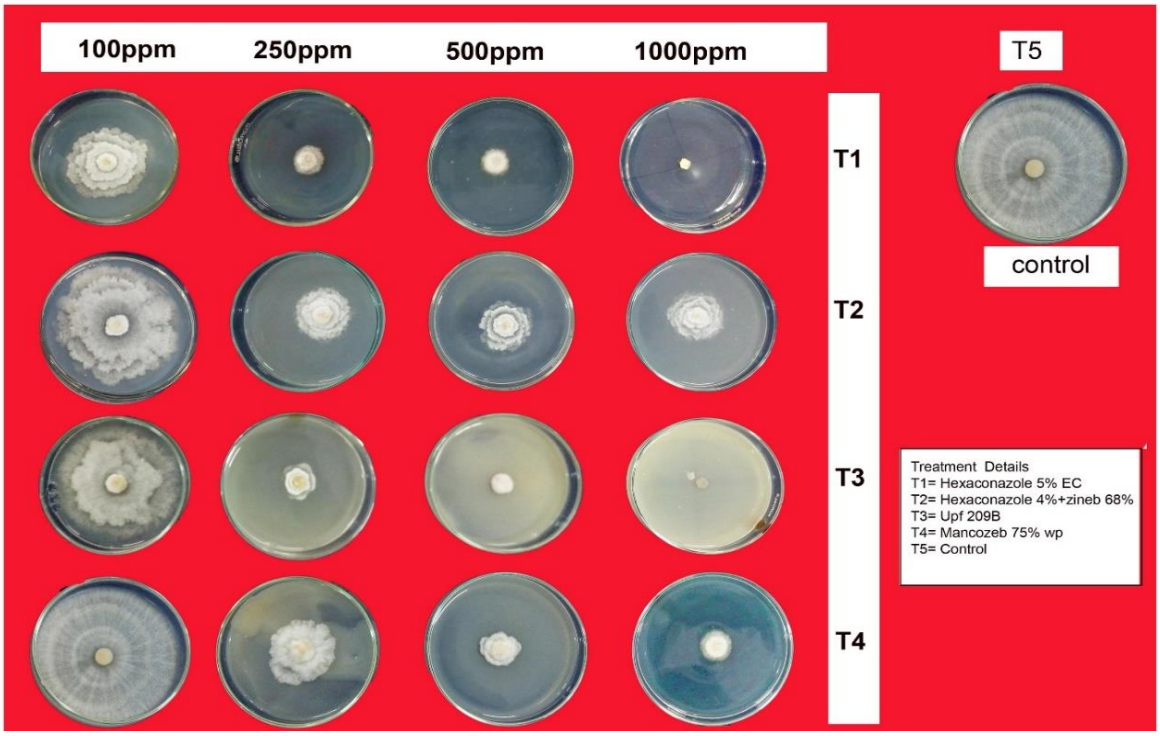


Fig.8 Effect of newly evolved fungicidal combinations on mycelial growth of R. solani of RS-4 culture

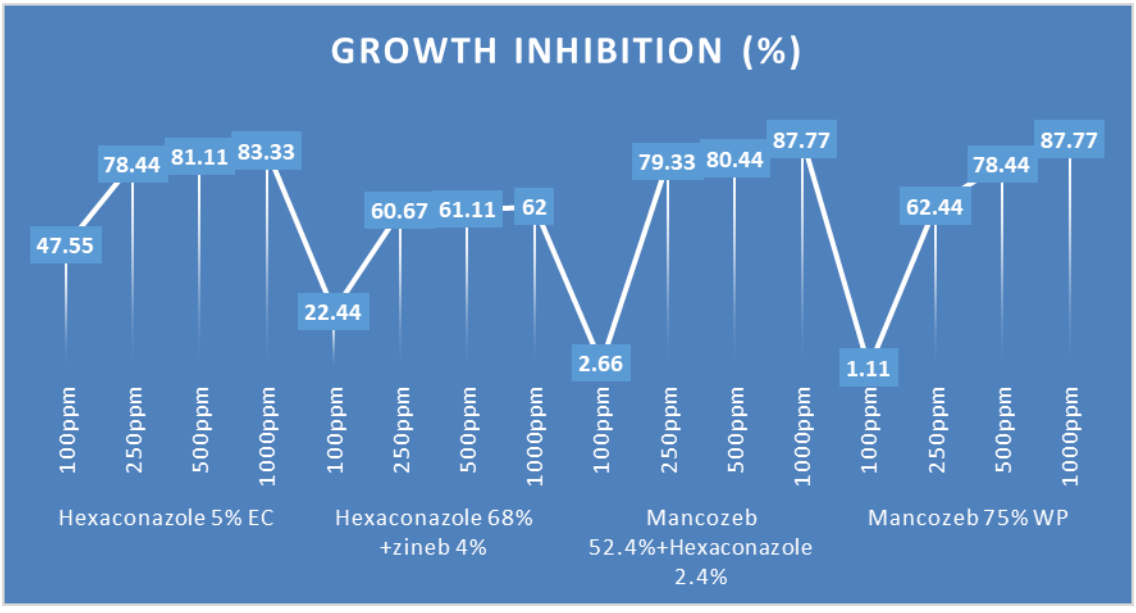


Fig.9 *Invitro* effect of fungicides against *R.solani* isolate of Swarma MTU 7029, Bardhaman

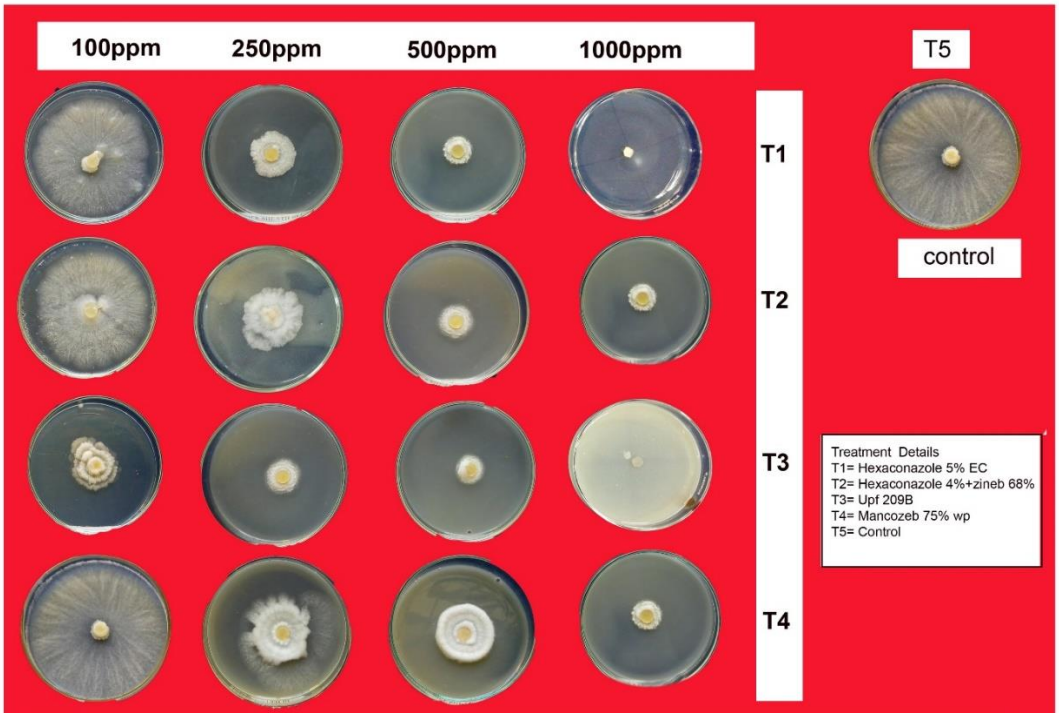


Fig.10 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-5 culture

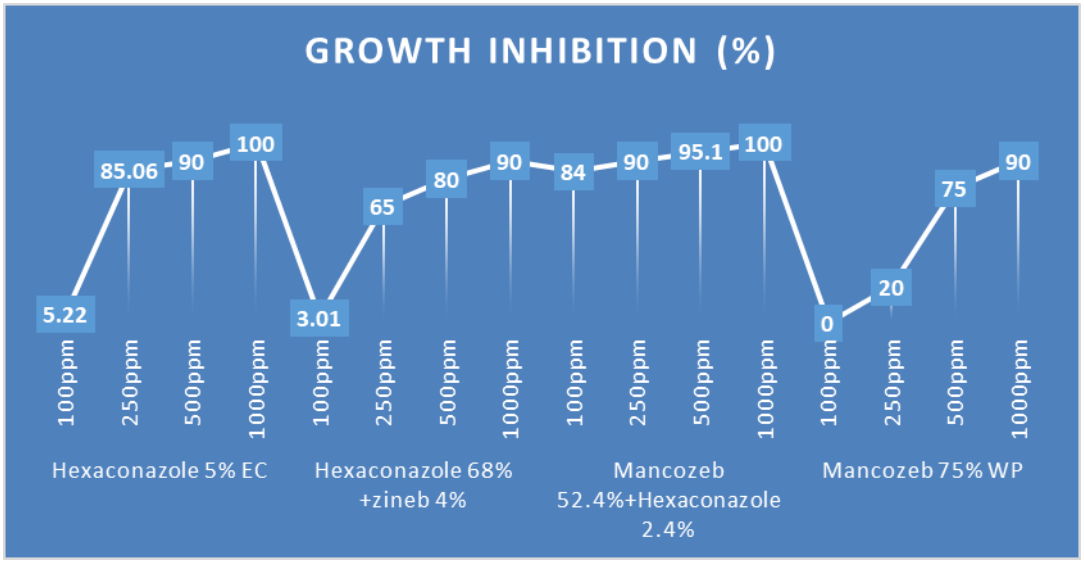


Fig.11 *Invitro* effect of fungicides against *R.solani* isolate of Swarma MTU 7029, Jaguli

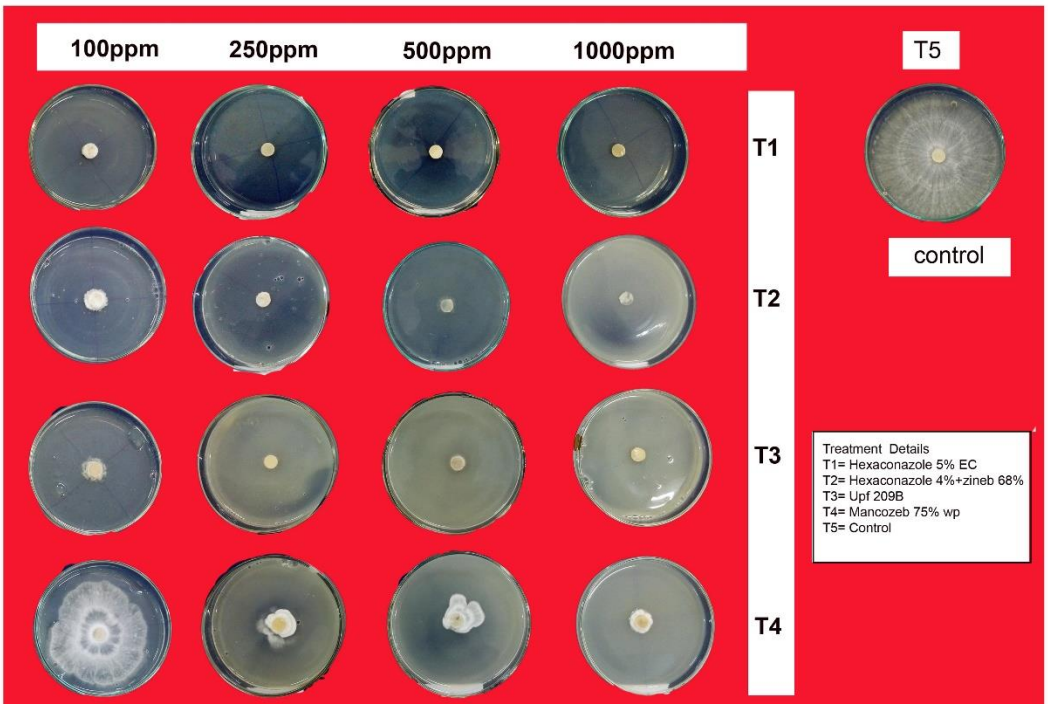


Fig.12 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-6 culture

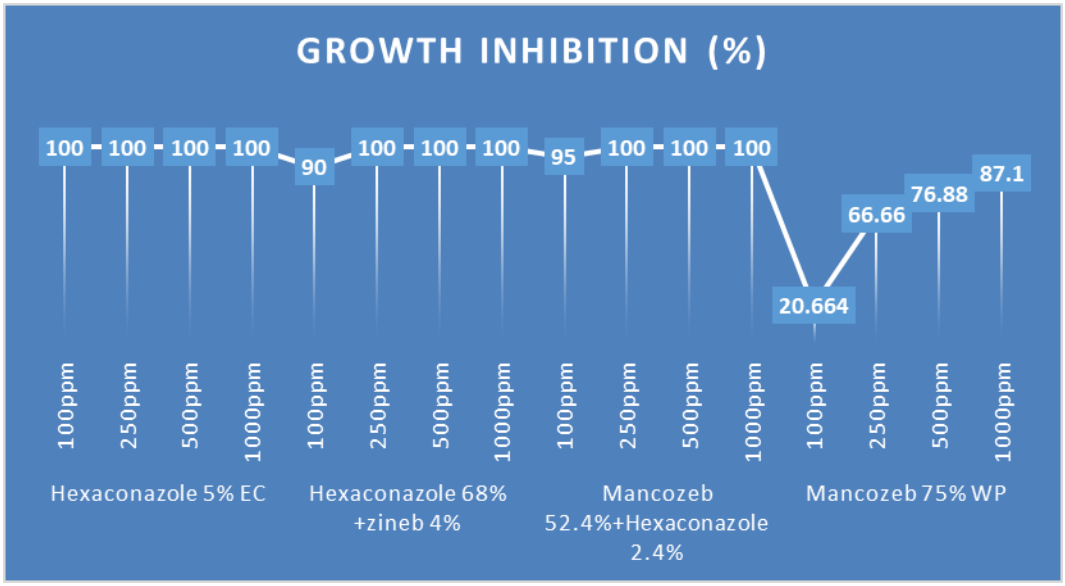


Fig.13 *Invitro* effect of fungicides against *R.solani* isolate of Swarma MTU 7029, Balindi farm

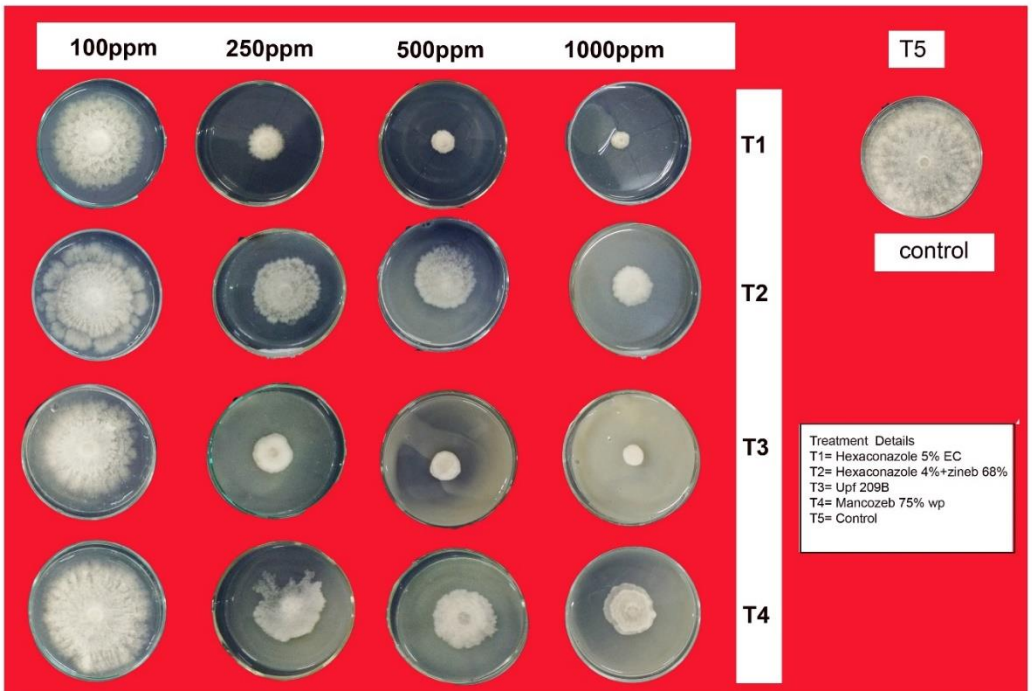


Fig.14 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-7 culture

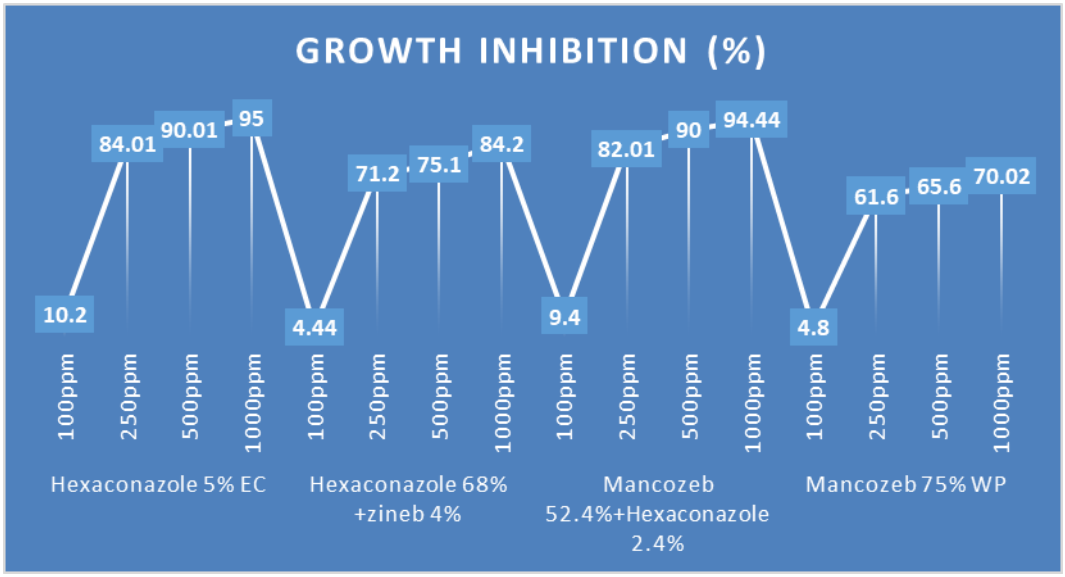


Fig.15 *Invitro* effect of fungicides against *R.solani* isolate of Pathika, Balindi farm

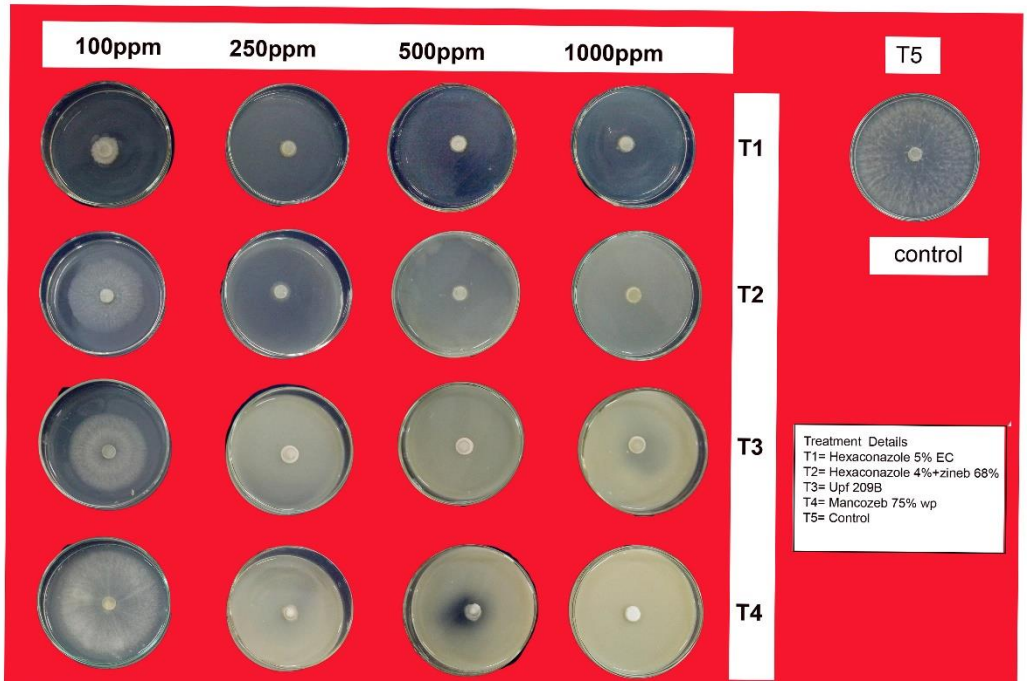


Fig.16 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-8 culture

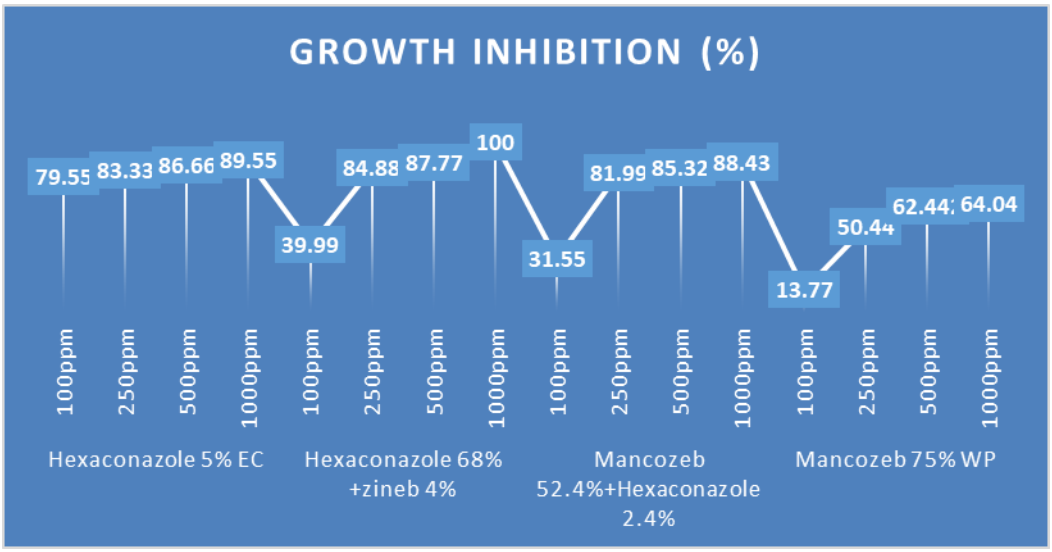


Fig.17 *Invitro* effect of fungicides against *R.solani* isolate of Swarna MTU 7029 kalsi block-A, Bardhaman

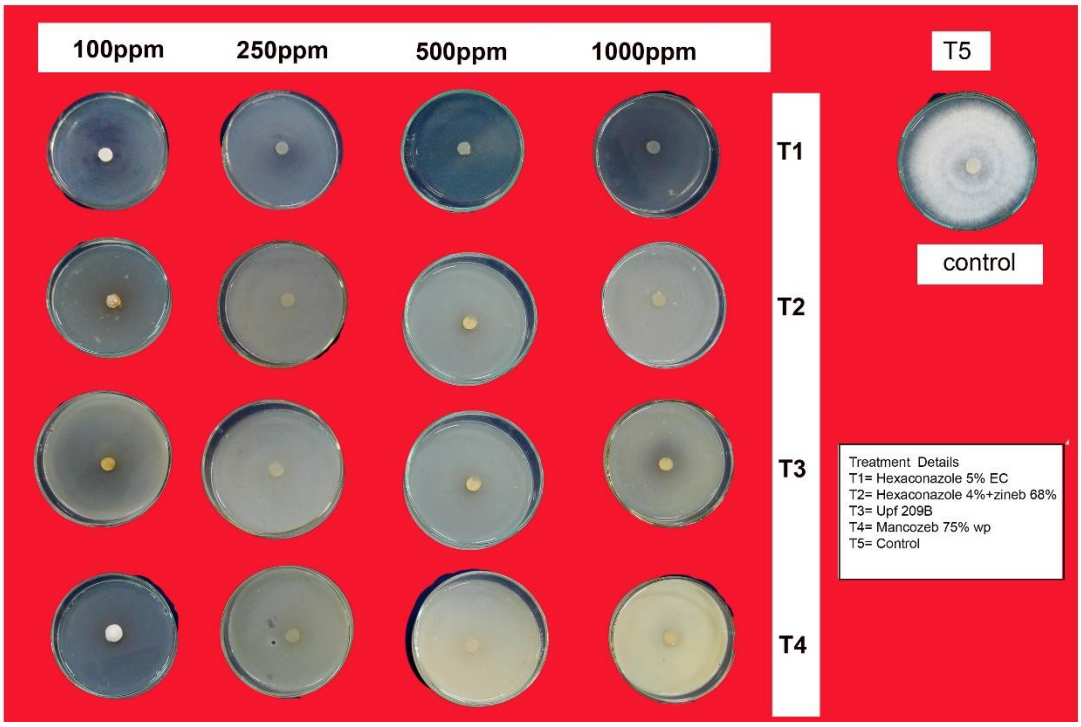


Fig.18 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-9 culture

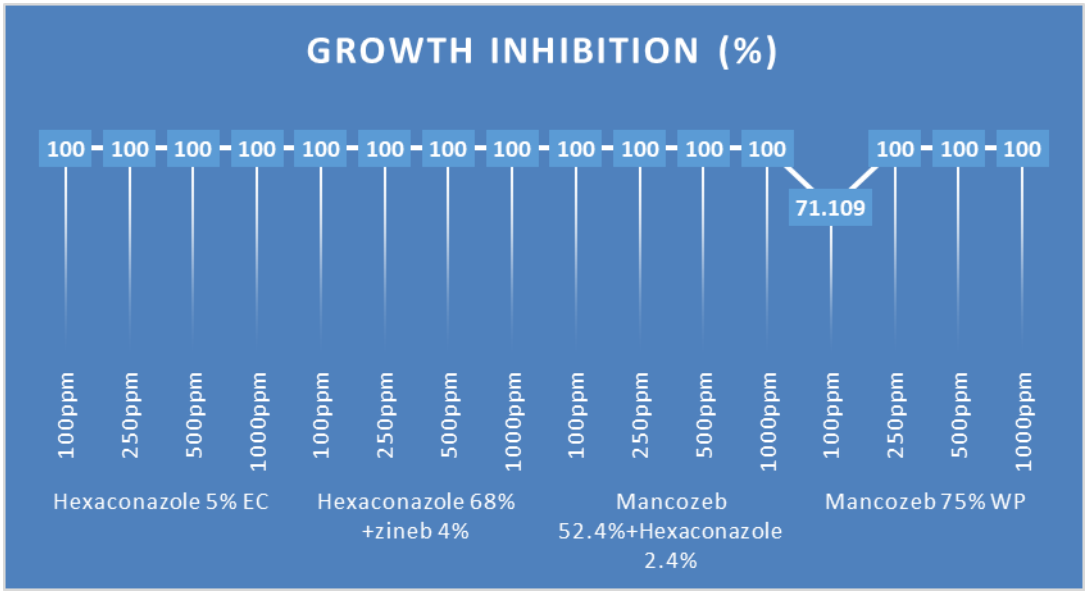


Fig.19 *Invitro* effect of fungicides against *R.solani* isolate of Satabdi, Jaguli farm

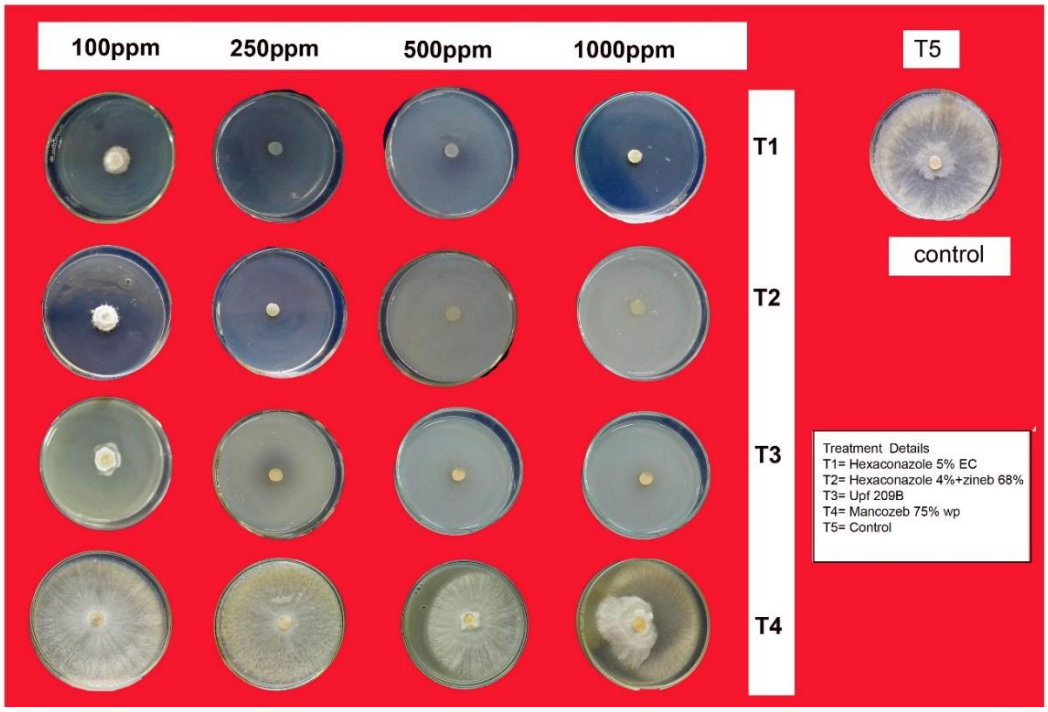
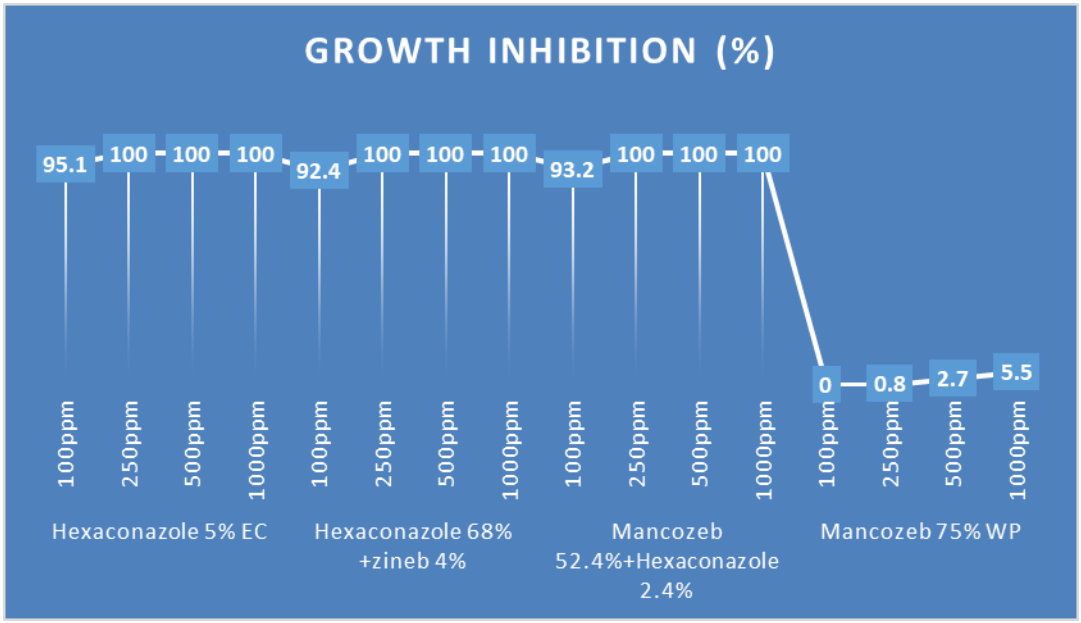


Fig.20 Effect of newly evolved fungicidal combinations on mycelial growth of *R.solani* of RS-10 culture



Future Scope:

To learn more about their impact on reducing disease severity or developing resistance, a wider variety of chemical stimulants, need to be studied at various rates and application times.

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