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Physical and chemical control of root rot of brinjal caused by *Rhizoctonia solani* Kuhn

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Abstract
Present investigation revealed the physical and chemical methods for controlling root rot of brinjal caused by *Rhizoctonia solani* under *in vitro* as well as *in vivo* condition. Under pot culture experiment, physical method *i.e*. soil solarization was used to control mortality of seedling caused by *R. solani*, which showed 76% seed germination and 15.78% rotting of seedlings as against 54% seed germination and 35.18% seedling mortality in non-solarized soil. Due to soil solarization plant height is also increased by conversion of nutrients into available form for profuse growth of seedlings. Efficacy of two fungicides *viz.* bavistin and thiram were tested by poisoned food technique for the controlling root rot of brinjal. This study revealed that the bavistin (0.02%) and thiram (0.05%) completely inhibited the radial mycelial growth. *In vivo* Seed treatment with bavistin and thiram resulted into increased seed germination and reduced root rot incidence considerably. Seedling treatment at the time of transplanting also reduced the disease incidence.

Keywords: *Rhizoctonia solani*, Soil solarization, fungicides, root rot, plant height, seedling mortality etc

Introduction
Egg - plant (*Solanum melongena* L.) an important of the popular vegetable worldwide. It is affected by several diseases, which do not let the plants to grow and yield to a best of genetic potential. Among various pathogens, fungi constitute an important group as they inflict damage to crop plant at different stages. Among the fungal diseases, the root - rot caused by *Macrophomina* remains to be a challenging task in terms of management, since it is soil -borne in nature. It is distributed worldwide and is prevalent in arid, sub - tropical and tropical climate, especially in the areas with low rainfall and high temperature. Various disease management methods have been implemented to combat and eradicate pathogenic fungi. These include cultural, regulatory, physical, chemical and biological methods. All these methods are effective only when employed well in advance as precautionary measure. Once a disease has appeared, these methods become impractical / ineffective. In that situation, chemical control along with physical methods offers a good choice to grower to control the disease. Chemical pesticides have been in use since long and they provide quick, effective and economic management of plant diseases. However, in recent past, it has been realized that only use of chemical in agriculture is not as beneficial as it was visualized. Chemical pose serious health hazards to an applicator as well as to a consumer of the treated material. In addition to target organism, pesticides also kill various beneficial organisms. Their toxic forms persist in soil and contaminate the whole environment. Increasing awareness of humankind toward the ecosystem and environment has made a marked along with physical methods *i.e*. soil solarization. The present investigation is, however, design in a way to investigate comparative effect of soil solarization and use of chemicals against *Rhizoctonia solani* on Eggplant.
Near about 28 metric tons yield of brinjal is reduced due to incidence of damping off, root rot and collar rot caused by *Rhizoctona solani.* Since last five to seven years the root rot disease was reported in severe proportion in Bhandara, Chandrapur and Nagpur districts of Maharashtra of Vidarbha region which falls in tropics and subtropics. The disease is becoming potentially dangerous for brinjal cultivation. Hence it was envisaged to investigate the effect of soil solarization and also efficacy of fungicides.

Methodology
Soil solarization
To assess the effect of soil solarization on survival of pathogen in soil and its disease causing capacity, seed germination, plant height and weed population the pot culture experiment was conducted by mixing mass culture of *R. solani* grown on sand sorghum grain medium thoroughly at the rate of 50 gm. per kg of sterilized soil.

The soil thus inoculated was filled in disinfected earthen pots (30 cm. diameter). The pots were watered thoroughly and kept sufficiently moist for next 3 days. Subsequently the pots were covered (closed) with 100 mu transparent polyethylene sheet. The covering was ' made airtight with string around the neck of pots. The covered pots were kept in open in bright sunlight continuously for 6 weeks during the month of May-June. The pots filled with inoculated soil but left uncovered with polyethylene sheet and kept under identical condition simultaneously were used as check. To see the effect of soil solarization on seed germination, seedling mortality, 50 seeds were sown in each pot (total 200 seeds) and observations were recorded up to 45 days from sowing and presented in table1.

***In vitro* assay of fungicides**

Chemicals *viz.* bavistin and thiram were used in three concentrations (0.1, .0.05, 0.02, and 0.2, 0.1, 0.05 percent respectively) to find out their relative toxicity on radial growth of *Rhizoctonia solani* by using 'Poison Food Technique' (Horsfall, 1956) [4]. Sterilized PDA incorporated with different concentrations of fungicides were poured into Petri plates and were centrally inoculated with 4mm diameter mycelial disc of test pathogen. Control sets were run simultaneously with normal PDA. Radial growth was measured 7 days after incubation at 27+1 °C. The experiment was arranged in five replications and percent growth of inhibition was calculated by using following formulae.

$$\text{Inhibition Percentage} = \frac{C-T}{C} X100$$

Where,

C = Growth in check plate (control) in mm.

T = Growth in plate treated with chemical in mm.

***In vivo* assay of fungicides: Seed treatment**

The concentrations of fungicides which showed maximum inhibition *in vitro* was selected for *in vivo* studies. Brinjal seeds were treated with solution of 0.02% bavistin and 0.05% thiram and used for sowing. Periodic observations were recorded on number of seeds germinated and number of seedlings rotted or wilted. The experiment was arranged in five replications.

Seedling treatment

One month pot grown seedlings were used for seedling treatment. The seedlings were removed from pot without damaging the root system and treated with the solutions of bavistin (0.02%) and thiram (0.05%) by root dip method and transplanted in pot with sick soil. The experiment was arranged in five replications and periodic observations were recorded.

Results and Discussion

From the above table 01, it was revealed that in solarized soil 76 percent germination and 15.78 percent rotting of seedlings as against 54 percent seed germination and 35.18 percent seedlings rotting in non-solarized soil was recorded. The percent seed germination in solarized soil increased by 22 and percent mortality decreased by 44.85 as against non-solarized treatment. Increase in percent germination may be due to elimination of soil-borne pathogen and increase in concentration of nitrogen and certain other soluble plant nutrients and reduction in inoculum of soil-home pathogen, also reduced the quantity of phytotoxins secreted by micro organisms. This might have favoured higher seed germination in solarized soil. Similar results were obtained by Katan *et al.* (1976, 1980) [5, 6].

Decrease in percent seedlings mortality in solarized pots was due to reduction in soil-home pathogen by increased soil temperature during solarization. Stapleton and Deavy (1984) [15], Kye and Kim (1985) [7] reported that soil solarization effectively controlled soil-home diseases caused by *Fusarium oxysporum* f. sp. Lycopersicae, *R. solani* and *sclerotium rolfsii* in barly.

Effect of soil solarization on plant height and weed population

To assess the effect of soil solarization on the growth of seedlings the observations in respect of height of seedlings at 45 days were recorded after sowing. For that 5 seedlings were selected from each pot and data regarding height was presented in table -02. At the same time observations on weed population were recorded and presented in same table 02.

From the above table 02 it was revealed that the solarized treatment showed increase in mean height of seedlings as compared to non-solarized treatment. The mean height of brinjal seedlings in solarized pot was 18.3cm. as against 12.6cm. in non-solarized pots. The percent increase in height over control was 45.23. This increase in height of seedling in solarized pots may be due to increased availability of nutrients. Similar results were recorded by Katan *et al*. (1970) and Stapleton and Davey (1982) [14]. As far as weed population is concerned, it was seen that the average number of weeds in solarized pots was zero as against 66 in non-solarized pots. The percent decrease in weed population was 100 percent in solarized pots as compared to non-solarized pot. Similar results were obtained by Hilderbrand (1985) [3].

Soil solarization was used to control mortality of seedlings. Decrease in percent seedling mortality in solarized pots was due to reduction of soil borne pathogen by increased soil temperature during solarization. Soil solarization enhanced the seed germination by 22 percent and decreased seedling mortality by 44.85 percent against non-solarized treatment. Solarization increased the height of seedlings by 45.23 percent. It also reduced the population of seasonal, annual and perennial weeds and completely inhibited weed emergence as compared to non-solarized treatment. This increased growth response of seedlings and reduction of population of weeds are an addition to the effect of controlling the target pathogen by soil solarization.

In vitro assay revealed that when bavistin and thiram were used in three different concentrations *i.e.* 0.1, 0.05, 0.02 and 0.2, 0.1, 0.05 percent respectively by using 'Poison Food Technique' given by Horsfall 1956 [4], both the fungicides were found very effective even at lowest concentration of 0.02% and 0.05% respectively for complete inhibition of test pathogen *i.e. R. solani* as compared to control and the data are presented in table 03. Similar results were reported by Viswakarma and Basuchaudhar) (1982) [16], Chakraborty *et al*. (1985) [2], Lakshmamana and Chandrasekharam Nair (1986) [8], Pandey and Shrivastava (1990) [10].

In *in vitro* studies bavistin 0.02% and thiram 0.05% were found effective in completely inhibiting the radial growth of *R. solani* and were used *in vivo* studies. In pot culture experiment for each treatment 150 seeds were used i.e. 30 seeds per pot. The seeds were treated with 0.02% solution of bavistin and 0.05% solution of thiram and sown in pot. The periodic observations on number of seed germinated, number seedlings rotted were recorded up to 45 days from date of sowing and data are present in Table 04. Data regarding

percent germination of seed and percent rotting of seedlings are presented in Table 04.

From the Table 4a, it is observed that the percent seed germination in case of bavistin was 73.33 percent where as in case of thiram 75 percent respectively as against control. The data regarding number of seedlings rotted (mortality of seedlings) was statistically analyzed and it is observed that both treatments were significantly superior to control disease but were found at par with each other. Similar results were recorded by Parthsarthy Prasad and Hiremath (1985) [11], Singh and Thapliyal (1987) [13], Bhaskar and Ahrnad (1990).

***In vivo* assay with fungicidal seedling treatment**

The fungicides *viz*. bavistin (0.02%) and thiram (0.05%) were used for seedling treatment, the observations were recorded till 30th days after transplanting of seedlings to pot with sick soil. The data regarding percent root rot incidence were recorded and presented in Table 05 and Table 5a. From Table 05, it is revealed that, the percent root rot incidence in case of bavistin was 28 percent while 36 percent in case of thiram as against 80 percent in control. The percent decrease in root rot incidence over control was 52 and 44 percent respectively. The data regarding percent incidence of root rot was statistically analyzed and it is observed that both treatments were significantly superior over control but were at par with each other.

Similar result were obtained by Borum and Sinchlair (1968) [1]. In the present study two fungicides *viz*. bavistin and thiram were evaluated *in vitro* for their efficacy against *R. solani*. Bavistin (0.02%) and thiram (0.05%) completely inhibited mycelial growth of test pathogen. Seed treatment with bavistin (0.02%) and thiram (0.05%) were found to be the best in controlling root rot disease in sick soil. In the same manner when one month old seedlings were treated with the solutions of these fungicides at the time of transplantation, there was considerable reduction in disease incidence.

Table 1: Effect of soil solarization on seed germination and seedling mortality in brinjal

Sr. No.	Treatment	No. of seeds		% germination	% germination increased over control	No. of plants rotted	% rotting	% mortality decreased over control
		Sown	Germinated					
1	Solarized soil	200	152	76	22	24	15.78	44.85
2	Non-solarized soil	200	108	54	-	38	35.18	-

Table 2: Effect of soil solarization on plant height and weed population

Sr. No.	Treatment	Mean height in cm at 45 days	% increase in height over control	Average No. of weeds	% decrease in weed population over control
1	Solarized	18.3	45.23	-	100
2	Non-solarized	12.6	-	66	-

Table 3: *In vitro* assay of fungicides

Treatment	Concentrations in Percent	*Average radial growth in mm	Percent inhibition
Bavistin	0.10	0.0	100.00
	0.05	0.0	100.00
	0.02	0.0	100.00
Thiram	0.20	0.0	100.00
	0.10	0.0	100.00
	0.05	0.0	100.00
Control (without chemical)	0.00	90.0	0.00

* Average of 5 replications

Table 4: Effect of seed treatment on root rot incidence

Seed treatment	No. of seeds Sown	No. of seeds germinated	Percent germination	No. of seedlings rotted	Percent rooting
Bavistin	150	110	73.33	10	9.09
Thiram	150	117	78.00	14	12.00
Control	150	85	56.66	35	41.17

Table 4a: Effect of seed treatment on root rot incidence (statistical analysis)

Sr. No.	Treatment	Percent seedling mortality					Mean
		R-I	R-II	R-III	R-IV	R-V	
1	Bavistin	6.66(15.00)	6.66(15.00)	3.33(10.47)	10.00(18.44)	6.66(15.00)	6.662(14.78)
2	Thiram	6.66(15.00)	10.00(18.44)	6.66(15.00)	13.33(21.39)	10.00(18.44)	9.330(17.65)
3	Control	23.33(28.86)	20.00(26.56)	26.66(31.11)	16.66(24.12)	30.00(33.21)	23.330(28.77)

(Figures in parenthesis are arcsine values).

Result: 'F' test - significant, SE: 1.38, C. D. at 5%: 3.00

Table 5: Effect of seedling treatment on root rot incidence (statistical analysis)

Sr. No.	Treatment	No. of seedlings planted	No. of seedlings rooted	% root rot incidence	% decrease in root rot incidence over control.
1	Bavistin	25	7	28	52
2	Thiram	25	9	36	44
3	Control	25	20	80	-

Table 5a: Effect of seedling treatment on root rot incidence (Statistical analysis)

S. No.	Treatment	Percent seedling mortality					Mean
		R-I	R-II	R-III	R-IV	R-V	
1	Bavistin	40.00(39.23)	20.00(26.56)	20.00(26.56)	40.00(39.23)	20.00(26.56)	28.00(31.62)
2	Thiram	20.00(26.56)	40.00(39.23)	40.00(39.23)	20.00(26.56)	60.00(50.77)	36.00(36.47)
3	Control	80.00(63.44)	100.00(90.00)	60.00(50.77)	80.00(63.44)	80.00(63.44)	80.00(66.21)

(Figures in parenthesis are aresine values)

Result: 'F' test: significant, sSE- 4.90, C. D. at 5% - 10.67

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