STUDIES ON COLLAR ROT OF ELEPHANT FOOT YAM CAUSED BY *Sclerotium rolfsii* Sacc.

By

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MAY, 2018

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A thesis submitted to the

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(Agricultural University)

Dist. Ratnagiri (Maharashtra State)

In partial fulfilment of the requirements for the degree of

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CERTIFICATE

This is to certify that the thesis entitled, **"Studies on collar rot of elephant foot yam caused by *Sclerotium rolfsii* Sacc."** submitted to the Faculty of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra State, in the partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (Agriculture)** in **PLANT PATHOLOGY,** embodies the results of a piece of bona-fide research carried out by **Ms. DIVYA DILIP JAMBURE** under my guidance and supervision and that no part of this thesis has been submitted for any other degree or diploma or published in other form. All the assistance and help received during the course of investigation and the sources of literature have been duly acknowledged by her.

Place: Dapoli
Date**:** May, 2018

(R. G. BHAGWAT)
Chairman,
Advisory Committee
and
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"Coming together is beginning, carrying together is progress and keeping together is success", this phrase comes to be true, while completing the post graduation. Therefore, at the outset, it is necessary to shape my feeling in words even though carrying of feelings in words is difficult, still a little effort is being done to access the never ending helping hands.

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Above all, I bow my head to great god for the peace of mind and strength given to me during various phases of my life journey.

Place: Dapoli

Date: ***(Miss. Divya Dilip Jambure)***

APPENDIX I

ABBREVIATION'S USED

%	Per cent
/	Per
@	At the rate
^{0}C	Degree celcius
C.D.	Critical Difference
Cm	centimeter
Co.	Company
Conc.	Concentration
DAP	Days after planting
d.f.	Degree of freedom
Dist.	District
Dr.BSKKV	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
EFY	Elephant foot yam
E.M.S.	Error mean sum of square
et al.	and others
etc.	et cetera
FYM	Farm yard manure
Fig.	Figure
g	gram
ha	hectare
i.e.	that is
Kg	kilogram
m	metre
M.S.S.	Mean sum of square
mg	milligram
P.F.T.	Poisoned Foot Technique
P.D.A.	Potato Dextrose Agar
ppm	Parts per million
Pvt.	Private
S.E.	Standard error
Syn.	Synonymous
viz.	Namely
w/w	weight : weight
Sr.	*Sclerotium rolfsii*
Tk	*Trichoderma koningii*
Th	*Trichoderma harzianum*
Tv	*Trichoderma viride*
Pf	*Pseudomonas fluorescens*
WP	Wettable Powder
BOD	Biological Oxygen Demand
lbs	Pounds
Psi	Per square inch
Sig.	Significant

APPENDIX – II

LABORATORY MEDIA USED

1) Czapek's Dox agar medium

a) Sucrose : 3.00 g

b) Sodium nitrate ($NaNO_3$) : 20.00 g

c) Potassium dihydrogen phosphate (K_2PO_4) : 1.00 g

d) Magnesium sulphate (MgSO4.2H2O) : 0.50 g

e) Potassium chloride : 0.50 g

f) Ferric chloride : 0.01 g

g) Agar-agar : 20.00 g

h) Distilled water : 1000 ml

2) Potato Dextrose Agar (PDA)

a) Peeled potato : 200 g

b) Dextrose : 20 g

c) Agar-agar : 20 g

d) Distilled water : 1000 ml

3) V8 Agar Medium

a) V8-agar : 44.3 g

b) Distilled water : 1000 ml

4) Oat Meal Agar Medium

a) Oat Meal : 72.5 g

b) Agar-agar : 20 g

c) Distilled Water : 1000 ml

5) Water Agar Medium

a) Agar-agar : 20 g

b) Distilled water : 1000 ml

6) Potato Malt Agar

a) Potato : 200 g
b) Malt extract : 20 g
c) Peptic digest of animal tissue : 1 g
d) Sucrose : 60 g
e) Agar : 20 g
f) Distilled water : 1000 ml
g) Final pH : 7.4 ±0.2

7) Host Bark Extract Agar

a) Peeled potato : 200 g
b) Agar-agar : 20 g
c) Dextrose : 20 g
d) Host bark extract : 100 ml
e) Distilled water : 900 ml

APPENDIX – III

Analysis of variance (Solid media × *Sclerotium rolfsii* Sacc.)

Source of variation	Degree of freedom	Sum of square	Mean sum of square	F-cal	F-tab	Result
Treatment	6	20716.74	3452.79	58.14642	3.87	Sig.
Error	14	831.3333	59.38095			
Total	20	21548.07				
S.Em.±	4.44					
C.D at 1 %	18.72					

APPENDIX –IV

Analysis of variance (Fungicides × *Sclerotium rolfsii* Sacc.)

Source of variation	Degree of freedom	Sum of square	Mean sum of square	F-cal	F-tab	Result
Treatment	6	37489.81	6248.30	3453.009	3.87	Sig.
Error	14	25.33333	1.80952			
Total	20	37515.14				
S.Em.±	0.77					
C.D at 1 %	3.26					

APPENDIX – V

Analysis of variance (Bioagents × *Sclerotium rolfsii* Sacc.)

Source of variation	Degree of freedom	Sum of square	Mean sum of square	F-cal	F-tab	Result
Treatment	4	7687.05	1921.763	44.3697	4.89321	Sig.
Error	15	649.6875	43.3125			
Total	19	8336.738				
S.Em.±	3.29					
C.D at 1 %	13.71					

DEPARTMENT OF PLANT PATHOLOGY

COLLEGE OF AGRICULTURE, DAPOLI.

Title of the thesis	:	"Studies on collar rot of Elephant Foot Yam caused by *Sclerotium rolfsii* Sacc."
Name of the student	:	*Miss. Divya Dilip Jambure.*
Regd. No.	:	2478
Name and Designation of the Research Guide	:	**Dr. R. G. Bhagwat** Assistant Professor of, Department of Plant Pathology, College of Agriculture, Dapoli-415 712, Dist. Ratnagiri (M.S.)
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THESIS ABSTRACT

Collar rot disease of Elephant foot yam caused by *Sclerotium rolfsii* Sacc. was noticed at AICRP on Tubers, Central Experimental Station, Wakavali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Taluka- Dapoli (Dist- Ratnagiri). The disease incidence observed was up to 30 to 45 per cent. Therefore, present study was planned and conducted at the department of Plant Pathology, Dr. BSKKV, Dapoli During 2017-18.

The pathogen was isolated from infected stem of Elephant foot yam on Potato Dextrose Agar in laboratory. The Pathogenicity of *S. rolfsii* Sacc. was proved on Elephant Foot Yam plants. The dark brownish lesions developed on stem and shriveling of the stem extended above collar for 2-5 centimeters. Thick mycelial mat and whitish pre mature sclerotia developed around collar region which later on converted into brown. Finally the seedling collapsed after 19th days of inoculation in field.

Among culture media tested, PDA recorded maximum (90 mm) mycelial growth of the pathogen after 7 days of inoculation, followed by OMA (88.33 mm), V8 (88.33 mm), PMA (83.33 mm), Host bark extract (71.66 mm), Czapek's Dox (18.33 mm) and WAM (16.66 mm) and significant variability with reference to mycelial characters was observed on different media.

Among the fungicides tested *in vitro,* propiconazole and metalxyl + mancozeb at 0.1 per cent, mancozeb 0.25 per cent totally inhibited mycelial growth and sclerotia formation of pathogen.

Among the bioagents tesed, *T. harzianum* resulted with significantly highest mycelial growth inhibition (68.88 %) and least number of sclerotia (6), followed by *T. viride* (56.66 % and 9.25) and *T. koningii* (43 % and 11.0).

Field screening of Elephant foot yam cultivars against *Sclerotium rolfsii* Sacc. revealed that among the sixteen varieties tested three varieties *viz.,* EFY DPL-2, EFY DPL-3 and BCA-4 were found to be resistant against *S. rolfsii,* up to 120 days.

CHAPTER I
INTRODUCTION

Tuber crops are the third most important food crop for man after cereals and grain legumes. Among them Elephant Foot Yam (*Amorphophallus paeoniifolius)* is important commercial tuberous root crop of tropical and subtropical region of the world mainly grown for its tubers. Elephant foot yam commonly known as Suran or Jimmikand and belongs to the family Araceae. Because of its higher yield potential, culinary properties, medicinal utility and therapeutic values, it is referred to as **"King of tuber crops"**. It has long been used as a local staple food in many countries such as Philippines, Indonesia, Bangladesh, India, China and other South Eastern Asian countries. It is a cheap source of carbohydrate, rich in minerals and vitamin A and B. The corm is used as vegetable and also for preparing curries and pickles. The tubers are recommended to cure dysentery, tumor, asthma, swelling of lungs, vomiting, abdominal pain and also as blood purifier.

Elephant foot yam corm (per 100 gm of edible portion) contains Moisture (78.7 %), Protein (1.2 gm), Fat (0.1 gm), Carbohydrates (18.4 gm), Minerals (0.8 gm), Fiber (0.8 gm), Calcium (161.08 mg), Phosphorus (166.91 mg), Potassium (327.83 mg), Iron (3.43 mg), vit.A (431 I.U) and Soluble oxalate (13.53 mg) (Chattopadhayay *et al.,* 2009). It contains appreciable amount of Riboflavin, Thiamine and Nicotinic acid. One of the greatest challenges of the 21st century will be to feed the burgeoning population with nutritionally quality food, so as to achieve food security in India as well as in many parts of the globe. Elephant foot yam is the crop having the potential to meet the nutritional requirements of the fast growing population of the developing country. The status of this crop in most of the state of India is that of a minor crop. However, it has made a considerable portion of

the very limited supply of vegetable to the majority of Indian diets. In fact, it is one the vegetables, which is most extensively consumed whereby the corms and cormels are the major economic parts of the crop.

In India, it is popularly cultivated in the states of Andhra Pradesh, W.B, U.P, Gujarat and Jharkhand, and Jharkhand being leading state. It is substantially cultivated in Ranchi, Khunti, and Gumla districts of western plateau zone and Giridih district of central and North-Eastern plateau zone. Its cultivation as intercrop in new orchard of mango and litchi is also gaining tremendous popularity among orchard growers of Jharkhand (Kumar, 2012).

The Elephant foot yam crop is affected by the diseases *viz.*, foot rot (*Rhizoctonia solani*), Collar rot (*Sclerotium rolfsii*), Anthracnose (*Colletotrichum gloeosporides Penz.*), Leaf spot (*Cornyspora cassiicol Berk and Curt),* Bacterial leaf spot (*Xanthomonas campestris pv amorphophalli*), Mosaic (*Elephant foot yam mosaic virus*), etc. Among these diseases, the collar rot caused by *S. rolfsii* has been considered as one of constraints in successful cultivation of Elephant foot yam crop in India. (Sivapraksam *et al.,* 1982). The pathogen *S. rolfsii* is distributed in tropical and subtropical regions of the world where high temperature prevails (Sahoo *et al.,* 2016). This pathogen has a wide host range of 500 species in about 100 families including groundnut, pepper, potato, sweet potato, tomato and watermelon (Aycock, 1966). It is more destructive during rainy season, followed by warm dry weather. Soft and pseudo stem of plant are more vulnerable to this disease. Injury to collar region during intercultural operation, poor drainage, water logging, etc. acts as predisposing factors for infection by *S. rolfsii*. The disease is more severe during rainy season, followed by warm dry weather (Sahoo *et al.,* 2016). In Konkan region, during recent years, this diseases has been found to occur at AICRP on Tubers, Central Experiment Station, Wakavali, Dr. BSKK,Dapoli,

causing considerable quantitative as well as qualitative losses. Therefore it was felt necessary to carry out the basic studies on this disease with following objectives.

1) To isolate the pathogen associated and prove its pathogenicity.
2) To evaluate the effect of various culture media on growth of the pathogen.
3) To evaluate *in vitro* efficacy of different fungicides against the pathogen.
4) To evaluate *in vitro* efficacy of bio-control agents against the pathogen.
5) To screening Elephant foot yam varieties against the pathogen.

CHAPTER II

REVIEW OF LITERATURE

2.1 Occurrence of collar rot (*S. rolfsii*) disease

The fungus has a wide distribution and it affects large number of wild and cultivated plants. The fungus, *Sclerotium rolfsii* causing tomato blight in Florida State of U.S.A. was first described by Rolfs in 1892.

Saccardo (1911) identified and named the fungus as *S. rolfsii* Sacc., in recognition of Rolfs pioneer work.

Coleman (1920) recorded occurrence of *S. rolfsii*, probably for the first time from the princely state of Mysore, India.

Sundararaman (1933) reported *S. rolfsii* from wilted ragi, from former Madras presidency.

Narain (1972) recorded wilt (Foot rot) of ragi caused by *S. rolfsii* from Orissa.

Niranjani *et al.* (1988) reported *S. rolfsii* as causal organism of onion bulb rot from Arali area of Jaffna, Sri Lanka.

Akem and Dashiell (1991) reported Southern blight of soybean caused by *S. rolfsii* for the first time from Nigeria.

Stanely *et al.* (1996) reported *S. rolfsii* incidence on perennial peanut plots of Arbrook at the North Florida Research and Education Centre.

Mathur and Sharma (2001) reported bulb rot of onion induced by *S. rolfsii* from Rajasthan.

Polizzi *et al.* (2003) reported the Southren blight caused by *Sclerotium rolfsii* Sacc. on Laurustinus (*Viburnus finus* L.) plants.

Hollowell and Shew (2004) first time reported *S. rolfsii* as a causal agent of common chickweed from North Carolina.

Bag (2004) observed a severe and fatal rotting disease on *Phaius flavus* and *Paphiopedilum venustum* orchid hosts caused by *S. rolfsii* from India.

Rakholiya *et al.* (2004) observed whitish fungal growth of *Sclerotium rolfsii* on roots of isabgol (*Plantago ovata*) from Gujrat, India.

Garibaldi *et al.* (2005) reported the Southern blight of *Dinochondra repens* incited by *Sclerotium rolfsii* Sacc. from Italy.

Kumar (2012) observed collar rot of elephant foot yam caused by *Sclerotium rolfsii* Sacc., from Ranchi, Jharkhand, India.

Pandav (2012) observed collar rot of gerbera incited by *Sclerotium rolfsii* Sacc., from Dapoli, Maharashtra, India

Salvi (2015) observed collar rot and root of pigeon pea incited by incited by *Sclerotium rolfsii* Sacc., from Dapoli, Maharashtra, India

2.2 Isolation of *S. rolfsii*

Dalvi (1985) isolated *Sclerotium rolfsii* Sacc. from infected groundnut roots, from Konkan region and maintained its culture on Potato Dextrose Agar.

Srivastava *et al.* (1987) isolated *Sclerotium rolfsii* Sacc. from infected sugar beet roots, purified it and maintained it on Potato Dextrose Agar.

Todankar (1994) isolated *Sclerotium rolfsii* Sacc. on Potato Dextrose Agar from infected groundnut plants.

Stanley *et al.* (1996) isolated *Sclerotium rolfsii* Sacc. on Potato Dextrose Agar, from perennial peanut in Florida.

D'souza *et al.* (2001) isolated and maintained pure culture of *Sclerotium rolfsii* Sacc. on Potato Dextrose Agar, from betel vine plants.

Pratt *et al.* (2003) isolated *Sclerotium rolfsii* Sacc. from diseased leaves of *Brassidium* hybrid orchid on acid Potato Dextrose Agar.

Polizzi *et al.* (2003) isolated *Sclerotium rolfsii* Sacc. on acidified Potato Dextrose Agar from Laurustinus (*Viburnus finus*) plants.

Suryawanshi *et al.* (2007) isolated *Sclerotium rolfsii* Sacc. from collar region of pigeon pea seedlings on Potato Dextrose Agar.

Sawant (2009) isolated *Sclerotium rolfsii* Sacc. and maintained the culture on Potato Dextrose Agar.

Kumar (2012) isolated *Sclerotium rolfsii* Sacc. on Potato Dextrose Agar from elephant foot yam.

Pandav (2012) isolated *Sclerotium rolfsii* Sacc. on Potato Dextrose Agar from gerbera.

Songvilay *et al.* (2012) isolated *Sclerotium rolfsii* Sacc. in Lao PDR during ad hoc disease survey causing stem rot of snake bean.

Orlikowski and Ptaszek (2013) isolated *Sclerotium rolfsii* Sacc. causing rot of foliage in ornamental plants in Poland.

Salvi (2015) isolated *Sclerotium rolfsii* Sacc. on Potato Dextrose Agar from pigeon pea.

2.3 Pathogenicity test of *S. rolfsii*

Weber (1931) proved pathogenicity of *S. rolfsii* on carrot and reported that the initial symptom of the disease was general yellowing of the older leaves, which finally resulted in wilting.

Das (1961) studied symptomatology and pathogenicity of *S. rolfsii* on *Polianthes tuberosa* in pots and reported that the fungus grew

within 5-7 days of inoculation on tuberose leaf pieces. High relative humidity and darkness favours growth of *S. rolfsii*.

Om Prakash and Singh (1976) reported that the basal rot of mango seedling caused by *S. rolfsii* occurs in patches and characterized by the presence of thick weft of fungal mycelium on which round sclerotia were formed.

Desai *et al.* (1980) proved pathogenicity of *S. rolfsii* by inoculating 25 days old culture grown on cornmeal-sand-medium in pots.

Bose and Yadav (1989) reported that *S. rolfsii* infecting tuberose produced prominent coarse mycelial mass on leaf surface, at or near soil level. The infected spots were pale green in colour which extended to cover whole leaf and followed by premature leaf fall.

Kodalkar (1992) proved pathogenicity of *S. rolfsii* on healthy seedlings of field bean, under artificial conditions. Toppling of the infected seedlings as a major symptom was visible within three days after inoculation. The stem of inoculated seedlings at soil level developed whitish water soaked lesions which later on turned brown. Complete wilting of seedlings was recorded on 5th day of inoculation.

Singh (2002) proved the pathogenicity of *S. rolfsii* by inoculating the mycelia bits and sclerotia of the pathogen on stem and leaves of betelvine under *in vitro* conditions. The symptoms similar to those produced on betelvine in field were also observed *invitro*.

Patil (2003) proved the pathogenicity of *S. rolfsii* and *Rhizoctonia bataticola*, a causal agents of seed/root/stem rot of sunflower, in pots by using artificially developed sick soil. The results revealed that both the fungi were pathogenic at varied degree of virulence.

Mundhe (2005) proved the pathogenicity of *S. rolfsii* causing foot rot of nagli [*Elusine coracana* (L.)] by inoculating the sclerotia in pot. The seedlings collapsed within 8 to 10 days of inoculation.

Gawande (2006) proved the pathogenicity of *S. rolfsii* by inoculating the fungal culture on healthy groundnut plant in sterilized soil in pots and healthy groundnut seeds in Petri dishes. White mycelial growth was observed at collar region of plants and also on seed. After 7-8 days brownish sclerotial bodies were formed.

Kolte (2007) proved the pathogenicity of *S. rolfsii* on healthy orchid plant, (*Dendrobium* spp.) The dark brownish lesions developed on leaves, stem and thick mycelial mat and whitish pre-mature sclerotia were developed around collar region within 12 to 15 days of inoculation. Finally, inoculated plants collapsed on 18th day of inoculation.

Omprakash (2007) proved the pathogenicity of *S. rolfsii* and *Fusarium oxysporum* on Vanilla (*Vanilla planifolia* Andr.) by inoculating the cultures of *S. rolfsii* and *F. oxysporum* to sterile soil separately. Typical symptoms of both the test fungi, similar to those observed in the field were also developed under laboratory conditions.

Sawant (2009) proved the pathogenicity of *S. rolfsii* on healthy curry leaf plants, in polythene bags filled with 750 g sterilized potting mixture (2 part Soil: 1 part FYM). In each 25 sclerotia were mixed in the upper 2 cm layer of potting mixture. Thick mycelial growth of the fungus and whitish pre mature sclerotia developed around collar region near soil surface. Finally, seedlings collapsed within 18 to 19 days after inoculation.

Kumar (2012) proved the pathogenicity of *S. rolfsii* on Elephant foot yam in pot. Symptoms appeared in first week of August when there was continuous rainfall. Leaves turned yellow at the tip which moved download covering entire leaf area. Water soaked lesions developed on the stem at collar region. As the disease progressed, the pseudo stem of the collar region girdled by fungal masses bearing

numerous sclerotia. The pseudo stem at collar region rotted, resulting in collapse of the entire plant.

Pandav (2012) proved the pathogenicity of *S. rolfsii* on gerbera plants, in pots. The dark brownish lesions developed on stem and shriveling of the stem extended above the collar. Thick mycelial mat and whitish pre mature and later brownish sclerotia developed around collar region of the affected plant. Finally, seedlings collapsed within 18 to 19 days after inoculation.

Salvi (2015) proved the pathogenicity of *S. rolfsii* on pigeon pea seedlings, in pots. The dark brownish lesions developed on stem and shriveling of the stem extended above collar for two centimeters. Thick mycelial mat and whitish pre mature sclerotia developed around collar region. Finally the seedling collapsed within 18th days of inoculation.

2.4 Effect of culture media on growth of *S. rolfsii*

Akram *et al.* (2015) reported that potato dextrose agar as the best medium for the radial growth and sclerotial production of *S. rolfsii.*

Chaurasia *et al.* (2013) studied influence of culture media on mycelial growth followed by its sclerotia production and reported potato-dextrose agar as most suitable for mycelial growth and sclerotia production.

Zape *et al.* (2013) reported potato dextrose agar as most suitable medium for better growth of *Sclerotium rolfsii* (90.00 mm), followed by peptone sucrose agar (PSA).

Sumia and Quadri (2015) reported malt extract peptone-dextrose agar as the best culture medium for better growth (59 mm) of *S. rolfsii.*

Bankar *et al.* (2017) reported potato dextrose agar medium as the best culture medium for maximum radial growth (90 mm) of *S. rolfsii.*

2.5 *In vitro* efficacy of fungicides against *S. rolfsii*

Punja *et al.* (1982) reported that fungicides *viz.*, PCNB, mancozeb, carboxin and captan as most effective in reducing the germination of sclerotia of *S. rolfsii* while thiram, benomyl and thiophanate methyl were ineffective.

Dalvi and Raut (1987) evaluated *in vitro* six fungicides against *S. rolfsii,* causing wilt of groundnut and reported brassicol (0.13%), emisan-6 (0.125%), hexathir (0.25%) and vitavax (0.15%) significantly inhibited its mycelial growth. Hexacap (0.125%) and dithane M-45 (0.15%) followed the above fungicides when used as seed dressers. Seed treatment with vitavax (0.15%) was found to be best as it fully controlled pre and post-emergence mortality of groundnut seedlings.

Narain and Kar (1990) reported that thiram (0.3%) and combination of bavistin (0.15%) + thiram (0.3%) completely checked the growth of *S. rolfsii,* causing wilt of groundnut.

Tiwari (1995) tested different fungicides against *Sclerotium rolfsii* causing root rot in gram and sunflower. Contaf 5 EC @ 0.1 per cent and 0.2 per cent along with bavistin 50 WP (0.2%) and topsin M-80 WP (0.2%) as a soil treatment *in vitro* and *in vivo* against root rot disease. Contaf was found highly effective in reducing the infection and controlling root rot in gram and sunflower.

Das and Panda (1997) evaluated *in vitro* fungicides viz., Propiconazole, epoxiconazole, copper oxychloride, tridemorph, mancozeb and carbendazim at five different concentrations against *Sclerotium rolfsii* causing collar rot of tuberose. Epoxiconazole @ 50

µg/ml and propiconazole and mancozeb @ 100 micro g/ml completely inhibited mycelial growth. Tridemorph @ 200 µg/ml. and carbendazim and copper oxychloride @ 500 µg/ml were moderately effective.

Johnson and Subramanyam (2000) studied the efficacy of eight fungicides against *S. rolfsii* causing stem rot of groundnut. They reported complete mycelial growth inhibition with hexaconazole, penconazole, and propiconazole, followed by tricyclazole (80 %) and mancozeb (53 %). Carbendazim and copper oxychloride were ineffective.

Singh and Kumar (2002) reported seed treatment with Topsin-M (1.0 g/kg seed), bavistin 50 WP, indofil M-45 and jkstein (carbendazimn) each at 2.0 g/kg seed eliminated the soil born fungus from the infected seeds.

Dutta and Das (2002) evaluated *in vitro*the efficacy of some fungicides against *Sclerotium rolfsii* Sacc. causing collar rot of tomato. They reported that dithane M-45 exhibited maximum inhibition of mycelial growth (76.5%) and sclerotial formation (98.6%), followed by thiram which caused mycelial growth inhibition and sclerotial production inhibition of were 70.3 percent and 96.5 percent, respectively.

Hanumantha and Kannan (2002) evaluated *in vitro* the efficacy of the fungicides *viz.*, Hexaconazole (0.02%), propiconazole (0.02%), epoxiconazole (0.0026%), triadimefon (0.02%), Bordeaux mixture (1%), chlorothalonil (0.3%) and carbendazim (0.03 and 0.05%) against *S. rolfsii* [*Corticium rolfsii*]. They reported that carbendazim (0.05%) resulted with cent per cent inhibition of mycelia growth, followed by hexaconazole (85 %) and carbendazim (84 %) each @ 0.03%. Bordeaux mixture (1%) was the least effective while propiconazole and epoxiconazole were totally ineffecetive.

Thakur *et al.* (2002) evaluated *in vitro* six fungicides *viz.*, Bavistin, thiram, benomyl, captan, prochloraz, and mancozeb against *S. rolfsii* and reported that bavistin, followed by benomyl and captan as most effective against the test pathogen.

Prabhu and Hiremath (2003) evaluated *in vitro* systemic and non-systemic fungicides *viz.,* Carbendazim, tridemorph, hexaconazole, propiconazole, captan, thiram, copper oxychloride and mancozeb each @ 0.1, 0.2 and 0.3 per cent against *S. rolfsii* causing collar rot of cotton. They reported that among systemic fungicides, hexaconazole, propiconazole and tridemorph as most effective and among non-systemic fungicides, thiram and mancozeb as most effective.

Tiwari and Singh (2004) evaluated *in vitro* the efficacy of 22 fungicides against *S. rolfsii* and *R. solani* causing collar rot and root rot of soybean and groundnut and reported hexaconazole, propiconazole, epoxiconazole and tridimefon as most effective against both the pathogens.

Mundhe (2005) evaluated *in vitro* eight fungicides against *S. rolfsii*, causing foot rot of nagli and reported that Tilt (0.05%), hexathir (0.2%), Score (0.05%) and contaf plus (0.05%) resulted with cent per cent (100 %) mycelial growth inhibition of the test pathogen, followed by bavistin (0.2%), dithane M-45 (0.25%), blue copper (0.25%) and captaf (0.05%), when resulted with 44.44, 40.17,38.22 and 34.11 per cent mycelial growth inhibition.

Gawande (2006) evaluated *in vitro* the fungicides hexaconazole, propiconazole and difenconazole each @ 0.5 per cent against *S. rolfsii* and reported that these fungicides completely inhibited mycelial growth as well as sclerotia formation of the pathogen.

Patil (2007) evaluated *in vitro* 13 fungicides against *S. rolfsii*. They reported that myclobutanil (0.05%), propiconazole (0.05%),

hexaconazole (0.05%) and metiram (0.10%) resulted with complete inhibition of mycelial growth, followed by propineb (78.89 %) and chlorothalonil (77.04 %) @ 0.1 %.

Patel *et al.* (2008) evaluated *in vitro*10 fungicides systemic and non systemic against *S. rolfsii* collar rotof Brinjal. He reported that propiconazole (Tilt), thiram (Thiram), penconazole (Topaz) at all three concentrations completely inhibited mycelial growth and sclerotia formation, followed by mancozeb @ 2500 ppm.

Rout and Mishra (2008) evaluated *in vitro* fungicides *viz.*, Topsin-M, bavistin, blitox-50, contaf, benlate, captan, thiram, manzate against *S. rolfsii* causing collar rot disease of marigold and reported that the fungicides captan, thiram and manzate each @ 0.3 % caused complete inhibition of mycelial growth.

Haralpatil and Raut (2008) tested *in vitro* 11 fungicides and one antibiotic against *Sclerotium rolfsii* and reported that metalaxyl + mancozeb (0.1%), propiconazole (0.05%), hexaconazole (0.05%) and metiram (0.1%) effectively controlled the test pathogen.

Khosla and Gupta (2008) evaluated *in vitro* six fungicides *viz,* Carbendazim, benomyl, hexaconazole, thiram and mancozeb each @ 0.05, 0.10, 0.20 and 0.40 per cent. They reported that carbendazim and benomyl completely inhibited mycelial growth and sclerotia formation of the test pathogen, even @ 0.05 per cent. Ergosterol inhibitor fungicides *viz*, hexaconazole, was effective @ 0.1 per cent.

Sawant *et al.* (2009) evaluated *in vitro* 11 fungicides against *S. rolfsii*, causing curry collar/stem rot; and reported that all test fungicides inhibited mycelial growth and sclerotia formation. However hexaconazole (0.1%), propiconazole (0.1%), mancozeb (0.2%), and difenoconazole (0.1%) completely inhibited the mycelial growth and

sclerotia formation of the test pathogen. Copper hydroxide (0.3%), copper oxychloride (0.2 %) and carbendazim (0.1%) were least effective.

Bhuiyan *et al.* (2012) evaluated *in vitro* six fungicides *viz.*, Provax-200, bavistin, ridomil, dithane M-45, rovral 50 WP and Tilt @ 100, 200 and 400 ppm against *S. rolfsii*. They reported complete inhibition of mycelial growth with Provax-200 at all the test concentrations, followed by Tilt at the higher concentration, (93.88 %). Bavistin and ridomil were less effective against the test pathogen.

Kumar (2012) evaluated *in vitro* the efficacy ofvarious fungicides against *S. rolfsii* causing collar rot of Elephant foot yam and reported that vitavax, propiconazole, hexaconazole, redomil mz @ 0.025 % completely inhibited mycelial growth of the test pathogen, followed by mancozeb, propineb and zineb @ 0.1 %.

Manu and Nagaraja (2012) evaluated *in vitro* the efficacy of various fungicides against *S. rolfsii,* causing foot rot of finger millet. They reported the systemic fungicides hexaconazole, propiconazole and difenoconazole non-systemic mancozeb as effective at all the tested concentrations and vitavax power (thiram 37.5% + carboxin 37.5%), avatar (hexaconazole 4% + zineb 68%), merger (tricyclazole 18% + mancozeb 62%) and nativo (tebuconazole + trifloxystrobin) except merger (tricyclazole 18% + mancozeb 62%) showed cent per cent inhibition of mycelial growth at all the five concentrations tested.

Pandav *et al.* (2013) reported that hexaconazole (0.1%), propiconazole (0.1 %), mancozeb (0.1% and 0.2 %) and captan (0.1 %) completely inhibited mycelial growth and sclerotia formation of *Sclerotium rolfsii*. Carbendazim (0.1%) and copper oxychloride (0.2 %) were less effective and thiophenate methyl (0.1%) was least effective fungicide.

Dadke *et al.* (2014) evaluated *in vitro* eight fungicides against *S. rolfsii,* causing stem rot of chilli. They reported maximum mycelial growth inhibition (100%) with carboxin, propiconazole, hexaconazole, difenconazole and carbendazim at all three concentrations (500, 1000 and 1500 ppm), followed by captan (79.30, 82.76 and 85.23%) and triadimenfon (49.13, 60.23 and 65.33 %).

Salvi *et al.* (2015) reported that difenconazole, hexaconazole, propiconazole, thiophanate methyl each @ 0.1 per cent, hexaconazole and propiconazole each @ 0.05 per cent and mancozeb @ 0.25 per cent completely inhibited mycelial growth and sclerotial formation of *Sclerotium rolfsii*. Carbendazim, validamycin, copper oxychloride each @ 0.1 per cent were least effective fungicide.

2.6 *In vitro* efficacy of bio-agent against *S. rolfsii*

Wells *et al.* (1972) reported *Trichoderma harzianum* as an effective bio-control agent against *S. rolfsii*.

Almeida and Landim (1981) reported *Trichoderma* species as hyper parasite on sclerotia of *S. rolfsii* in culture media.

Bell *et al.* (1982) studied antagonistic activities of *T. viride*, *T. harzianum* against *S. rolfsii* and reported *T. harzianum* as highly effective *in vitro* and in field against *S. rolfsii*.

Rangeshwaran and Prasad (2000) reported *P. fluorescens* as most effective against *S. rolfsii* causing collar rot of sunflower.

D'souza *et al.* (2001) studied the antagonistic potential of *Trichoderma harzianum* Rifai. against four fungal pathogens of betelvine (*Phytophthora parasitica*, *Colletotrichum capsici*, *S. rolfsii* and *Rhizoctonia solani*) Among the different isolates used T_1, T_2 and T_3 were found promising as the overgrow the mycelia growth of pathogen within 5-6 days.

Dutta and Das (2002) reported out of three *Trichoderma* spp, *T. harzianum* was more inhibitory to *Sclerotium rolfsii* Sacc, with 61.5 % mycelial growth inhibition, followed by *T. viride* (59.1%) and *T. koningii* (57.2%).

Vyas and Mathur (2002) reported the effectiveness of different antagonists *viz., P. fluorescens*, *B. subtilis* and *T. viride* against *S. rolfsii* causing Jasmine (*Jasminum sambac* L.) wilt.

Sen *et al.* (2006) reported *Pseudomonas fluorescens* as most potential bio agent against *Sclerotium rolfsii* Sacc.

Shahare *et al.* (2008) reported *Trichoderma harzianum* resulted with highest mycelial growth inhibition (92.85 %) of *S. rolfsii*, causing collar rot of soybean, followed by *Aspergillus niger* and *T. viride* (71.42%).

Mundhe *et al.* (2009) evaluated *in vitro* the efficacy of biocontrol agents against *S. rolfsii*, causing *nagli* foot rot disease and reported maximum mycelial growth inhibition with *T. harzianum* (73.77%) followed by *T. harzianum* (73.00%), *T. viride* (72.66%) and *P. fluorescens* (71.55%).

Sawant *et al.* (2013) reported *Trichoderma harzianum* as most potent to restrict mycelia growth and sclerotia formation of *S. rolfsii* than followed by *T. viride* and *T. koningii*.

Pandav (2012) evaluated *in vitro* the effectiveness of fungal bio-agents *viz.*, *Trichoderma harzianum*, *T. viride* and *T. koningii*, *Aspergillus niger* and Yeast (*Saccharomyces cerevisiae*) against *S. rolfsii* causing collar rot of gerbera and reported maximum mycelial growth inhibition with *T. viride,* followed by *T. harzianum, Aspergillus niger*, *T. koningii* and *Saccharomyces cerevisiae*.

Salvi *et al.* (2015) evaluated *in vitro* the bio-agents *viz.*, *T. harzianum* (T_h), *T. viride* (T_v), and *P. fluorescens* (P_f) against *S. rolfsii*

and reported that *T. harzianum* (T_h), exhibited maximum mycelial growth inhibition and sclerotia formation.

2.7 Varietal screening

Main (1976) screened 45 varieties of gladiolus against the collar rot caused by *Sclerotium rolfsii*. 21 varieties were observed free from infection and remaining were infected to varying degrees of fairly resistant to highly susceptible.

Dalvi (1985) studied 23 varieties of groundnut were tested in laboratory for their reaction to disease. The result revealed that variety M-13 was found resistant while the varieties *viz.,* Gaug-1, Junagadh-11, FSB 7-2, DH 3-30, Robout 31-1, M-37, SB11,LG-4, UF 70-103, Kopergaon No.1, M-145, L-33,PG-1,Robout 33-1 and Karad 4-11 were highly susceptible and others were less susceptible.

Hilal (1988) studied the reaction of carnation varieties against the stem rot caused by *Sclerotium rolfsii*. The cultivars Amber Rose, Lena were found resistant.

Makwan (1994) tested eight groundnut varieties against *Sclerotium* rot caused by *Sclerotium rolfsii*. Among the tested varieties, GT-2 was found resistant.

Dabre (2000) studied relative resistance and susceptibility of the selected varieties of gerbera against *Sclerotium rolfsii*. The varieties *viz.,* Pink elegance, Dordenella, Goldengate, Nevada, Thalassa, Sundance and Ornella were observed resistant (0.00-25.00% disease intensity). The varieties Aida and Diablo were found to be moderately resistant (26.00-50.00% disease intensity). The variety Sunset was found highly susceptible (51.00-75.00% disease intensity) to *S. rolfsii.*

Pandav (2012) studied investigation on varietal reactions of gerbera against *Sclerotium rolfsii,* he showed that among the varieties tested only one variety 'Goliyat' was found to be resistant variety.

Salvi (2015) studied the *in vitro* screening of some cultivars of pigeon pea against *Sclerotium rolfsii* Sacc. and revealed that among the varieties tested five varieties *viz.*, BDN-711, TAT-10, ICPL-87119, T-Vishakha and UPAS-120 were found disease free from *S. rolfsii* up to 21 days.

CHAPTER III

MATERIAL AND METHOD

The various aspects of present investigation on collar rot of Elephant foot yam were undertaken at the Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during 2017-18.

The materials used and methods adopted during of present investigation are being described under following sub heads.

3.1 Materials

The following materials were used during the course of the present investigation.

3.1.1 Disease samples

Collar rot diseased samples of Elephant foot yam plants were collected from the field of AICRP on Tubers, Central Experimental Station, Wakavali, in paper bags and brought to the laboratory for further studies.

3.1.2 Culture media

Culture media such as, Potato Dextrose Agar (PDA) and Host Bark Extract Agar (HBEA) were used for isolation of the pathogen, cultural studies and other *in vitro* studies.

3.1.3 Chemicals

The chemicals used for the studies were of analytical grade of various manufacturers Hi-Media, E-Merek, Glaxo, and obtained from the Department of Plant Pathology, College of Agriculture, Dr. BSKKV, Taluka-Dapoli, Dist-Ratnagiri. (M.S.)

3.1.4 Glass wares

Standard Borosil brand glassware such as Petri plates and flasks were used during present study.

3.1.5 Equipments

Laboratory equipments such as autoclave, laminar air flow cabinet, B.O.D incubator, refrigerator, research microscope, sintered glass filter, centrifuge etc. were used.

3.1.6 Biocontrol agents

Fresh pure cultures of *Trichoderma* spp. (*T. harzianum* (T_h), *T. viride* (T_v), *T. koningii* (T_k) and *Pseudomonas fluorescens* (P_f) were obtained from the Department of Plant Pathology Dr. B.S.K.K.V., Dapoli, maintained by sub culturing and used in present study.

3.1.7 Fungicides

Following fungicides were used in present *in vitro* study.

Sr. No.	Common/ Technical Name	Trade Name	AI and Formulation	Cost (Rs)	Manufacturer
1	Thiophenate methyl	Roko	70 % WP	685 per 500 g	Chemtura Chemicals India Ltd., J.P. Nagar, (UP)
2	Mancozeb	Dinthane M-45	75 % WP	180 per 500 g	Indofil chemicals company, Mumbai

3	Copper-oxy-chloride	Blitox	50 % WP	270 per 500 g	Syngenta India Ltd., Mumbai-20
4	Propiconazole	Tilt	25 % EC	181 per 100 ml	Syngenta India Ltd., Mumbai-20
5	Carbendazim	Bavistin	50 % WP	295 per 500 g	BASF India Ltd. Mumbai-25
6	Metalaxyl-M + Manocozeb	Redomil Gold	4 % + 64 % WP	1860 per kg	Syngenta India Ltd., Mumbai-20

3.1.8 Tubers of Elephant foot yam crop varieties

The Elephant foot yam 16 varieties were collected from farmers, purchased from market and obtained from AICRP on Tubers, Central Experiment Station, Wakavali, Dr. BSKKV, Dapoli.

3.1.10 Miscellaneous materials

Electronic balance, cork borer, polythene bags, forceps, inoculation needles, spirit lamps, cotton, etc. available were used during present study.

3.2 Methods

3.2.1 Isolation and identification of disease causing organism

1. Examination of disease samples

i) Visual observations

Visual observations were recorded in the field to record manifestation of collar rot symptoms on Elephant foot yam crop.

ii) Microscopic Examination

Fresh collar rot diseased samples of Elephant foot yam plant were collected from the field, brought to the laboratory and washed in running tap water to remove extraneous materials. Temporary mounts of the diseased specimen on glass slide in Lacto phenol cotton blue were prepared and examined under compound microscope.

iii) Incubation of the disease samples in humid chamber

Small pieces of infected plant parts were placed on surface sterilized micro slide. Each micro slide was kept on pair of glass rods in sterilized Petri plate internally lined with layer of sterilized moist blotting paper. These plates then were incubated at room temperature and later on examined daily up to 8 days for the growth of pathogen. The growth observations were recorded.

3.2.2 Isolation of associated organism

Isolation from the diseased tissue (collar region) of plants

The Elephant foot yam plants showing typical symptoms of collar rot disease were subjected to tissue isolation on PDA. For the purpose, disease plant specimens were initially washed in running tap water to remove extraneous materials and blot dried. These were cut into small bits of affected tissues along with the healthy tissues and such bits were then surface sterilized in 0.1 per cent mercuric chloride ($Hgcl_2$) solution for 1 to 2 minutes. These were further washed sequentially thrice in sterilized distilled water to remove traces of mercuric chloride. These surface sterilized bits were blot dried and inoculated aseptically on solidified Potato Dextrose Agar (PDA) medium in glass Petri plates. Simultaneously, white sclerotial bodies developed on collar region of diseased Elephant foot yam plants were collected and surface sterilized 0.1 % mercuric chloride, washed thrice with distilled sterile water, blot dried and plated on PDA. These plates were incubated in BOD incubator standardized at 27 ± 2^0C for 5-7 days. Pure culture growth developed on plates was aseptically transferred on fresh PDA slants in glass test tubes to obtain pure culture of the test pathogen and pure culture tubes were sealed with paraffin wax and were maintained in refrigerator for further studies.

3.2.3 Pathogenicity test

Inoculation of fungal culture

To prove the disease causing ability of the isolated fungus on Elephant foot yam, 45-55 days old plants grown in field containing soil + FYM (2:1), were inoculated with test fungus. Ten days old fungal mycelium and sclerotia grown in Petri plates were mixed in 100 ml sterilized distilled water. The soil around plant roots was removed and mycelial and sclerotial suspension was mixed in soil. Plants were immediately watered and observed for the development of fungal infection.

Reisolation

Re-isolation of the causal organism was done from the artificially inoculated stem showing typical symptoms. The fungal growth obtained grown on PDA medium by reisolation was compared to the original culture obtained from naturally infected plants under field condition.

Identification of the pathogen

Based on symptomatology, pathogenicity test, morpho-cultural characters and microscopic observations, the test pathogen was identified.

3.2.4 Effect of various culture media

A total of seven culture media with different compositions were evaluated to assess their effect on growth of *S. rolfsii*.

The experimental details are as given below.

Design : Completely Randomized Design (CRD)

Replications : 3

Treatments : 7

Table 1 Treatment details

Tr. No.	Treatments	Tr. No.	Treatments
1	Czapek's Dox Agar	5	Water Agar
2	Potato Dextrose Agar	6	Potato Malt Agar
3	V8 Agar	7	Host Bark Extract
4	Oat Meal Agar	-	-

3.2.5 *In vitro* efficacy of fungicides against *S. rolfsii* Sacc.

Six fungicides were tested against the test fungus by using poisoned food technique (Nene and Thapliyal, 1983). Potato Dextrose Agar medium was used as basal medium and distributed in 100 ml aliquots in each 250 ml Erlenmeyer conical flasks, which were sterilized at 1.0545 kg/cm^2 pressure for 20 minutes. The quantity of fungicides for each concentration was calculated for 100 ml medium separately. The weighed quantity of the fungicides added in melted PDA at 40^{0}C mixed thoroughly and poured into sterilized Petri plates and allowed to solidify. The mycelial discs of 5 mm diameter were cut from 7 day old culture with the help of sterile cork borer. Each disc was transferred aseptically to the centre of the already poured plates. The PDA plates without fungicide were also inoculated with fungal culture which served as control. The plates were incubated at 28 ± 1^{0}C in incubator. Three replications per treatment were maintained. The observations for colony diameter and sclerotia formation were recorded until whole of the plate in control treatment was fully covered with mycelial growth.

Per cent inhibition of growth was calculated by the following formula (Vincent, 1927).

$$X = \frac{Y - Z}{Y} \times 100$$

Where,

X = Per cent inhibition

Y = Growth of fungus in control (mm)

Z = Growth of fungus in treatment (mm)

The experimental details are as given below

Design : Completely Randomized Design (CRD)

Replications : 3

Treatments : 7

Table 2 Treatment details

Tr. No.	Treatments	Conc. %	Tr. No.	Treatments	Conc. %
T_1	Thiophenate methyl 70 % WP	0.1	T_5	Carbendazim 50 % WP	0.1
T_2	Mancozeb 75 % WP	0.25	T_6	Metalaxyl-M + Manocozeb	0.1
T_3	Copper oxychloride 50 % WP	0.25	T_7	Control	-
T_4	Propiconazole 25 % WP	0.1	-	-	-

3.2.6 Efficacy of bio-control agents against *S. rolfsii* Sacc. *in vitro*

To study the effectiveness of fungal bio agents *viz, Trichoderma harzianum, T. viride, T. koningii* and *Pseudomonas fluorescens* against pathogen *S. rolfsii in vitro,* trial were laid out in Petri plates with four replication each. For this experiment, *T. harzianum*, *T. viride*, *T. koningii* and *Pseudomonas fluorescens* and *Sclerotium rolfsii* were grown on PDA for seven days. For the bacterial bio agents the pathogen mycelium disc were placed at center of the plate and the bacterial agents were streaked in such way that both organism will have equal opportunity for growth. The following antagonisms of fungal and bacterial bio agents were studied against test fungi using dual culture technique.

Table 3 Fungal bio agents

Sr. No.	Biocontrol agent
1	*Trichoderma koningii*
2	*Pseudomonas fluorescens*
3	*Trichoderma harzianum*
4	*Trichoderma viride*
5	Control

3.2.7 Dual Culture Technique

The antagonistic activity of bio agents against *S. rolfsii* was determined by dual culture technique under *in vitro* condition (Stack *et al.*, 1986).

Mycelial discs measuring 8 mm diameter from one week old cultures of both fungal antagonist and the test pathogen were placed at equidistant on sterile Petri plates containing PDA medium. However for *Pseudomonas fluorescens,* one day old culture of bacteria was streaked on opposite side of the pathogen on NA medium. The Petri plates were incubated at 27 ±1°C. Four replications were maintained in each treatment. Suitable controls were kept without antagonist. Zone of inhibition were measured simultaneously day after inoculation of antagonist. Percentage inhibition of mycelial growth of test pathogen was calculated and the observations on sclerotial development affected due to bio-control agent were also recorded.

Per cent inhibition of growth was calculated by the following formula (Vincent, 1927).

$$X = \frac{Y - Z}{Y} \times 100$$

Where,

X = Per cent inhibition

Y = Growth of fungus in control (mm)

Z = Growth of fungus in treatment (mm)

3.2.8 Screening of some cultivars against *S. rolfsii* Sacc.

Sixteen entries of Elephant foot yam available with AICRP on tubers at CES, Wakavali, were screened under natural conditions at during Aug-Sept, 2017-18. Recommended dose of FYM (25 t ha^{-1}), NPK/ha is 80:60:100 Kg. The details are mentioned below.

Experiment layout

Season	*Kharif*, 2017	**Plants per cultivar**	9
Date of planting	15/6/2017	**Plot size**	4m × 3m
Design	RBD	**Spacing**	75cm × 75cm
Replication	3	**Treatments**	16

The Elephant Foot Yam entries were locally collected by the scientist of AICRP on tuber crops from the konkan region were designated by the name of the farmers or name of locations by the person who collected the cultivar. For our study purpose these entries are named as give in table.

Sr. No.	Varieties	Sr. No.	Varieties
1	EPY DPL-1	9	EPY DPL-6
2	EPY DPL-2	10	EPY DPL-7

3	EPY DPL-3	11	EPY DPL-8
4	BCA-4	12	EPY DPL-9
5	NDB-9	13	EPY DPL-10
6	EPY DPL-4	14	EPY DPL-11
7	Gajendra	15	EPY DPL-12
8	EPY DPL-5	16	EPY DPL-13

3.2.9 Observations on disease incidence

In each replication, plants were randomly selected to record the disease incidence. The selected plants were tagged and observations on disease incidence were recorded on the same plants, thrice at an interval of 1 month.

Disease reaction collar rot

On the basis of disease score each variety / cultivar was graded as Resistant, Moderately resistant, Moderately susceptible, Susceptible and Highly susceptible as per scale presented by Sinha and Prasad (1986).

Sr. No.	Per cent mortality	Reaction type
1	Below 1	Resistant
2	1-10	Moderately resistant
3	11-20	Moderately susceptible
4	21-30	Susceptible

5	31-100	Highly susceptible

Per cent Disease Incidence

Total numbers of healthy and infected plants were counted and accordingly PDI was calculated.

Per cent disease incidence (PDI) was calculated by the formula given by Rao *et al.,* (2016),

$$\text{PDI} : \frac{\text{Total Number of Infected Plant}}{\text{Total Number of Plants Assessed}} \times 100$$

3.2.10 Statistical analysis

The data obtained in different experiments were statistically analyzed using methods suggested by Gomez and Gomez (1986). Completely Randomized Design (CRD) was used for radial growth, poisoned food technique and dual cultural technique and the standard error (S.Em.) and critical difference (C.D.) at level P=0.01 were worked out in lab experiment and results obtained were compared statistically.

CHAPTER IV

EXPERIMENTAL RESULTS

The results of the experiments conducted on various aspects of collar rot of Elephant foot yam incited by *Sclerotium rolfsii* Sacc., are presented in this chapter. The aspects were isolation, pathogenicity test, *in vitro* evaluation of fungicides and bio-agents, cultural characters of pathogen, screening of Elephant foot yam varieties against the pathogen.

4.1 Occurrence of the disease

The Collar rot disease *Sclerotium rolfsii* Sacc. was observed on Elephant foot yam crop grown at AICRP on Tubers, Central Experimental Station, Wakavali, Taluka - Dapoli.

4.1 Identification of the pathogen

4.1.1 Examination of disease samples

i) Visual observations

The collar rot diseased Elephant foot yam plants exhibited a browny or ashy black discoloration at collar region, leaves turned yellow and finally diseased plants wilted within 18 days. On infected tissue numerous brown sclerotia were observed.

ii) Microscopic examination

Microscopic observations revealed hyaline, septate and extensively branched mycelium. The clamp connections rare and sclerotia produced were initially whitish and finally brown coloured.

iii) Incubation of the disease samples in humid chamber

The incubated (27 ± 2^0 C) diseased plant specimens white, cottony, septate mycelium and a initially whitish and later brownish sclerotia were developed.

4.2 Isolation of the pathogen

Elephant foot yam collar rot diseased plant tissues, on incubation yielded typical colony growth on PDA plates, which was purified further and maintained on PDA slants in test tubes.

4.3 Pathogenicity test

In *S. rolfsii* sick soil, the Elephant foot yam plants exhibited yellowing at two week after planting and such leaves started drying and fall off within next two days. Finally, plants died after 18^{th} day after planting. Dark brownish lesions developed on stem near collar region, resulted in rotting of basal stem portion, which later turned brown to dark brown, black leading to shrinkage and partial drying of tender shoots. Thick mycelial growth of fungus was observed and whitish pre mature sclerotia developed around collar region near soil surface. Whitish sclerotia later turned dark brown coloured. Finally, plants collapsed within 18 to 20 days after planting.

4.3.1 Reisolation

On PDA plates, the fungus was reisolated from artificially collar rot diseased stem portion of Elephant foot yam and on incubations it yielded typical colony growth, which was exactly identical with the colony growth developed by isolating the pathogen from naturally collar rot diseased Elephant foot yam plants. Thus, Koch's Postulate was confirmed.

4.3.2 Identification of the pathogen

On the basis of symptomatology, cultural and morphological characters and pathogenicity test, the test pathogen was identified as

Sclerotium rolfsii Sacc. and further confirmed by correlating with the mycological characters of *S. rolfsii*.

4.4 Cultural characters of *Sclerotium rolfsii*

Cultural characteristics of *S. rolfsii* were studied on potato dextrose agar medium. Fungus produced white mycelium in culture. Advancing mycelium and colonies often grew in a distinctive fan-shaped pattern and the coarse hyphal strands may have a somewhat ropy appearance. Cells were hyaline with thin cell walls and sparse cross walls. Main branched hyphae may have clamp connections on each side of the septum. In agar plate culture, sclerotia were not formed until the mycelium covers the plate. *In vitro*, sclerotia begin as small tufts of white mycelium that form spherical sclerotia 0.5 to 1.5 mm in diameter. Sclerotia darkened as they mature, becoming brown to dark brown in colour. Young sclerotia often exude droplets of clear to pale yellowish fluids. Mature sclerotia were hard, slightly pitted, and have a distinct rind. Although most sclerotia were spherical, some were slightly flattened or coalesce with others to form an irregular sclerotium. *S. rolfsii* does not form asexual fruiting structures or spores.

4.5 Effect of culture media on growth of *S. rolfsii*

Different culture media were prepared as described earlier and the effect of these media on growth of the pathogen were recorded. The results are presented in Table 4.

The data from Table 4 and (PLATE III) revealed that, of the seven different solid culture media tested. Potato dextrose agar medium, oat meal agar medium, V8 juice agar medium and potato malt agar medium was found most suitable and were significantly superior over rest of the media and encouraged maximum radial mycelial growth

(90.00 mm, 87.33 mm, 88.33 mm and 87.33 mm respectively) of *S. rolfsii.* The next best culture medium found was host bark extract (71.66 mm). Least colony growth of test fungus was recorded on Czapek's dox medium (15.66 mm) and water agar medium (15.16 mm) indicating that Czapek's dox medium and water agar medium were the poorest media for the growth of *Sclerotium rolfsii.*

Table 4 Growth and Sclerotia production of *S. rolfsii* on different media

Tr. No.	**Treatments**	**Radial mycelia growth (mm)***	**Sclerotia formed**
T_1	V8 juice agar	88.33	None
T_2	Czapek's Dox agar	15.66	55.33
T_3	Potato malt agar	87.33	64.33
T_4	Water agar	15.16	None
T_5	Oat meal agar	87.33	56.66
T_6	Host bark extract agar	71.66	40.33
T_7	Potato dextrose agar	90.00	129.33
SEM ±		**4.44**	
CD (P=0.01)		**18.72**	

* Mean of three replications

It was indicated that from the data presented in Table 4 and (PLATE III). The sources of nutrients also affect on the development of sclerotia. Media WAM and V8 agar were not suitable for the sclerotial development. Maximum sclerotial developed on PDA (129.33 no.) and

minimum sclerotial development was observed on host bark extract medium (40.33 no.).

Table 5 Colony characters of *S. rolfsii* Sacc. on different solid culture media

Treat	Media	Mycelia colour	Growth pattern	Distribution of mycelia growth
T_1	V8 juice agar	Dull white	Compact	Thick
T_2	Czapek's Dox agar	Pure white	Filamentous	Irregular
T_3	Potato malt agar	Dull white	Filamentous	Thin
T_4	Water agar	Pure white	Filamentous	Irregular
T_5	Oat meal agar	Cottony white	Compact	Thick
T_6	Host bark extract agar	Cottony white	Compact	Thick
T_7	Potato dextrose agar	Pure white	Compact	Thick

With respect to colony colour, three types of colours were observed on different solid media in Table 5 (PLATE III). Among the media *viz.,* PDA, water agar and Czapek's Dox showed pure white colonies, where as V8 juice agar and potato malt agar showed dull white coloured colony. On oat meal agar and host bark extract agar cottony white coloured colony were observed. With regard to growth pattern, *S. rolfsii* showed compact growth on V8 juice agar, PDA, oat meal agar and host bark extract agar was recorded. On Czapek's Dox agar, potato malt agar and water agar, it showed filamentous growth. With respect to distribution of mycelial growth, *S. rolfsii* showed thick mycelial growth on PDA, V8 juice agar, oat meal agar and host bark extract agar. However in Potato malt agar, it showed thin mycelia

growth whereas in Czapek's Dox agar and water agar showed irregular mycelial growth.

4.6 *In vitro* efficacy of different fungicides against *S. rolfsii*

Six fungicides were screened against *Sclerotium rolfsii* Sacc. by Poisoned Food Technique (PFT). The data on the efficacy of different fungicides and their effect on mycelial growth and sclerotia formation of *Sclerotium rolfsii* were presented in Table 6 and (PLATE IV). The data revealed that all the fungicides inhibited the mycelial growth and sclerotia formation. Metalxyl M + mancozeb (0.1 %), propiconazole (0.1 %), and mancozeb (0.25 %) completely inhibited (100 %) the growth and sclerotia formation of *S. rolfsii*. Copper Oxychloride (0.2 %) and carbendazim (0.1%) resulted in 13.7 and 8.5 per cent inhibition of test fungus with 46.33 and 37.33 sclerotia, respectively. Whereas least inhibition (0 %) and more sclerotia formation (56.33 nos.) was recorded in thiophenate methyl (0.1 %).

Table 6 *In vitro* efficacy of various fungicides against *S. rolfsii*

Tr. No.	Treatments	Conc. %	Mean colony diameter (mm)*	Per cent inhibition over control	No. of sclerotia produced/plate
T_1	Thiophenate methyl	0.1	90.00	0	56.33
T_2	Mancozeb	0.25	0.00	100	0
T_3	Copper-oxy-chloride	0.25	82.33	8.5	46.33
T_4	Propiconazole	0.1	0.00	100	0
T_5	Carbendazim	0.1	77.66	13.7	37.00
T_6	Metalaxyl-M + Manocozeb	0.1	0.0	100	0
T_7	Control		90.00	0	82
S. Em		**0.77**			
C.D at 1%		**3.26**			

* Mean of three replications

4.7 Efficacy of bio-agents against *S. rolfsii* Sacc.

The results revealed that the antagonists significantly reduced the growth of *S. rolfsii* either by overgrowing or by exhibiting inhibition zone. The data in Table 7 (PLATE V) revealed that maximum per cent reduction (68.88 %) in colony diameter and less No. of sclerotia formation (6 No of sclerotia) by *S. rolfsii* over control was achieved due to *Trichoderma harzianum* when test fungus was placed. This was followed by *T. viride* (56.66% and 9.25 no. of sclerotia), *T. koningii* (43.00 %

Table 7 *In vitro* efficacy of bio-agents against *S. rolfsii*

Tr. No.	Treatments	Mean colony diameter (cm)*	Percent inhibition over control	No. of sclerotia produced/plate
T_1	*T. koningii*	5.1	43.00	00.00
T_2	*P. fluorescens*	5.4	40.00	11.00
T_3	*T. harzianum*	2.8	68.88	6.00
T_4	*T. viride*	3.9	56.66	9.25
T_5	Control	9.00	0	68.25
S.Em ±		**3.29**		
C.D at 1%		**13.71**		

* Mean of Four replications

and 0 no. of sclerotia) and *P. fluorescens* (40.00 % and 11 no. of sclerotia) in the order mentioned.

4.8 Reactions of Elephant foot yam varieties and elite lines against *S. rolfsii*

Table 8 Reactions of Elephant foot yam varieties, against *S. rolfsii*

Vr. No.	Varieties	Disease reaction at DAP		
		60	90	120
V-1	EFY DPL - 1	-	+	+
V-2	EFY DPL - 2	-	-	-
V-3	EFY DPL - 3	-	-	-
V-4	BCA–4	-	-	-
V-5	NDB–9	+	+	+
V-6	EFY DPL - 4	+	+	+
V-7	Gajendra	+	+	+
V-8	EFY DPL - 5	-	+	+
V-9	EFY DPL - 6	+	+	+

V-10	EFY DPL - 7	-	+	+
V-11	EFY DPL - 8	-	+	+
V-12	EFY DPL - 9	-	+	+
V-13	EFY DPL - 10	+	+	+
V-14	EFY DPL - 11	+	+	+
V-15	EFY DPL - 12	+	+	+
V-16	EFY DPL - 13	+	+	+

+ Disease observed, - Disease not observed.

DAP : Days after planting

Table 9 Field reactions of Elephant foot yam varieties against *S. rolfsii*

Vr. No.	Varieties	% Mortality at DAP		Total % mortality	Reactions (90 DAP)
		60	90		
V-1	EPY DPL-1	11.11	44.44	55.55	HS
V-2	EPY DPL-2	0.00	0	0	R
V-3	EPY DPL-3	0.00	0	0	R
V-4	BCA-4	0.00	0	0	R
V-5	NDB-9	55.55	77.77	133.32	HS
V-6	EPY DPL-4	66.66	88.88	155.54	HS
V-7	Gajendra	22.22	44.44	66.66	HS
V-8	EPY DPL-5	11.11	22.22	33.33	S
V-9	EPY DPL-6	22.22	33.33	55.55	HS
V-10	EPY DPL-7	11.11	22.22	33.33	S
V-11	EPY DPL-8	11.11	33.33	44.44	HS
V-12	EPY DPL-9	11.11	33.33	44.44	HS
V-13	EPY DPL-10	55.55	77.77	133.32	HS
V-14	EPY DPL-11	33.33	55.55	88.88	HS
V-15	EPY DPL-12	44.44	66.66	111.11	HS
V-16	EPY DPL-13	55.55	77.77	133.32	HS

It is apparent from the results in Table 8 (PLATE VI) that 13 varieties *viz.* EFY DPL-1, NDA-9, EFY DPL-4, Gajendra, EFY DPL-5, EFY DPL-6, EFY DPL-7, EFY DPL-8, EFY DPL-9, EFY DPL-10, EFY DPL-11, EFY DPL-12 and EFY DPL-13exhibited collar rot symptoms, 2-3 months after planting.

Out of 16 varieties screened three varieties *viz.*, EFY DPL-2, EFY DPL-3 and BCA-4 were found resistant, two varieties *viz.,* EPY DPL-5, EPY DPL-7, were found susceptible and Eleven varieties *viz.*, EPY DPL-1, EPY DPL-4,EPY DPL-6,EPY DPL-8, EPY DPL-9, Gajendra,,NDB-9, , EPY DPL-13, EPY DPL-10, EPY DPL-11, EPY DPL-12 were found highly susceptible.

CHAPTER V

DISCUSSION

5.1 Occurrence of the Disease

Elephant foot yam plant suffers from various fungal diseases. The Collar rot of Elephant foot yam caused by *Sclerotium rolfsii* Sacc., was observed at AICRP on Tubers, Central Experimental Station (CES), Wakavali, Dr. BSKKV, Dapoli during Aug-Sep., 2017.

Infection of the pathogen resulted in sudden collapse of Elephant foot yam plants. On an average, 30 to 45 per cent disease incidence was observed in many fields of CES.

5.2 Identification and Isolation of *S. rolfsii*

The pathogen was identified upto species level as *Sclerotium rolfsii* Sacc. by mycologist, Department of Plant Pathology, College of Agriculture, Dapoli. On the basis of its cultural characters on PDA. The identification was confirmed as *Sclerotium rolfsii* Sacc. under microscope. The fungus was repeatedly isolated from infected stems of Elephant foot yam plants. The pure culture of the fungus was established by hyphal tip method on PDA. These results are in conformity with Srivastava (1987), Todankar (1994), D'souza *et al.* (2001), Suryawanshi *et al.* (2007), and Salvi (2015) who isolated and identified *S. rolfsii* on sugar beet, ground nut, betel vine and pigeon pea respectively.

5.3 Pathogenicity test

The pathogenicity of the fungus was proved by inoculating 45 to 55 days old healthy Elephant foot yam plants with seven days old mycelial culture along with sclerotia. The typical symptoms of collar rot disease were manifested by rotting of basal stem portion which turned brown to dark brown with concomitant shrinking of the stem in

the affected region and partial drying of tender shoots which finally collapsed within 18 to 20 days of inoculation. The present findings are in agreement with those of Kodalkar (1992), Gawande (2006), Kolte (2007), Omprakash (2007) and Sawant (2009), Pandav (2012), Kumar (2012), Salvi (2015) who also inoculated the same pathogen on field bean, groundnut, orchid, vanilla, curry leaf, gerbera, Elephant foot yam and tur plants respectively.

5.4 Effect of various culture media on growth of *S. rolfsii*

Cultural characteristics of *Sclrotium rolfsii* were studied on potato dextrose agar medium. Mycelium on potato dextrose agar medium were silky white during early growth stage and becomes dull in later stages, sclerotia were formed after week, but they can observed after 4 days, hyphae were hyaline, and septate mycelial growth on culture medium.

The fungus possessed an ability to utilize a wide spectrum of nutrients as a source of energy. Maximum vegetative growth of the test fungus was observed on potato dextrose agar medium, oat meal agar medium. The second best culture medium found was potato malt agar medium. This was followed by V8 medium and host bark extract medium. Least colony growth of test fungus was recorded on Czapek's dox agar medium and water agar medium. Maximum sclerotial bodies were recorded on potato dextrose agar, potato malt agar medium, Czapek's dox agar, oat meal agar. It was poor on water agar medium. Akram *et al.* (2015) reported that potato dextrose agar was best for the radial growth and sclerotial production of *S. rolfsii*. Chaurasia *et al.* (2013) studied influence of culture media on mycelial growth followed by its sclerotia production. Potato-dextrose medium was found to be more suitable for mycelial growth and sclerotia production. Zape *et al.* (2013) reported that the most suitable medium for better growth of

Sclerotium rolfsii was potato dextrose agar (PDA) (90.00 mm). It was also found that potato dextrose agar (PDA) and peptone sucrose agar (PSA) medium were suitable for the sclerotial production of *S. rolfsii.* Sumia and Quadri (2015) reported that malt extract peptone-dextrose agar was found to be the best culture medium to obtain the maximum radial growth (59 mm). Banakar *et al.* (2017) reported maximum growth was observed in Potato Dextrose Agar (9 cm) and more test weight (262 mg) of sclerotial bodies was recorded in Saboured's dextrose agar. Cultural studies showed the maximum dry mycelial weight of fungus in potato dextrose broth (750 mg) followed by oat meal agar (663 mg).

With respect to colony colour, three types of colours were observed on different solid media. Among the media *viz.,* PDA, water agar and Czapek's Dox showed pure white colonies, where as V8 juice agar and potato malt agar showed dull white coloured colony. On oat meal agar and host bark extract agar cottony white coloured colony were observed. With regard to growth pattern, *S. rolfsii* showed compact growth on V8 juice agar, PDA, oat meal agar and host bark extract agar was recorded. On Czapek's Dox agar, potato malt agar and water agar, it showed filamentous growth. With respect to distribution of mycelial growth, *S. rolfsii* showed thick mycelial growth on PDA, V8 juice agar, oat meal agar and host bark extract agar. However in potato malt agar, it showed thin mycelia growth whereas in Czapek's Dox agar and water agar showed irregular mycelial growth. Banakar *et al.* (2017) reported significant
variability with reference to mycelial characters on different media.

5.5 *In vitro* efficacy of fungicides against *S. rolfsii*

Among the different fungicides tested under *in vitro* conditions, propiconazole (0.1%), mancozeb (0.25%), metalxyl M+mancozeb (0.1%) gave complete inhibition of mycelial growth as well as sclerotia

formation. But, carbendazim (0.1%), copper oxychloride (0.25%) and thiophanate Methyl (0.1%) were ineffective against the pathogen. These findings are in concurrence with those reported by Prabhu and Hiremath (2003), Tiwari and Singh (2004), Mundhe (2005), Patil (2007), Haralpatil and Raut (2008), Patel *et al.* (2008), Sawant (2009) and Pandav (2012), Kumar (2012), Salvi (2015). The results of present study revealed that the fungicides in trizole group are very effective against the soil borne pathogen. The fungicides included in the study found to be effective against the development of sclerotia in plate. The fungicides included in the study found to be effective against the development of sclerotium in plate.

5.6 *In vitro* efficacy of bio-agents against *S. rolfsii*

In present study, the antagonism of three fungal bio-agents (*Trichoderma viride, T. koningii* and *T. harzianum*) and one bacterial bio-agent (*Pseudomonas fluorescens*) was studied. It was revealed that, *T. harzianum* exhibited maximum per cent reduction in colony diameter (68.88%) with less sclerotia (6 nos.) of *S. rolfsii*. It was followed by *T. viride* (56.66 % and 9.25 nos.), *T. koningii* (43.00 % and 0 nos.), *P. fluorescens* (40.00 % and 11.00 nos.) exhibited minimum inhibition of mycelial growth and sclerotia formation, in dual culture technique.

The above findings are in conformity with the results of Bell *et al.* (1982), who reported that *T. harzianum* was the most effective bio-control against *S. rolfsii*, both *in vitro* and *in vivo*. Pranab Dutta and Das (2002) found that out of three *Trichoderma* spp. T. *harzianum* was inhibitory to *Sclerotium rolfsii* Sacc. as it caused 61.5 per cent inhibition of mycelial growth followed by *T. viride* (59.1%)and *T. koningii* (57.2%) as compared to control. Mundhe *et al.* (2009) found that maximum inhibition of mycelial growth of *Sclerotium rolfsii* causing Nagli foot rot , occurred due to *T. harzidnum* (73.77%) followed

by *T. viride* (72.66%) and *P. fluorescens* (71.55%). The results of present study are in accordance with those of Mundhe *et al.* (2009), in respect of fungal bio-agents but not in case of *P. fluorescens*. It was interesting to note that, in the present study, the mycelium of the pathogen overgrew on the growth of *P. fluorescens*. However, the reason behind this was not understood. The result of this also indicated that all the bio-control agents are effective in reducing the sclerotial development in the plate.

5.7 *In vivo* screening of some cultivars against *S. rolfsii* Sacc.

Out of 16 varieties screened three varieties *viz.*, EFY DPL-2, EFY DPL-3 and BCA-4 were found resistant, two varieties *viz.*, EPY DPL-5, EPY DPL-7, were found susceptible and Eleven varieties *viz.*, EPY DPL-1,EPY DPL-4,EPY DPL-6,EPY DPL-8, EPY DPL-9, Gajendra,,NDB-9, , EPY DPL-13, EPY DPL-10, EPY DPL-11, EPY DPL-12 were found highly susceptible.

CHAPTER VI
SUMMARY AND CONCLUSION

Tuber crops are the third most important food crop for man after cereals and grain legumes. Among them EFY (*Amorphophallus paeoniifolius)* is important commercial tuberous root crop of tropical and subtropical region of the world mainly grown for its tubers. Elephant foot yam commonly known as Suran or Jimmikand and belongs to the family Araceae. Because of its higher yield potential, culinary properties, medicinal utility and therapeutic values, it is referred to as **"King of tuber crops".** It has long been used as a local staple food in many countries such as Philippines, Indonesia, Bangladesh, India, China and other South Eastern Asian countries. It succumbs to a number of fungal diseases. Among these, collar rot incited by *Sclerotium rolfsii* Sacc. is of common occurrence in most of the areas where the crop is cultivated. This soil borne pathogen attacks several crops in diverse families. Under field conditions, the disease initially manifests in the form of collar rot of infected plants with eventual wilting and death of the plants.

The occurrence of collar rot of Elephant foot yam was noticed in severe form to the tune of 30 to 45 per cent at AICRP on Tubers, Central Experimental Station, Wakavali, Dr. BSKKV in Taluka - Dapoli (Dist- Ratnagiri).

The pathogenicity of *S. rolfsii* was proved on Elephant foot yam plants raised in field. The dark brownish lesions developed on stem and shriveling of the stem extended above the collar region. Thick mycelial mat and whitish pre-mature sclerotia developed around collar region. Finally, inoculated plants of elephant foot yam collapsed within 60 days after planting.

In culture media evaluation for growth of the pathogen, PDA was the most effective medium as it recorded maximum (90 mm) of mycelia

growth of the pathogen after 7 days of inoculation. It was followed by OMA (88.33 mm), V8 (88.33 mm), PMA (83.33 mm), host bark extract (71.66 mm), Czapek's Dox (18.33 mm), WAM (16.66 mm) was the least effective medium. As the sclerotial development is concern V8 and host bark extract media were not suitable for sclerotial development.

With respect to colony colour, three types of colours were observed on different solid media. Among the media *viz.,* PDA, water agar and Czapek's Dox showed pure white colonies, where as V8 juice agar and Potato malt agar showed dull white coloured colony. On oat meal agar and host bark extract agar cottony white coloured colony were observed. With regard to growth pattern, *S. rolfsii* showed compact growth on V8 juice agar, PDA, oat meal agar and host bark extract agar was recorded. On Czapek's Dox agar, potato malt agar and water agar, it showed filamentous growth. With respect to distribution of mycelial growth, *S. rolfsii* showed thick mycelial growth on PDA, V8 juice agar, oat meal agar and host bark extract agar. However in Potato malt agar, it showed thin mycelia growth whereas in Czapek's Dox agar and water agar showed irregular mycelial growth.

Among different fungicides tested, propiconazole (0.1 %), metalxyl + mancozeb (0.1 %) and mancozeb (0.25 %) were the best as they completely inhibited the mycelial growth and development of sclerotia of *S. rolfsii*.

Trichoderma harzianum (Th), *Trichoderma viride* (Tv), and *Trichoderma koningii* (Tk) were potential antagonists of *S. rolfsii* but *P. fluorescens* was not found effective against the pathogen. Maximum inhibition of mycelial growth and less no of sclerotia formation by *S. rolfsii* was achieved due to *T. harzianum* (68.88 % and 6 nos.) followed by *T. viride* (56.66 % and 9.25 nos.) followed by *T. koningii* (43.00 % and 0 nos.) As the bio-control agents were effective in reducing sclerotial development in media.

In vivo screening of some cultivars of Elephant Foot Yam against *Sclerotium rolfsii* Sacc., revealed that EFY DPL-1, NDA-9, EFY DPL-4, Gajendra, EFY DPL-5, EFY DPL-6, EFY DPL-7, EFY DPL-8, EFY DPL-9, EFY DPL-10, EFY DPL-11, EFY DPL-12 and EFY DPL-13 exhibited collar rot symptoms, 2-3 months after planting.

Out of 16 varieties screened three varieties *viz.*, EFY DPL-2, EFY DPL-3 and BCA-4 were found resistant, two varieties *viz.,* EPY DPL-5, EPY DPL-7, were found susceptible and Eleven varieties *viz.*, EPY DPL-1, EPY DPL-4, EPY DPL-6, EPY DPL-8, EPY DPL-9, Gajendra,, NDB-9, , EPY DPL-13, EPY DPL-10, EPY DPL-11, EPY DPL-12 were found highly susceptible.

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LITERATURE CITED

Akem, C. N. and Dashiell, K.E., 1991. First report of Southern blight caused by *S. rolfsii* on soybeans in Nigeria. *Plant Disease*. **75**(5): 537.

Akram, M., Saabale, P. R., Kumar, A. and Chattopadhay, C. 2015. Morphological, cultural and genetic variability among Indian populations of *Sclerotium rolfsii*. *Journal of food legume*. **28**(4) : 330-334.

*Almeida, R.T.D.E. and Landim, C.M.U., 1981. Preliminary studies on the biological control of *S. rolfsii* Sacc. causal against of sclerotia wilt of cowpea (*Vigna unguiculata* L.) *Fitossanidade*. **5**(1): 15-20.

Aycock, R. 1966. Stem rots and other disease caused by *Sclerotium rolfsii* North Carolind agricultural experiment station technical bulletin No. 174, P : 202.

Bag, T. K., 2004. Oxford, U.K; Blackwell Publishing [En, 4 ref.] Plant Pathology Section, National Research Centre for Orchid (ICAR), Pakyong 737106, Sikkim, India. *Plant Pathology*. **3**(2): 25.

Bankar, S. N. 2017. Morphological and cultural studies of *Sclerotium rolfsii* Sacc. causing foot rot disease of tomato. *International Journal of Current Microbiology and Applied Science.* **6**(2) : 1146-1153.

Bell, D. K. and Wells, H.D. and Markham, C.R., 1982. *In vitro* antagonistic of *Trichoderma species* against six fungal plant pathogens. *Phytopath*. **72**(4): 279-382.

Bhuiyan, M. A. H. B.; Rahman, M. T. and Bhuiyan, K. A., 2012. *In vitro* screening of fungicides and antagonists against *Sclerotium rolfsii. African J. of Biotech.* **11**(82), pp. 14822-14827.

Bose, T. K. and Yadav, L. P., 1989. Commercial flowers 'Nava Prakash' 206 Bidhan Sarani, Calcutta, India.

*Coleman, L. C., 1920. The cultivation of ragi in Mysore. Bull. *Dep. Agric., Mysore Gen. Ser*. 11-12.

Chattopadhyay, A., Saha, B., Pal, S., Bhattacharya, A., and Sen, H., 2009. Quantitative and qualitative aspects of elephant foot yam. *International Journal of Vegetable Science*, **16**(1) : 73-84.

Chaurasia, S., Chaurasia, A. K., Chaurasia, S. and Chaurasia, S. (2013) Pathological studies of *S. rolfsii* causing foot-rot disease of brinjal (*Solanum melongena* Linn.). *International Journal of Pharmacy and Life Science*, **5**(1) : 3257-3264.

Dabre, S. G., (2000). Studies on collar rot (*Sclerotium rolfsii* Sacc.) of gerbera (*Gerbera jamesonii* Hook). M.Sc.(Ag.) thesis submitted to the M.P.K.V., Rahuri (M.S.),India.

D'souza, A.; Roy, J. K.; Mahanty, B. and Dasgupta, B., 2001. Screening of *Trichoderma harzianum against* major fungal pathogens of betelvine.*Indian Phytopathology.* **54**(3): 340-345.

Dadke, M. S. Wagh, S. S. Kuldhar, D. P. Pawar, D. V. Chavan, A. A. Thaware, D. S., 2014. *In vitro* evaluation of fungicides and botanicals against stem rot of chilli caused by *Sclerotium rolfsii*. *International J. of Pl. Prot.* **7**(2):437-440.

Dalvi, M. B., 1985. Sclerotial wilt of groundnut in Konkan. M.Sc. (Agri.). Thesis submitted to K.K.V., Dapoli (M.S.), India. pp. 42-43.

Dalvi, M .B. and Raut S. P., 1987. Chemical control of sclerotial wilt of groundnut in Konkan. *Pesticides.* **21**(9): 27-30.

Das, A.C., 1961. Diseases of Rajanigandha (*Polianthes tuberosa* L.) and Larkspur (*Delphinium ajacis* L.) caused by *S. rolfsii* Sacc. *Sci. and Cult*. **27**(11): 543-550.

Das, S. R. and Panda, S. N., 1997. Evaluation of fungicides against *Sclerotium rolfsii* causing collar rot of tuberose. *Orissa J. of Horti.* **25**(1):46-48.

Desai, R. D.; Siddharmaih, A. L. and Hedge, R.K., 1980. Three additional hosts to *S. rolfsii, Curr. Res*. **9**(9): 151-152.

Dutta, P. and Das, B. C, 2002. Management of Collar rot of Tomato by *Trichoderma* spp. and chemicals. *Indian Phytopath.***55** (2) 235-237.

Garibaldi, A.; Minuto, A. and Gullino, M. L., 2005. First report of Southren blight incited by *Sclerotium rolfsii* on Dichondra repens in Italy. *Plant disease*. **89**(2): 203.

Gawande, A. D., 2006. Studies on major fungal diseases of groundnut and their management. Ph.D. Thesis (unpub.) Dr. B.S.K.K.V., Dapoli, (M.S.), India.

Hanumantha, B. T and Kannan, N., 2002. *In vitro* evalution of fungicides against soft rot of coffee caused by *Sclerotium rolfsii. J.coffee Res.* **30** (2) : 137-140.

Haralpatil, S. K. and Raut, S.P, 2008. Efficacy of fungicides, Bio agents and Botanicals against collar rot of Betelvine. *J.Pl.Dis.Sci.* **3**(1): 93-96.

Hilal T. K (1988) Stem rot and rust disease of carnation and their control.Agricultural Reasearch Review., **79**(4):440-453.

*Hollowell, J. E. and Shew, B.B., 2004. St. Paul, U.S.A., American Phytopathological Society (En.) Department of Plant Pathology, North Carolina State University, Raleigh, NC 27695, *U.S.A. Plant Disease*. **88**(4): 426.

Johnson, M. and Subramanyam, K., 2000. *In vitro* efficacy of fungicides against stem rot pathogen (*S. rolfsii*) of groundnut. *Annals of Pl. Prot. Sci*. **8**(2): 255-257.

Khosla, K. and Gupta, A. K., 2008. Intergation of fungicides and *T.viride* for Management of seedling blight disease of Apple caused by *Sclerotium rolfsii.Indian Phytopath.* **61**(1): 43-48

Kodalkar, V. S., 1992. Studies on sclerotial rot of wal (*Lablab purpurens* L. Sweet) incited by *S. rolfsii* Sacc. M.Sc. (Agri.) Thesis (unpub.) submitted to K.K.V., Dapoli (M.S.), India.

Kolte, V. S., 2007. Studies on collar rot disease of orchid (*Dendrobium orchreatum* L.) incited by *Sclerotium rolfsii* Sacc. M. Sc. (Agri.) Thesis (unpub.) submitted to Dr.B.S.K.K.V. Dapoli, (M. S.), India.

Kumar, P., 2012. Management of collar rot of elephant foot yam caused by *Sclerotium rolfsii* Sacc. M. Sc. (Agri.) Thesis (unpub) submitted to Birsa Agricultural University., Ranchi, (Jharkhand), M.S.

Main T. J. (1976). Foot and collar rot of gladiolus and their control. *India Journal of Expt. Bio.*, **13**: 211-214.

Makwan S.G (1994). Diseases of peanut and its control. *Pl. Disease report*, **54**(2): 224-226.

Manu, T. G. and Nagaraja, A., 2012. *In vitro* evaluation of fungicides against *Sclerotium rolfsii*, causing foot rot disease on finger millet. *Mysore J. of Agril. Sci.* **46**(4): 924-927.

Mathur, K. and Sharma, S.N., 2001. Bulb rot infected by *S. rolfsii*. A new threat to onion cultivation in Rajasthan. *Indian J. Mycol. and Pl. Pathology*. Vol. **26**(1) pp. 132-133.

Mundhe, V. G., 2005. Studies on foot rot of nagli (*Elusine coracana* (L.) Gaertn.) and its management. M.Sc. (Agri.) Thesis (unpub.) Dr. B.S.K.K.V., Dapoli, (M. S.)

Mundhe, V. G.; Diwakar, M.P.; Kadam, J.J.; Joshi, M.S. and Sawant, U.K., 2009. *In vitro* evulation of bio-agents and botanicals against *Sclerotium rolfsii* causing foot rot of finger millet (nagli). *J. Pl.Dis. Sci.* **4**(2) : 183 186.

Narain, A., 1972. Foot rot diseases of ragi in Orissa. *Curr. Sci*. **41**: 823-824.

Narain, A. and Kar, A. K., 1990. Wilt of groundnut caused by *S. rolfsii Fusarium* sp. and *Aspergillus niger. Crop Res. Hisar*. **3**(2) : 257-262.

*Nene, Y. L. and Thapliyal, P. N., 1983. Fungicides in plant disease control. IInd Edn. Oxford and IBH Publ. New Delhi, India. pp. 531-532.

*Niranjani Ramanathan B. Sivakadadeham, K. Theivendirarajah and N. Ramanathan, 1988. A new isolate of *S. rolfsii* Sacc. causing bulb rot in onion (*Allium cepa* L. var. Poona red) *J. of the National Science Council of Srilanka.* **16**(2) : 183-194.

Om Prakash and Singh, U. N., 1976. Basal rot of mango seedlings caused by *S. rolfsii*. *Indian J. Mycol. Pl. Pathol*. **6** : 75.

Omprakash, N., 2007. Studies on stem rot and root rot diseases of Vanilla (*Vanilla planifolia* Andrs.).M.Sc.(Agri.) Thesis (unpub.) Dr. B.S.K.K.V., Dapoli, (M. S.).

Orlikowski, L. and Ptaszek, M., 2013. First report of sclerotium rot of foliage ornamental plants in Poland. *J. of pl. prot. res.* **53**(2):190-193.

Pandav, S. M., 2012. Studies on collar rot of disease of Gerbera (Gerbera jamesonii Hook.) incited by *S. rolfsii*. M.Sc. (Agri). Thesis (unpub.) submitted to Dr. B.S.K.K.V., Dapoli (M.S.).

Pandav, S. M.; Kadam, J. J.; Zagde, P. M.; Joshi, M. S.; Karande, R. A. and Gurav, N. P., 2013. *In vitro* bio-efficacy of fungicides and bio-agents against *Sclerotium rolfsii* Sacc. causing collar rot disease in gerbera. *J.Pl.Dis.Sci.* **8**(2): 215-217.

Patel, S. J.; Solankey, K. U. and Naik, B.M., 2008. Bio-efficacy of fungicides against collar rot pathogen of Brinjal. *J.Pl.Dis.Sci.* **2**(1): 32-33.

Patil, P. P., 2003. Bioefficacy of antagonists against seed/root/ stem rot of sunflower. M. Sc. (Agri.) Thesis (unpub.) Dr. P.D.K.V., Akola (M.S.).

Patil, P. P., 2007. Management of major air borne and soil borne fungal diseases of Vanilla (Vanilla planifolia) thesis (unpub.) Dr. B.S.K.K.V., Dapoli (M.S.).

Polizzi, G.; Vitale, A. and Parlavecchio, G., 2003. First report of Southren blight caused by *Sclerotium rolfsii* on Laurustinus. *Plant disease.* **88**(3): 310.

Prabhu, H. U. and Hiremath P. C., 2003. Bioefficacy of fungicides against collar rot of cotton caused by *S. rolfsii* Sacc. University of Agri. Sci. [En, 11 ref.], Department of Plant Pathology, Uni. Of Agri. Sci. Dharwad, India. *Karnataka Journal of Agri. Sciences*. **16**(4): pp. 576-579.

Pratt, R. T.; McMillan, Jr. and Graves, W.R., 2003. First report of *Sclerotium rolfsii* on *Brassidium* hybrid orchid. *Plant Disease.* **87** (4):446.

Punja, Z. K.; Grogan, R. G. and Unruh, T., 1982. Chemical control of *S. rolfsii* on golf green in northern California plant disease. **66**: 108-111.

Rakholiya, K. B.; Chheladiya, K. K.; Parakhia, A.M.; Kikani, B.K., 2004. Root rot of isabgol; Indian Phytopathological Society [En.] Department of Plant Pathology, College of Agri., Gujrat Agri. Univ., Junugadh, India; *Indian Phytopathology*. **56**(4): 503.

Rangeshwaran, R. and Prasad, R. D., 2000. Biological control of Sclerotium rot of sunflower. *Indian Phytopath*. **53**(4): 444-449.

Rao, S., Danish, S., Keflemaraiam, S., Tesfagergish, H., Tesfamariam, R. and Habtemariam, T., 2016. Pathological survey on disease incidence

and severity of major diseases on tomato and chilli crops grown in Sub Zoba Hamelmalo, Eritrea. *International Journal of Research Studies in Agricultural Science.* **2**(1) : 20-31.

*Rolfs, R. H., 1892. Tomato blight some hints. Florida Agric. Exp. 8th Bull. 18.

Rout, M. K. and Mishra, B., 2008. Studies on collar rot disease of marigold and its management. *J. of Mycopath. Res.* **46**(2):283-284.

*Saccardo, P. A., 1911. Notes mycolohicae. *Ann. Mycol. Brel.* **9**: 249-257.

Sahoo, B., Nedunchezhiyan, M. and Acharyya, P., 2016. Incidence of collar rot in elephant foot yam (*Amorphophallus paeoniifolius* Dennst. Nicolson) as influenced by varied nutrient regimes in East and South-eastern coastal plain zone of Odisha. *Journal of crop and weed.* 12(3) : 160-162.

Salvi, P. P., 2015. studies on collar rot and root rot of pigeon pea (*Cajanus cajan* (L.) Millsp.) incited by *Sclerotium rolfsii* Sacc. M.Sc. (Agri). Thesis submitted to Dr. B.S.K.K.V., Dapoli (M.S.).

Sawant, A. V., 2009. Studies on collar rot and stem rot of curry leaf (*Murraya koenigii* (L.) sprengal) incited by *Sclerotium rolfsii* Sacc. M.Sc. (Agri). Thesis submitted to Dr. B.S.K.K.V., Dapoli (M.S.).

Sawant, A. V.; Gadre, U. A.; Joshi, M.S. and Pawar, H.D., 2013. *In vitro* evaluation of fungicides and bio-agents against *sclerotium rolfsii* causing collar and stem rot of curry leaf. *J.Pl.Dis.Sci*. **8**(2):237-238.

Sen, S., Bose, T.; Basu, K.; Acharya, R.; Samajapati, N. and Acharya, K., 2006. *In vitro* antagonistic effect of *fluorescent pseudomonas* BRL-1 against *Scleroium rolfsii. Indian Phytopathology.* **59** (2): 227-230.

Shahare, N. H.; Pachkhede, A. U. and Kanherkar, S.H., 2008. Evaluation of fungal antagonists and plant extracts against *Sclerotium rolfsii* causing collar rot of Soybean. *J.Pl.Dis.Sci.***3** (1):122-124.

*Singh, A., 2002. Studies on collar rot of beetelvine (*piper betel* L.).Ph.D. thesis, Lucknow University, Lucknow, India.

Singh, J. and Kumar, K., 2002. Location survival, transmission and control of soil borne fungus. *Annals Pl. Protection Sci*. **10**(1): 111-113.

Sinha, D. C. and Prasad, K. K. 1986. Rhizopus rot of sweet potato in India. *Indian Phytopathology*., 39**(1)** : 89-90.

Sivaprakasam, K. and Kandaswamy, T. K., 1982. Root and corm rot of *Amorphophallus paeoniifolius* in India. *Indian Phytopathology.* 35 : 721-722.

Songvilay, P; Groenewald, J. Z.; Vongpahachanh, P.; Sayapattha, S.; Chittarath, K.; Crous, P. W and Burgess, L. W., 2012. First report of *Sclerotium rolfsii* in the Lao PDR. *Australian Pl. Dis. Notes*.

Srivastava, S. N.; Agnihotri, V. P. and Singh, K., 1987. Factors influencing competitive saprophytic ability of *Sclerotium rolfsii* in soil. *Indian Phytopath*.**40** (4): 495-499.

Stack, J. P., Kenerley, C. M., Pettit, R. E., (1986). Application of biological control agents. *In : Biological Control of Plant Diseases*. Butterworth, London, 71 pp

Stanley, R. L.; Shokes, F. M. and Berger, D. A., 1996. First report of *Sclerotium rolfsii* on Perennial Pea nut in Florida. *Pl. Dis*. **80**(1):105.

Sumia, F. and Quadri U. 2015. Effect of different media on radial growth of *Sclerotium rolfsii* causing chilli rot. *An International Peer Review Journal.* **4** : 2319-4731.

*Sundararaman, S., 1933. Administration report of the mycologist for the year 1931-32. pp. 17.

Suryawanshi, A. P.; Ladkat, G. M.; Dhoke, P. K.; Somawanshi, S.D. and Pensalwar, S. N. (2007). Evalution of some *plant* extracts against *Sclerotium rolfsii* on Pigeon pea, *J. pl. Dis. Sci.,* **2(**1): 32- 33

Thakur, K. S.; Keshry, P. K.; Tamrakar, D. K. and Sinha, A. K., 2002. Studies of management of collar rot diseases (*S. rolfsii*) of chick pea by use of fungicide. *P.K.V., Res. J.* **26** (1 and 2): pp. 51-52.

Tiwari, R. K. S., 1995. Comparative evaluation of three systemic fungicides against *S. rolfsii* causing root rot in gram and sunflower. *Indian J. Mycol. Pl. Pathol*., Vol. **25**(3): 243-245.

Tiwari, R. K. S. and Singh, A., 2004. Efficacy of fungicides on *Rhizoctonia solani* and *Sclerotium rolfsii* and their effect on *Trichoderma harzianum* and *Rhizobium leguminosarum*. *J.Mycol.Pl.Pathol.* **34**(2): 482-484.

Todankar, S. S., 1994. Studies on *Sclerotium rolfsii* causing wilt of groundnut (*Arachis hypogaea* L.) M.Sc. (Agri.) thesis (unpub.) submitted to Dr. B.S.K.K.V., Dapoli (M.S).

Vincent, J. M., 1927. Distortion of fungal hypae in the presence of certain inhibitors. Nature 159:850.

Vyas, R. K. and Mathur, K., 2002. Distribution of *Trichoderma* spp. in cumin rhizosphere and their potential in supression of wilt. *Indian Phytopath*. **55**(4): 451-457.

*Weber, G. F., 1931. Blight of carrot caused by *S. rolfsii* with geographic distribution and host range of the fungal. *Phytopath.* **21**: 1129-1140.

Wells, H. D., Bell, D. K. and Jaworski, C.A., 1972. Efficacy of *T. harzianum* as a biocontrol for *S. rolfsii. Phytopathology*. **62**: 442-447.

Zape, A. S., Gade, R. M. and Singh, R. 2013. Physiological studies on different media, pH, temperature on *Sclerotium rolfsii* isolates of soybean. *Journal of Agricultural Science.* 2(6) : pp.238-241.

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*Original not seen

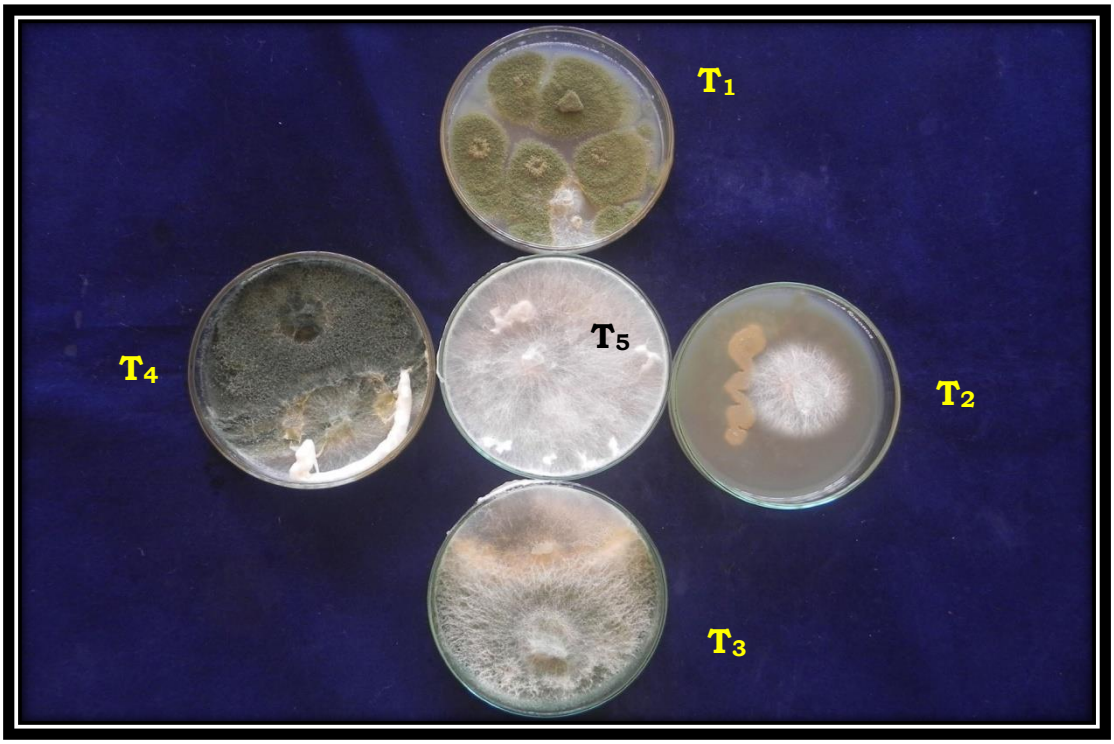
PLATE II

Pathogenicity test

A. Healthy plant

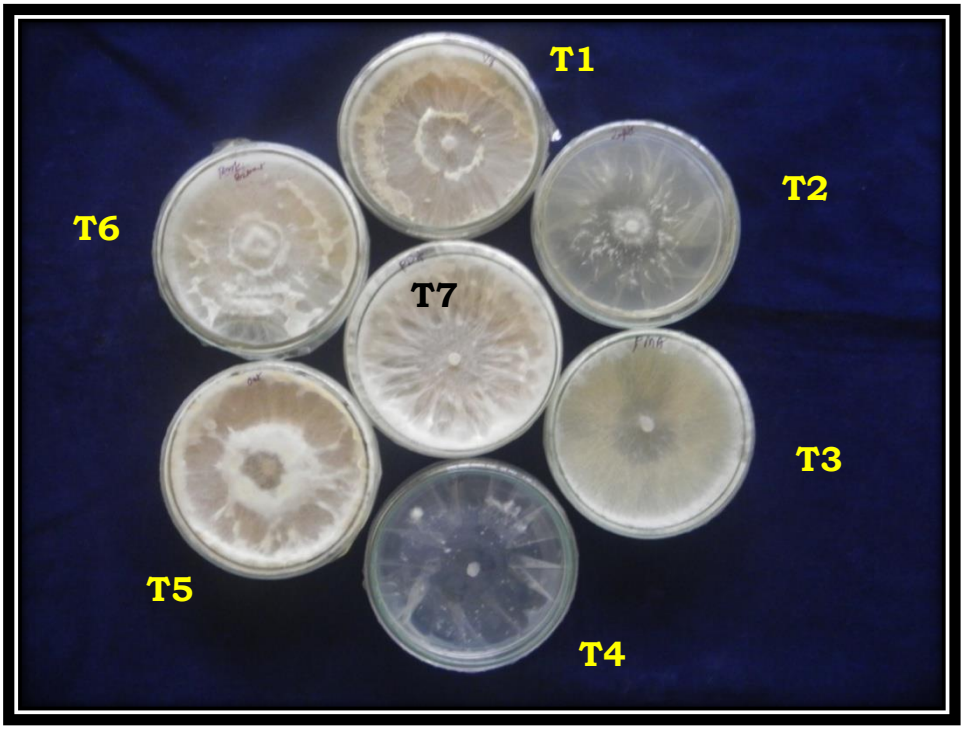
B. Inoculated plant

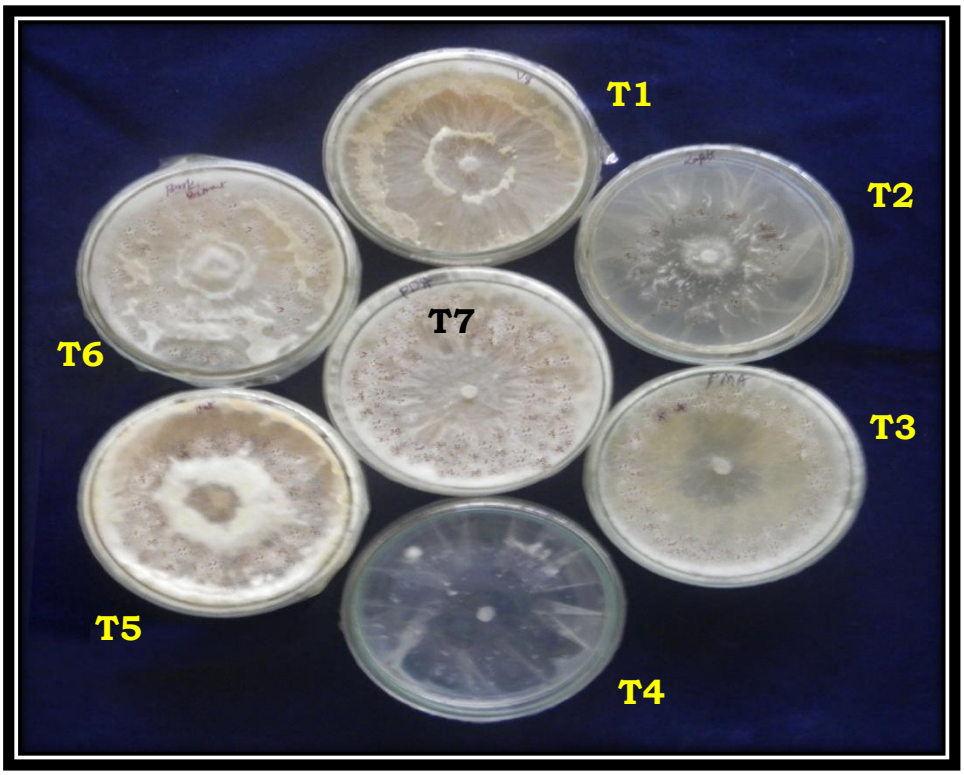
PLATE V



Efficacy of bioagents against *Sclerotium rolfsii* Sacc.

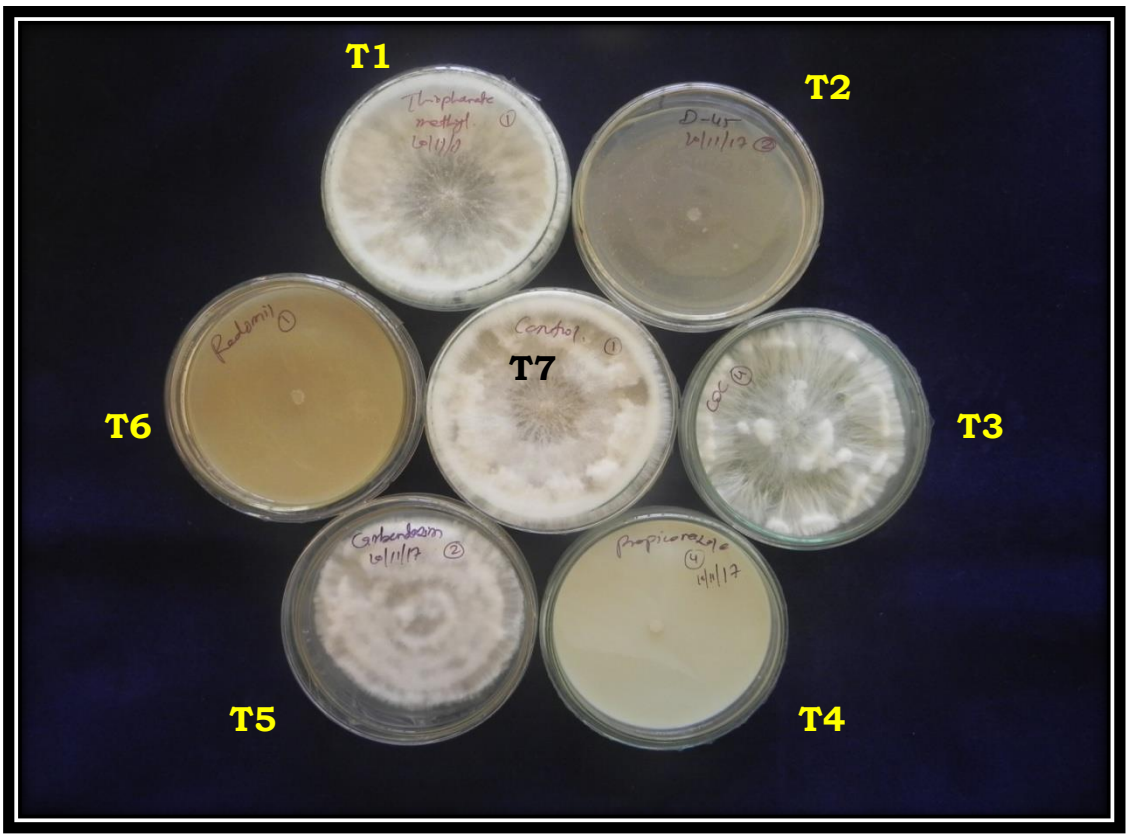
PLATE III





Effect of various culture media on growth of *Sclerotium rolfsii*

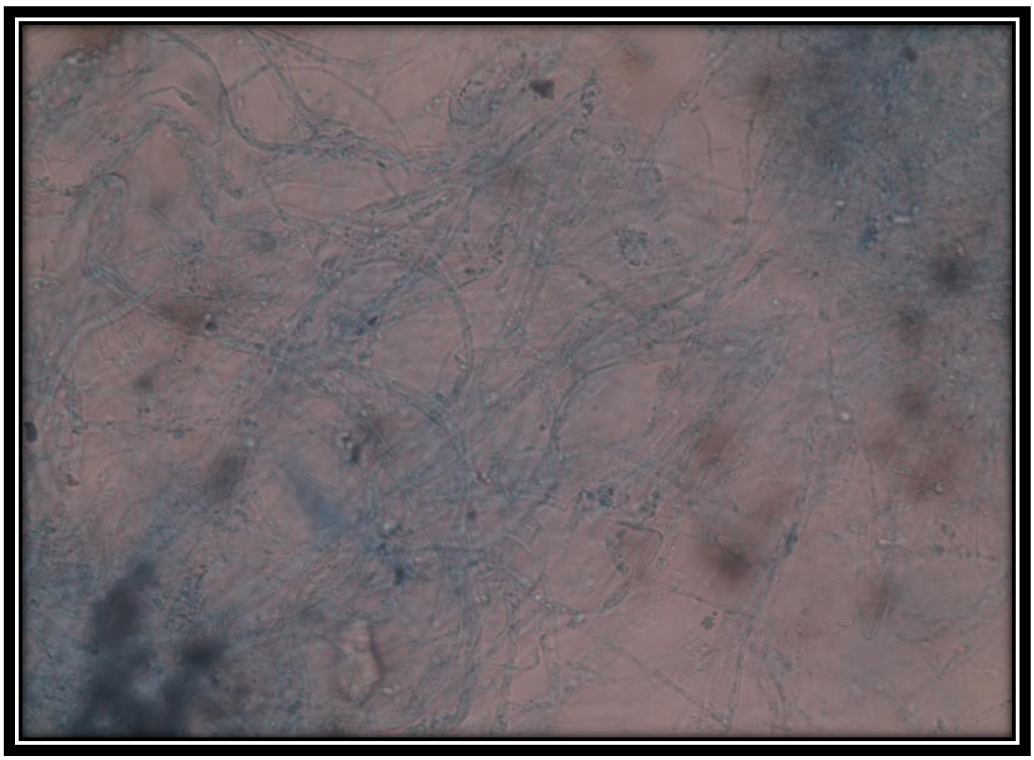
PLATE IV



In vitro* efficacy of various fungicides against *Sclerotium rolfsii

PLATE I

A. Pure culture and sclerotia of *Sclertium rolfsii*



B. *Sclerotium rolfsii* Microphotograph (40 X)

PLATE VI

Screening of Elephant foot yam cultivars against *Sclertium rolfsii*

a) Before infection

a) After infection under natural epiphytotics

TREATMENT DETAILS

(Plate IV)

In vitro efficacy of various fungicides against *Sclerotium rolfsii* Sacc.

Tr. No.	Treatments	Concentration (%)
T_1	Thiophenate methyl	0.1
T_2	Mancozeb	0.25
T_3	Copper-oxy-chloride	0.25
T_4	Propiconazole	0.1
T_5	Carbendazim	0.1
T_6	Metalaxyl-M + Manocozeb	0.1
T_7	Control (No fungicide)	-

TREATMENT DETAILS

(Plate V)

In vitro* efficacy of bioagents against *Sclerotium rolfsii

Tr. No.	*Placement details*
T_1	*Tk* *Sr*
T_2	*Pf* *Sr*
T_3	*Th* *Sr*
T_4	*Tv* *Sr*
T_5	*Sr*

Where,

Sr = Sclerotium rolfsii

Th = Trichoderma harzianum

Tv = Trichoderma viride

Tk = Trichoderma koningii

Pf = Pseudomonas fluorescens

TREATMENT DETAILS

(Plate VI)

Screening of Elephant foot yam varieties against *S. rolfsii*

Vr. No.	Varieties
V-1	EFY DPL - 1
V-2	EFY DPL - 2
V-3	EFY DPL - 3
V-4	BCA - 4
V-5	NDB - 9
V-6	EFY DPL - 4
V-7	Gajendra
V-8	EFY DPL - 5
V-9	EFY DPL - 6
V-10	EFY DPL - 7
V-11	EFY DPL - 8
V-12	EFY DPL - 9
V-13	EFY DPL - 10
V-14	EFY DPL - 11
V-15	EFY DPL - 12
V-16	EFY DPL - 13

TREATMENT DETAILS

(Plate III)

Effect of various culture media on growth of *Sclerotium rolfsii*

Tr. No.	Treatments
T_1	V8 juice agar
T_2	Czapek's Dox agar
T_3	Potato malt agar
T_4	Water agar
T_5	Oat meal agar
T_6	Host bark extract agar
T_7	Potato dextrose agar

LEGENDS

(Fig. 1)

Effect of various culture media on growth of *Sclerotium rolfsii*

Tr. No.	Treatments
T_1	V8 juice agar
T_2	Czapek's Dox agar
T_3	Potato malt agar
T_4	Water agar
T_5	Oat meal agar
T_6	Host bark extract agar
T_7	Potato dextrose agar

LEGENDS

(Fig. 2)

***In vitro* efficacy of various fungicides against *Sclerotium rolfsii* Sacc.**

Tr. No.	Treatments	Concentration (%)
T_1	Thiophenate methyl	0.1
T_2	Mancozeb	0.25
T_3	Copper-oxy-chloride	0.25
T_4	Propiconazole	0.1
T_5	Carbendazim	0.1
T_6	Metalaxyl-M + Manocozeb	0.1
T_7	Control (No fungicide)	-

LEGENDS

(Fig. 3)

In vitro* efficacy of bioagents against *Sclerotium rolfsii

Tr. No.	Placement details
T_1	*Tk* *Sr*
T_2	*Pf* *Sr*
T_3	*Th* *Sr*
T_4	*Tv* *Sr*
T_5	*Sr*

Where,

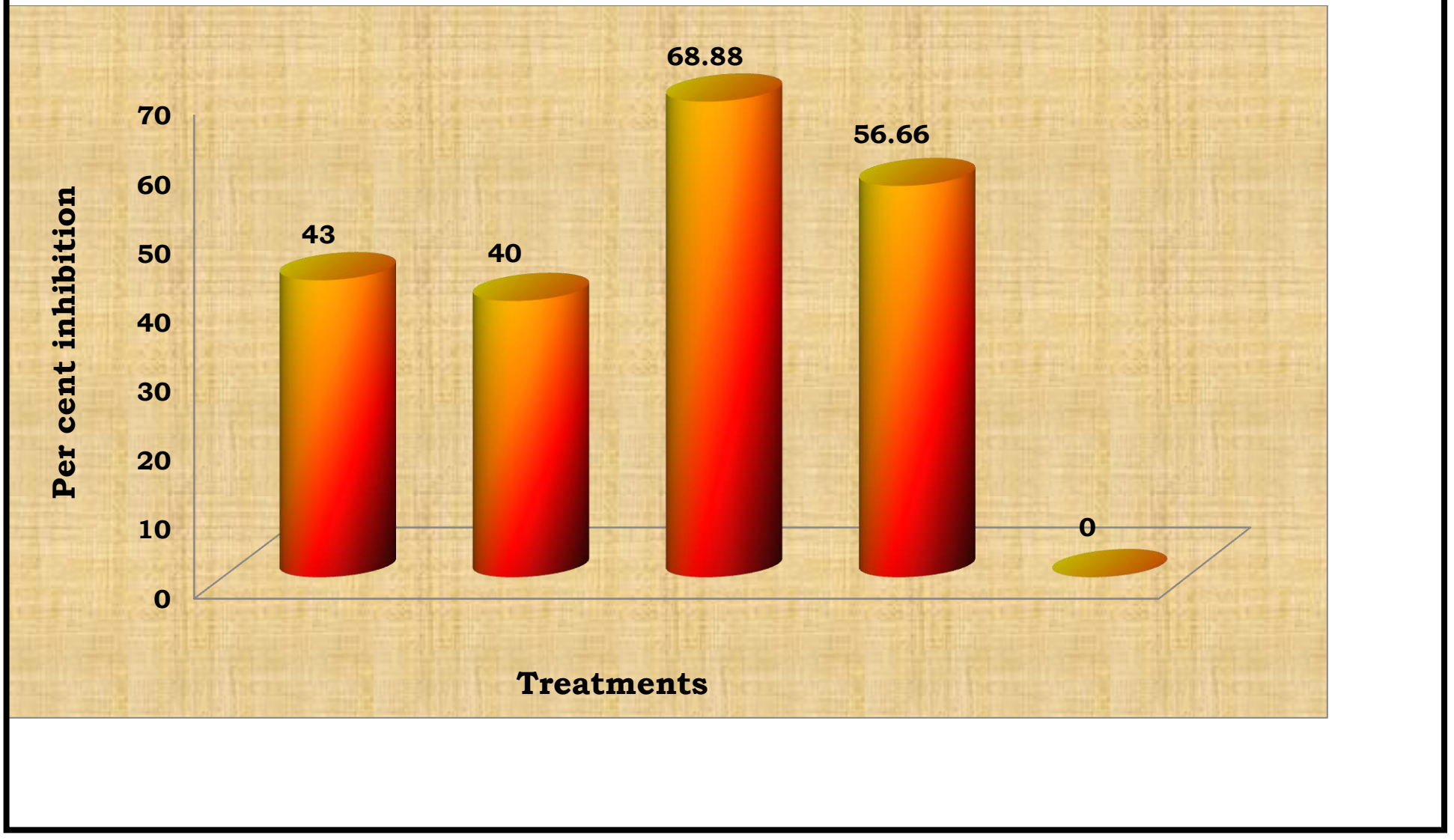
Sr = Sclerotium rolfsii

Th = Trichoderma harzianum

Tv = Trichoderma viride

Tk = Trichoderma koningii

Pf = Pseudomonas fluorescens


Per cent inhibition
70
60
50
40
30
20
10
0
43
40
68.88
56.66
0
Treatments

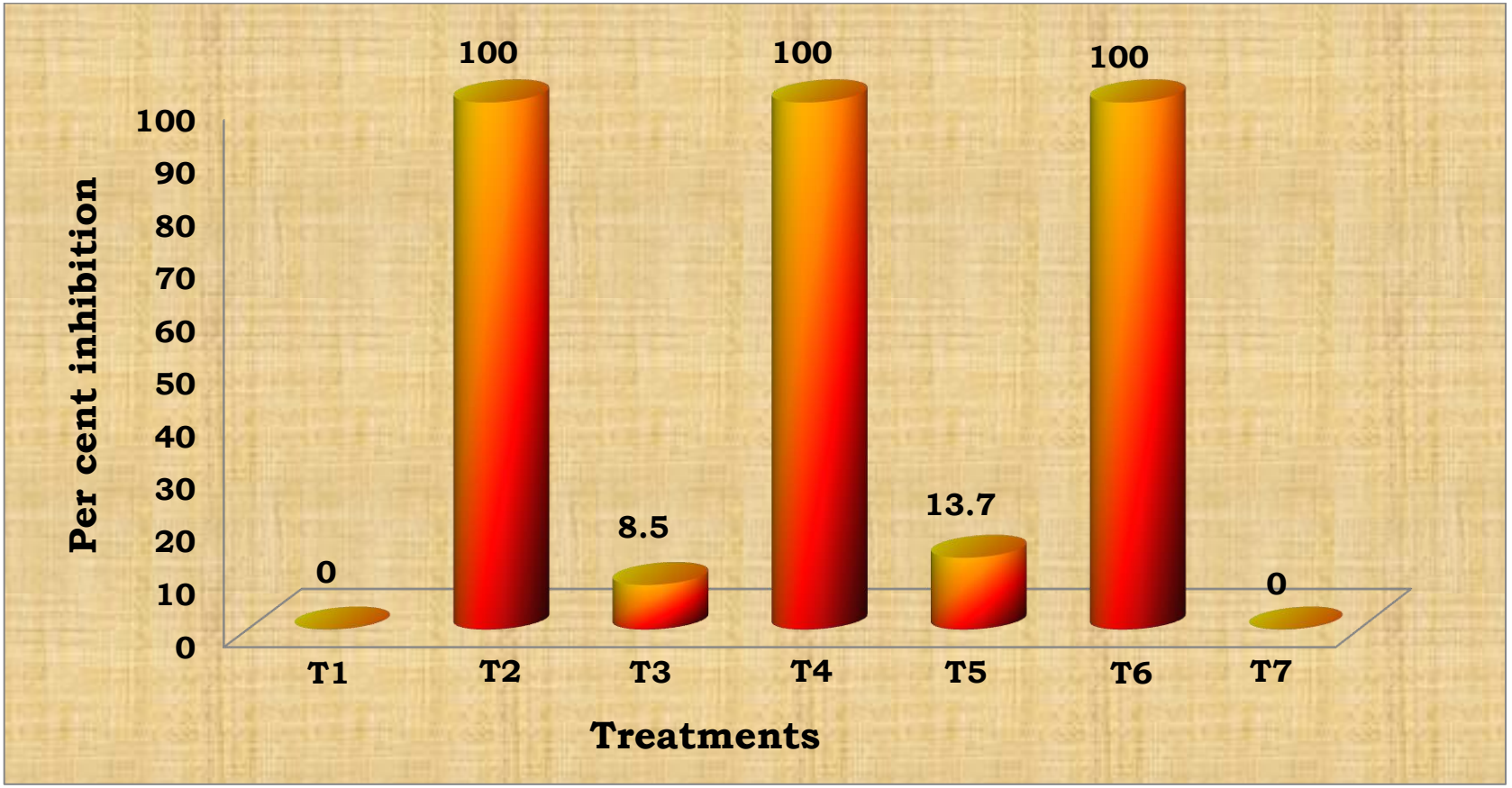


Fig. 2 Efficacy of fungicides against *Sclerotiumrolfsii*

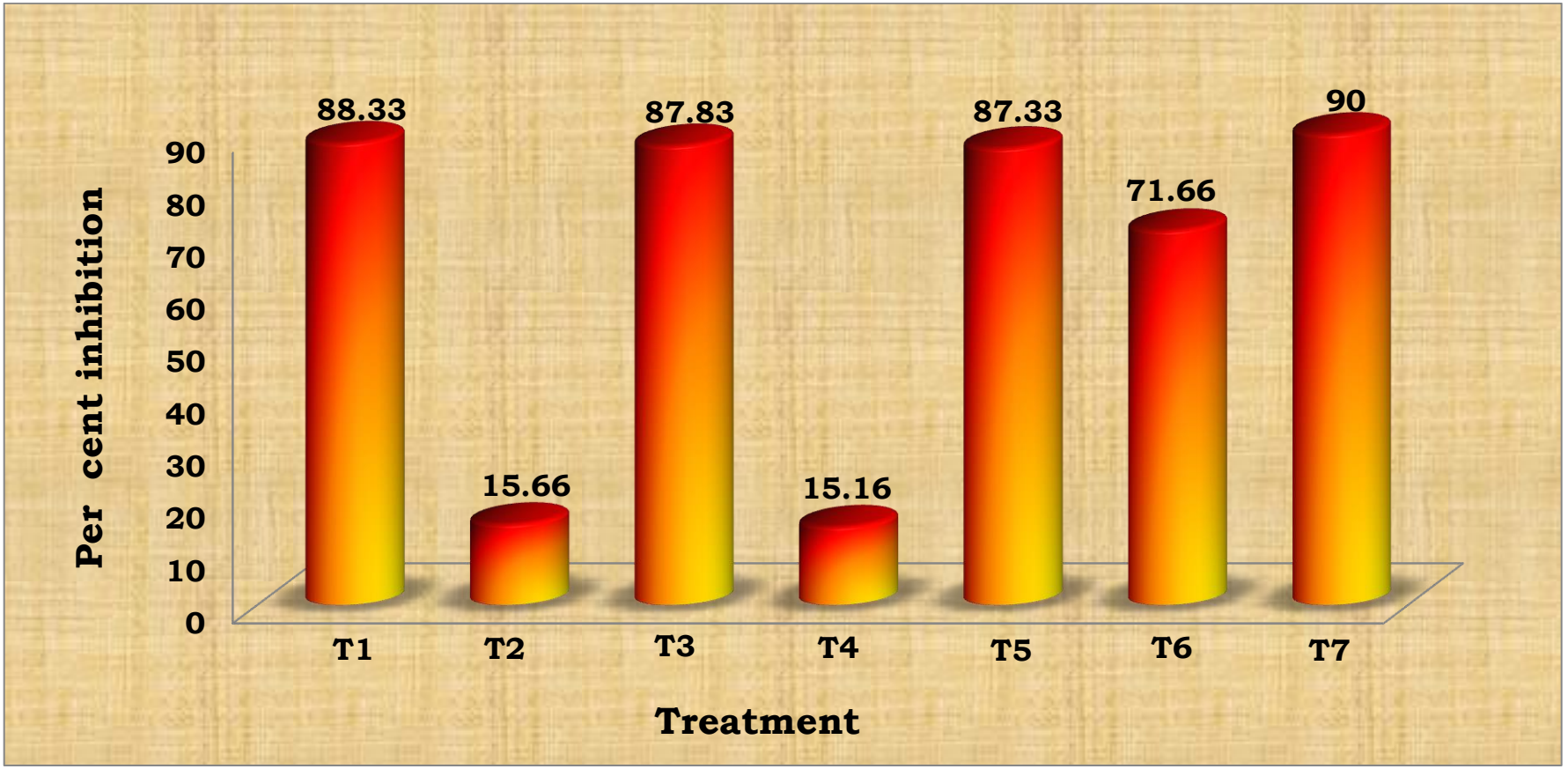


Fig. 1 Effect of various culture media on growth of *Sclrotiumrolfsii*