INTERNATIONAL JOURNAL OF PLANT PROTECTION / VOLUME 5 | ISSUE 2 | OCTOBER, 2012 | 195-200

RESEARCH ARTICLE

Solarization and antagonistic organisms for management of rhizome rot of ginger in Karnataka

■ M. S. LOKESH[1*], S. V. PATIL[2], S.B GURUMURTHY[2], M.G. PALAKSHAPPA[3] AND M. ANANDARAJ[4]

[1*]AICRP on Spices, Horticulture Research Station, University of Horticultural Sciences, Bagalkot, SIRSI (UTTARA KANNADA) (KARNATAKA) INDIA

[2]College of Horticulture, University of Horticultural Sciences, Bagalkot, SIRSI (UTTARA KANNADA) (KARNATAKA) INDIA

[3]AICRP on Sesame and Niger, University of Agricultural Sciences, DHARWAD (KARNATAKA) INDIA

[4]Indian Institute of Spices Research, CALICUT (KERALA) INDIA

ARITCLE INFO

Received : 10.03.2012
Revised : 20.04.2012
Accepted : 05.07.2012

Key **W**ords :
Ginger,
Mancozeb,
Trichoderma harzianum,
Bacterial
consortium

*Corresponding author:
lokeshsirsi@rediffmail.com

ABSTRACT

Rhizome rot was less in solarized rhizomes as compared to non-solarized ones. Disease was less where the rhizomes were treated with bioagents in combination *i.e.*, *T. harzianum,* bacterial consortium (for growth, nematode and *Pythium* suppression). However, individual bioagent treatments were also effective in reducing the rhizome rot both in solarized rhizomes and non solarized rhizomes in case of *T. harzianum* and bacterial consortium. Disease incidence was least with chemical check with mancozeb @ 0.25 per cent both in solarized and non-solarized rhizomes. Unprotected rhizomes both in solarized and non solarized recorded maximum disease. Germination of rhizomes were maximum both in solarized and non-solarized rhizomes where the rhizomes were treated with mancozeb (@ 0.25%). Rhizomes of both solarized and non-solarized treated with bioagents either *Trichoderma harzianum* alone or bacterial consortium or their combination showed better germination. solarized rhizomes showed more tiller than non-solarized ones. Rhizomes of both solarized and non-solarized treated individually with Mancozeb (0.25%) along with bed treatment recorded highest fresh and projected yield. *T. harzianum* and bacterial consortium along with bed treatment both in solarized and non-solarized rhizomes produced more fresh and projected yield than individual bioagent treatments. Performance of *T. harzianum* was superior over bacterial consortium in recording fresh and projected yield. Solarized rhizomes yields were more as compared to non-solarized rhizomes. Unprotected rhizomes (check) yields were least both in solarized rhizomes and non-solarized rhizomes.

How to view point the article : Lokesh, M.S., Patil, S.V., Gurumurthy, S.B, Palakshappa, M.G. and Anandaraj, M. (2012). Solarization and antagonistic organisms for management of rhizome rot of ginger in Karnataka. *Internat. J. Plant Protec.*, **5**(2) : 195-200.

INTRODUCTION

Ginger (*Zinginber officinale* Rose) an important medicinally spice is used for carminative and to get relived from cold, cough, throat infections and stomach ache induced indigestion. In the world, India accounts for one third of total production of ginger. It is used as raw or processed and has high export earning produce.

Parthasarathy *et al.* (2007) opined that prevalence of congenial climate for multiplication and spread of rhizome rot and bacterial wilt pathogens resulting in severe economic loss in heavy rainfall was the major concern.

Major biotic threat for cultivation of ginger in the region is rhizome rot (*Pythium aphinidermatum (*Edison) Fitz. which results in huge loss (> 50% to 80 %) by affecting quality and quality of produce (Joshi and Sharma, 1980 and Parthasarathy

et al. 2007). Suryanarayana *et al*. (2008) reported that high incidence (31.50 per cent) of rhizome rot was recorded in Sirsi Taluka followed by Siddapur (16.00 per cent) and least in Yellapur (14.03 per cent) Taluka. The disease appears during peak monsoon *i.e.* , July with high intensity of disease during September onwards. Affected plants exhibit by turning of top leaves to pale yellow and appearance of water-soaked lesion on the roots followed by collar region which extents to rhizome. Subsequently, infected region exhibit discoloured sunken patches, softening and rotting of roots, rhizomes and pseudostem. In due course, affected roots and rhizomes get rotted. In such plants, leaves become yellowing, drooping, and falling of pseudostem coupled with mortality of whole plant. Rotted tissues emit foul smell and affected pseudostem comes out for gentle pulling.

Since, the disease is most important of the region and to help the farmers to over come the disease by cost effective techniques *viz.,* solarization and use of bioagents. Hence, an attempt was made to study the efficacy of solarization of rhizomes and biocontrol agents in comparison with fungicides for efficient management of the disease.

MATERIALS AND METHODS

The experiment was laid out at Agricultural Research Station (Pepper), Sirsi, Uttara Kannada dist. of Karnataka for two years from 2006-2007 to 2007-2008. The average rainfall of the region was 2600 mm and a soils with latertic sandy loam in nature with pH 6.8 and nutrient status of 110 kg , 38 kg and 242 kg/ha NPK, respectively.

The experiment was laid out in split plot design where in solarized and non-solarized rhizomes as main treatment and five sub treatments with *T. harzianum,* bacterial consortium (for growth, nematode and *Pythium* suppression) , and their combination, macozeb and untreated control. The variety used for the solarization was farmers cultivated local variety which was highly susceptible to rhizome rot.

Rhizomes of ginger were solarized under polyethylene sheet (200 micron) at 47 ^{0}C for 30 min during June 2006 and June 2007 as one set and another set without solarization for the management of rhizome rot. Before planting, both the solarized and non-solarized rhizomes were further treated with *T. harzianum,* bacterial consortium and both the bioagents in combination for 30 minutes. Further, beds were also treated with respective bioagents as drench at the time of planting of rhizomes and application of Bacterial consortium (For growth, Nematode and *Pythium* suppression) after sowing of rhizomes. Chemical check was done with Mancozeb (@ 0.25 per cent as rhizome and bed treatments and one more treatment without any rhizome and bed treatment as control. The size of the beds were 1x3m with fifteen replications.

Fifteen days after sowing, beds were drenched with respective rhizomes treated bioagents as drenching and repeated at monthly intervals after 15 days of 50 per cent germination as a protective measures to ginger plants. Mancozeb (@ 0.25 per cent as chemical check for rhizome and bed treatments was done in a similar procedure followed for bioagents and one more treatment was maintained without any rhizome and bed treatment as control.

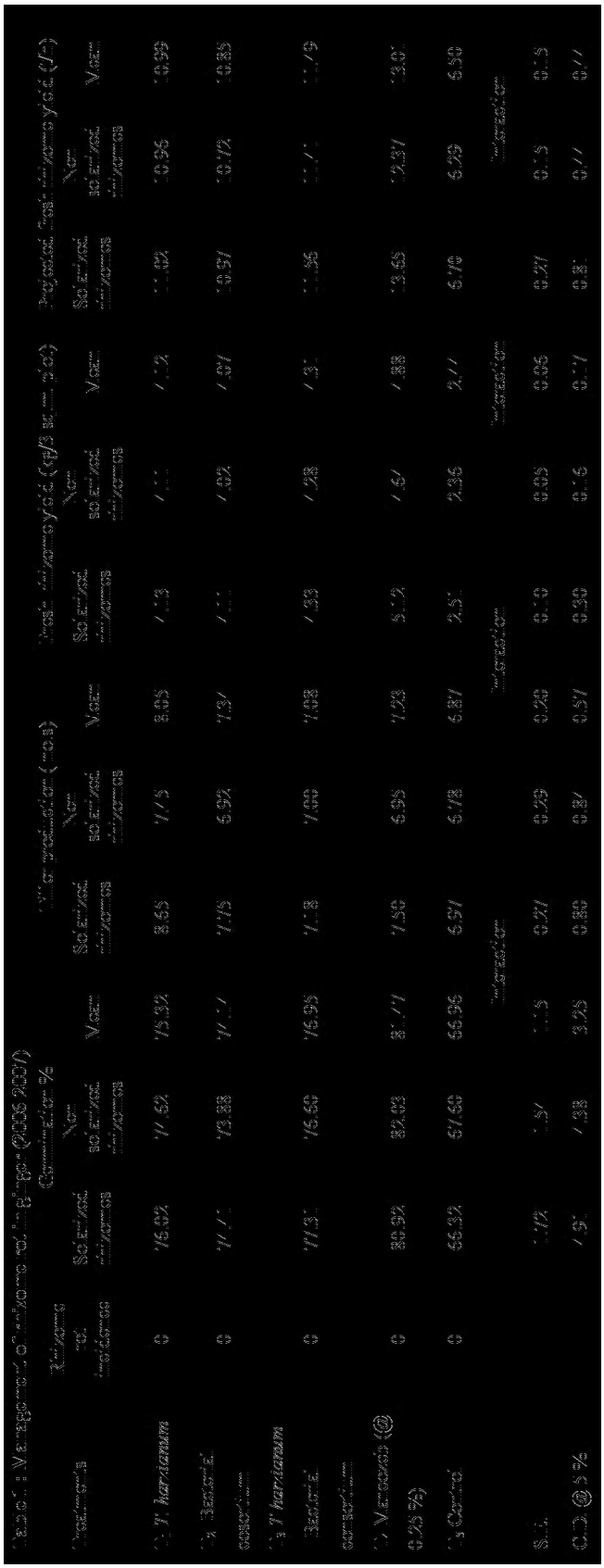
RESULTS AND DISCUSSION

Rhizome rot was not noticed in any of the treatments both in solarized and non-solarized rhizomes during 2006-07. *T. harzianum* was effective in improving the germination of solarized rhizomes (76.02 per cent) where as combination of both *T. harzianum* and bacterial consortium treated rhizomes showed higher per cent germination (76.60 per cent). Mancozeb (@ 0.25 per cent) treated rhizomes of both solarized (80.92 per cent) and non-solarized (82.03 per cent) gave highest germination. Solarized (66.32 per cent) and non-solarized rhizomes (67.60 per cent) without any protection with either bioagents or chemical showed minimum germination (Table 1).

Solarized rhizomes treated with *T. harzianum* showed highest tiller production (8.65 nos). This is followed by solarized rhizomes treated with bacterial consortium (7.75 nos.). But the least tiller production (6.97 nos.) was in non-solarized and unprotected rhizomes

Fresh rhizome yield was maximum (5.12 kg per 3 sq mt plot, 13.65 t/ha projected yield) wherein the solarized rhizomes were treated with Mancozeb (@ 0.25 per cent) as rhizome and bed treatment. Solarized rhizomes when treated with combination of bioagents *viz., T. harzianum* and bacterial consortium recorded higher yield (4.33 kg per 3 sq mt plot, 11.56 t/ha projected yield). *T. harzianum* performed better in solarized rhizomes in increasing the yield (4.13 kg per 3 sq mt plot, 11.02 t/ha projected yield) . Lowest yield was noticed in unprotected rhizomes (control) *viz.,* both in solarized (2.51kg per 3 sq mt plot, 6.70 t/ha projected yield) and non-solarized rhizomes (2.36 kg per 3 sq mt plot, 6.29t/ha projected yield) (Table 1).

Rhizome rot was recorded in both solarized and non-solarized rhizomes with different intensities. However, there was less disease in solarized rhizomes as compared to non-solarized ones. Rhizome rot was less where the rhizomes were treated with bioagents in combination *i.e.*, *T. harzianum,* bacterial consortium as rhizome and bed treatment both in solarized rhizomes (12.98 per cent) and non-solarized rhizomes (11.90 per cent). However, individual bioagent treatments were also effective in reducing the rhizome rot both in solarized rhizomes (13.49 per cent) and non-solarized rhizomes (14.01 per cent) in case of *T. harzianum* where in case of bacterial consortium as solarized rhizomes (14.49 per cent) and non-

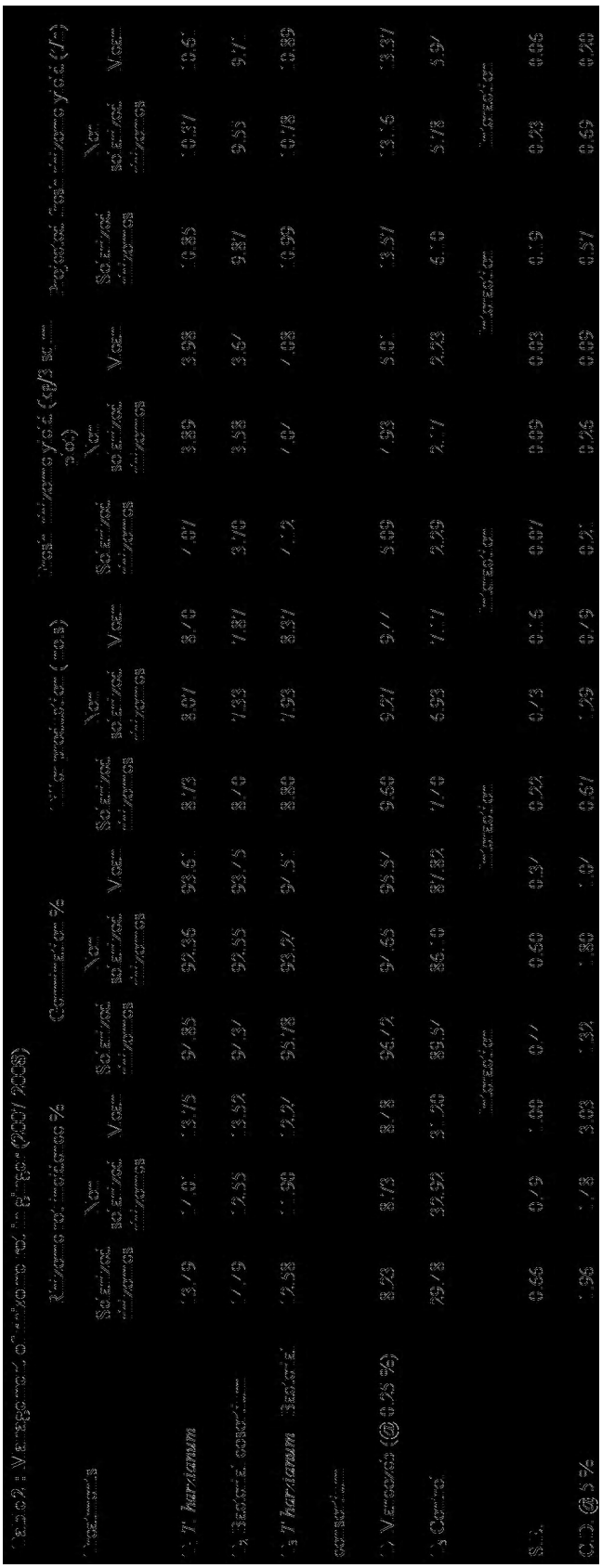


solarized rhizomes (12.55 per cent). Disease incidence was least with chemical check with mancozeb @ 0.25 % both in solarized (8.23 per cent) and non-solarized (8.73 per cent) rhizomes. Unprotected rhizomes both in solarized (29.48 per cent) and non-solarized (32.92 per cent) recorded maximum disease (Table 2).

Germination of rhizomes was maximum both in solarized (96.42 per cent) and non-solarized rhizomes (94.65 per cent) where the rhizomes were treated with Mancozeb (@ 2.5 per cent). Solarized rhizomes improved the rhizome germination as compared to non-solarized rhizomes. Rhizomes of both solarized and non-solarized treated with bioagents either *Trichoderma harzianum* alone (94.85 per cent and 92.36 per cent) or bacterial consortium alone (94.34 per cent and 92.55 per cent) or their combination 95.78 and 93.24 per cent) showed better germination, respectively. However, there was severe reduction of germination of rhizomes both in solarized (89.54 per cent) and non-solarized (86.10 per cent) rhizomes without any treatment (control).

With respect to tiller production, solarized rhizomes showed more tiller than non-solarized ones. Tiller numbers were more (9.60 numbers and 9.27 numbers) in case of Mancozeb treated solarized and non-solarized rhizomes, respectively. This was followed by bio agents treatments *viz., T. harzianum* (8.73 nos. and 8.07 nos. and consortium of bacteria (8.40 nos. and 7.33 nos.) individually and their combination (8.80 nos. and 7.93 nos.) both in solarized and non-solarized rhizomes, respectively and they were on par to each other. Tiller production was least in non-solarized rhizomes (6.93 nos.) as compared to solarized rhizomes (7.40 nos.) in unprotected rhizomes as check (Table 2).

Rhizomes of both solarized and non-solarized treated individually with Mancozeb (0.25%) along with bed treatment recorded highest fresh and projected yield (solarized rhizomes 5.09 kg /3m^2 with projected yield of 13.57 t/ha and non-solarized rhizomes 4.93 kg / 3m^2 with projected yield of 13.16 t/ha). Among the bioagents, rhizomes treated with *T. harzianum* and bacterial consortium along with bed treatment both in solarized and non-solarized rhizomes produced more fresh and projected yield (4.12 kg /3m^2 with projected yield of 10.99 t/ha and 4.04 /3m^2 with projected yield of 10.78 t/ha, respectively) than individual bioagents treatments. Between the bioagents, performance of *T. harzianum* was superior over bacterial consortium in recording fresh and projected yield (solarized rhizomes 4.07 /3m^2 with projected yield of 10.85 t/ha and non-solarized rhizomes 3.89 /3m^2 with projected yield of 10.37 t/ha). Solarized rhizomes yields were more as compared to non-solarized rhizomes. Unprotected rhizomes (check) yields were least both in solarized rhizomes (2.29 /3m^2 with projected yield of 6.10 t/ha) and non-solarized rhizomes (2.17/3m^{2}with projected yield of 5.78 t/ha) (Table 2).



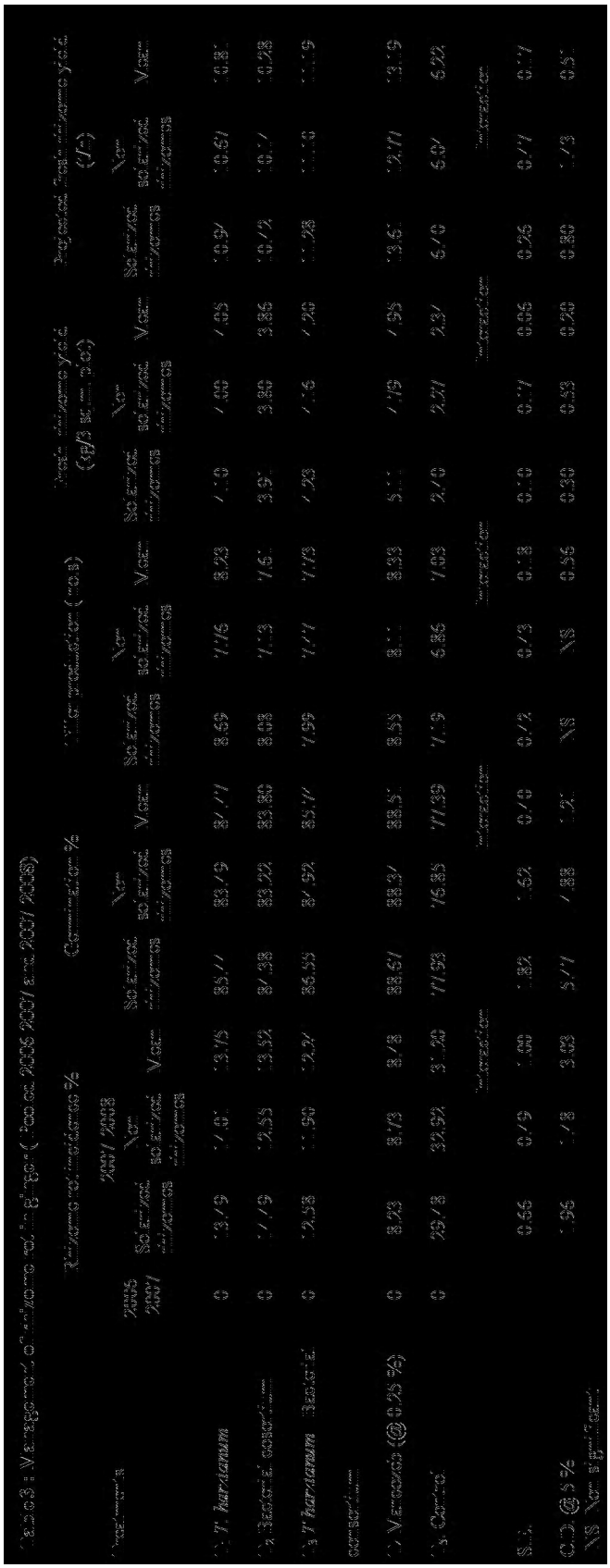
Pooled (2006-2007 and 2007-2008) :

Rhizome rot was observed both in solarized and non-solarized rhizomes with different intensities during 2007-2008 but disease was absent in 2006-2007. Upon compared to solarized and non-solarized rhizomes, disease incidence was less in solarized rhizomes. In case of solarized rhizomes treated with biocontrol agents in combination *i.e., T. harzianum,* bacterial consortium as rhizome and bed treatment, rhizome rot was less in solarized rhizomes (12.58 per cent) and non-solarized rhizomes (11.90 per cent). However, individual bioagent treatments were also effective in reducing the rhizome rot both in solarized rhizomes (13.49 per cent) and non-solarized rhizomes (14.01 per cent) in case of *T. harzianum* where in case of bacterial consortium as solarized rhizomes (14.49 per cent) and non solarized rhizomes (12.55 per cent) Disease incidence was least with chemical check with mancozeb @ 0.25 % both in solarized (8.23 per cent) and non-solarized (8.73 per cent) rhizomes. Unprotected rhizomes showed maximum incidence of rhizome rot *ie.* in solarized (29.48 per cent) and non solarized (32.92 per cent) (Table 3).

With respect to germination of rhizomes, solarized rhizomes exhibited more germination than non-solarized rhizomes. Maximum germination was noticed both in solarized (88.67 per cent) and non-solarized rhizomes (88.34 per cent) where the rhizomes were treated with Mancozeb (@ 2.5%). Rhizomes of both solarized and non-solarized treated with bioagents either *Trichoderma harzianum* alone (85.44 per cent and 83.49 per cent) or bacterial consortium alone (84.38 per cent and 83.22 per cent) or their combination 86.55 and 84.92 per cent) showed better germination respectively . Unprotected (check) solarized (77.93 per cent) and non solarized (76.85 per cent) recorded maximum reduction of germination of rhizomes (Table 3).

With respect to tiller production, there was no significant difference between solarized rhizomes and also among the treatments. However, numerically solarized rhizomes showed more tillers than non-solarized ones. There was statistically significant difference among the treatments over two years. Tiller numbers were more (8.33 numbers) in case of Mancozeb treated rhizomes and *T. harzianum* treated rhizomes (8.23 numbers). This was followed by bio agents treatments *viz., T. harzianum* and consortium of bacteria (7.73 numbers.) and consortium of bacteria alone (7.61 numbers) which were on par each other. Tiller production was least (7.03 numbers) in unprotected rhizomes as check (Table 3).

Rhizomes treated with Mancozeb (0.25%) to both solarized and non-solarized along with bed treatment recorded highest fresh and projected yield (solarized rhizomes 5.11 kg /3m^2 with projected yield of 13.61 t/ha and non solarized rhizomes 4.79 kg / 3m^2 with projected yield of 12.77 t/ha). Among the bioagents, rhizomes treated in combination with *T. harzianum* and bacterial consortium (solarized 4.23 kg//



3m^2 and projected yield of 11.28 t/ha and non-solarized rhizome 4.16 kg//3m^2 and projected yield of 11.10 t/ha) and *T. harzianum* alone (solarized 4.10kg//3m^2 and projected yield of 10.94 t/h and non solarized rhizome 4.00kg//3m^2 and projected yield of 10.67 t/ha) were on par to each other. This was followed by bacterial consortium alone treatment to rhizomes and bed (solarized 3.91 kg//3m^2 and projected yield of 10.42 t/ha and non-solarized rhizome 3.80 kg//3m^2 and projected yield of 10.14t/ha). Between the bioagents, performance of *T. harzianum* was superior over bacterial consortium in recording fresh and projected yield. Solarized rhizomes yields were more as compared to non-solarized rhizomes. Unprotected rhizomes as check recorded least yield in solarized rhizomes (2.40 /3m^2 with projected yield of 6.40 t/ha) and non-solarized rhizomes (2.27/3m^{2}with projected yield of 6.04 t/ha) (Table 3).

Jayasekhar *et al.* 2001 reported that seed of ginger treated with mancozeb @ 0.25% and bed were applied with *T. viride* along with neem cake application reduced the rhizome rot and increased the yield. Sharma and Dohroo (1980) established that mancozeb @ 0.2 % as seed dip of ginger was effective in controlling the rhizome rot and increased the yield. Ram *et al.* (2000) obtained that resident isolates of biocontrol agents (BCAs) *Trichoderma harzianum*, *T. aureoviride* and *Gliocladium virens* and a non-resident isolate of *T. viride* were effective in control of rhizome rot of ginger with more yield. The present investigations are in conformity the findings of the above mentioned scientists. The results of the present finding obviously showed that rhizome rot of ginger was least in solarized rhizome coupled with either fungicidal rhizome and bed treatment with mancozeb @ 0.25 % or combination of *T. harzianum* and bacterial consortium or *T. harzianum* alone and produced more yield.

Acknowledgement :

The authors are grateful to Dr. M. Anandaraj, Director and Project Co- ordinator (Spices), Indian Institute of Spices Research, Calicut, India for encouragement, technical guidance and financial support for conducting the experiment.

REFERENCES

Jayasekhar, M. Joshua, J.P. and Pillai, O.A.A. (2001). Management of rhizome rot of ginger caused by *Pythium aphanidermatum*. *Madras Agric.J.,* **87** (1-3): 170-171.

Joshi,L.K. and Sharma, N.D. (1980). Diseases of ginger and Turmeric. In: Ginger and turmeric, Nair, M.K. Premkumar, T. Ravindran, P. N. and Sarma, Y.R. Published by Central Plantation Crops Research Institute. Kasragod (KERALA) INDIA pp.101-103.

Parthasarathy, V. A., Krishnamurthy, K. S. and Srinivasan, V. (2007). Ginger. In: National Symposium on spices and aromatic crops (SYMSACIV) on threats and solutions to spices and aromatic crops industry, 25-27 November, 2007 at Orissa University of Agriculture and Technology, Bhubaneswar (ODISHA) INDIA.

Ram, D., Mathur, Kusum, Lodha, B.C., Webster, J. and Mathur, K. (2000). Evaluation of resident biocontrol agents as seed treatments against ginger rhizome rot. *Indian Phytopathol.*, **53**(4): 450-454.

Sharma, S. L. and Dohroo (1980). Efficacy of chemicals in controlling rhizome rot of ginger. In: *Ginger and turmeric* Nair, M.K. Premkumar, T. Ravindran, P.N. and Sarma, Y.R. Published by Central Plantation Crops Research Institute, Kasragod (KERALA) INDIA pp.120-122.

Suryanarayana, V., Lokesh, M.S., Naik, S.T. and Kulkarni, Srikanth (2008). Status and symptomotology of soft rot of ginger, a medicinally valued spice in Uttara Kannada of Karnataka. Paper presented at National Seminar on "Forest, medicinal plants and people" held at Dept. of Natural Resource Management , College of Forestry, Sirsi, University of Agricultural Sciences, Dharwad (KARNATAKA) INDIA, pp.134.

****