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In vitro and *in vivo* Efficacy of Plant Extract against Pyricularia *grisea* Causing Finger Millet Blast Disease

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Among nine plant part extracts tested *in vitro* against growth and sporulation of *Pyricularia grisea* at a concentration of 500,1000 and 1500 ppm minimum mycelial growth and maximum per cent zone inhibition as well as less sporulation was recorded in garlic (*Allium sativum*) bulb and onion (*Allium cepa*) bulb extracts. Among different plant extracts used as foliar spray, garlic bulb extract was found most effective showing significantly less leaf blast severity as well as less neck and finger blast incidence as compared to other extracts including control. The grain yield and cost benefit ratio were also significantly higher in garlic (*Allium sativum*) bulb extract.

Keywords: plant extracts growth and sporulation of *Pyricularia grisea* Finger millet Blast disease.

Finger millet (*Eleusine coracana* (L) Gaertn.) commonly known as ragi is one of the most important crop and largely grown in Bastar region of Chhattisgarh. It is widely consumed as the staple food in place of rice in the rural community of Bastar, Chhattisgarh. Even though, finger millet is known to be one of the hardiest crops, it is affected by number of diseases such as blast, foot rot, smut, streak and mottling virus (Govindu and Shivanandappa 1967).Among these, blast disease caused by *Pyricularia grisea* is the most devastating disease affected different aerial parts of the plant at all stages of its growth starting from seedling to grain formation. Yield loss due to blast may be around 28 per cent (Vishwanath *et al.*, 1997), but under favorable conditions it may be up to 80-90 per cent.

Since finger millet is predominantly grown as rain fed crop by small farmers, the disease management by chemical means is found to be effective. However, reliance on pesticides to manage disease and pest problems has aggravated environment decline and caused serious health effects on agricultural workers and rural communities. Pesticides residues also raise food safety concerns among domestic consumers and pose trade impediments for export crops. It is in this context that plant extracts have recently become the focus of research and resources in many countries. Scientists worldwide are now exploring suitable and effective botanicals pesticides as among the strategies to achieved improved and sustainable crop production. In many Asian countries botanical pesticides technologist are now in various stages of development and utilization.

Jagannathan and Narashimhan (1988) reported that *in vitro* screening of plant extracts/ products and a synthetic product i.e. garlic oil, neem oil, neem leaf, parthenium leaf, turmeric rhizome and garlic bulb extracts were effective in inhibiting spore germination and growth of *P. grisea.* Three neem-based botanicals were taken

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to evaluate their efficacy against leaf and neck blast of rice along with Bavistin 50WP as standard check fungicides. Bavistin has the highest control on leaf and neck blast. Achook @ 5ml/litre and Tricure @ 5ml/liter both were at par with Bavistin but significantly highly effective than Biotos in controlling of both leaf and neck blast (Anonymous, 2004). Six plant extract with different concentrations were tested for controlling the blast disease of rice caused by *Pyricularia oryze* and it was found that garlic bulb extract @ 40 ml /l water as a foliar spray was found to be most effective in checking the incidence of rice blast (Anonymous,2006). Among the plant extracts neem and garlic were the most effective against *Bipolaris oryzae* Farid Ahmed *et al*., (2002). Therefore present study different plant part extracts were tested for their efficacy under *in vitro* and *in vivo* condition against *Pyricularia grisea*, the blast pathogen of finger millet.

MATERIALS AND METHODS

In vitro antimicrobial efficacy of plant extracts

In vitro evaluation of antifungal efficacy of Plant extract at different concentrations (500, 1000 and 1500 ppm) was studied by poison food technique (Grover and Moore, 1962; Mishra and Tiwari 1992, Nene and Tapliyal 2000). Nine plant part extracts viz.; Kalmegh (*Andrographis paniculata)* leaf, Neem (*Azadirachta indica*) leaf, Datura (*Datura stramonium*) leaf, Nilgiri (*Eucalyptus citriodora*) leaf, Karange (*Pongamia pinnata*) leaf, Garlic (*Allium sativum*) bulb, Jangli tulshi (*Hiptis suaveolens*) leaf, Kara (*Holarrhena antidysenterica*) leaf and Onion (*Allium cepa*) bulb extract with one standard fungicides Hinosan (Ediphenphas) were evaluated *in vitro* for antimicrobial properties against *Pyricularia grisea* using poisoned food technique.

100 ml potato dextrose agar medium (PDA) was prepared in conical flask of 150 ml capacity and sterilized in autoclave. Crude plant extracts were used at levels of 500, 1000 and1500 ppm concentration for this experiment. Above concentrations of extracts were prepared by mixing aseptically 5ml, 10ml and 15 ml of stock solution (100%) in 100 ml of semi solid PDA medium (Tiwari *et al*., 2005). The amended medium was then poured in sterilized petriplates. Seven mm discs of the test pathogen cut from the margin of 12 days old culture and placed centrally in each of the petriplates. The disc was kept inverted to allow the contact of the fungus with the medium. The inoculated petriplates without plant extract served as control. The inoculated petriplates were incubated at 27 ± 1^0C and mycelium growth (mm) was recorded. Colony diameter of the pathogen was measured after 4, 8 and 12 days of inoculation. Sporulation was recorded after 12 days. Per cent growth inhibition was calculated using following formula (Verma and Kharwar, 2006).

$$\% \text{ inhibition} = 100 \times \frac{\text{Mycellial growth in control} - \text{Mycellial growth in treatment}}{\text{Mycellial growth in control}}$$

In vivo evaluation of plant extracts to control Ragi blast disease caused by *Pyricularia grisea*

Nine plant part extracts i.e. Kalmegh (*Andrographis paniculata)* leaf, Neem (*Azadirachta indica*) leaf, Datura (*Datura stramonium*) leaf, Nilgiri (*Eucalyptus citriodora*) leaf, Karange (*Pongamia pinnata*) leaf, Garlic (*Allium sativum*) bulb, Jangli tulshi (*Hiptis suaveolens*) leaf, Kara (*Holarrhena antidysenterica*) leaf and Onion (*Allium cepa*) bulb extract were all sprayed @ 2.0 % along one standard fungicides Hinosan (Ediphenphos) @ 0.1% and untreated check for the control of blast disease of finger millet caused by *Pyricularia grisea.*

The experiment was laid out in augmented randomized block with three replications. The highly susceptible finger millet variety PR-202 was sown in 3 x 2 m^2 plots following the recommended package of practices. The plant extracts were applied as foliar spray at @ 2.0 %. Sprays of extracts were applied two times as first after the initiation of disease and second spray was given after 10 days of first. Spray. Spray of water served as check.

Observations were recorded for leaf, neck and finger blast separately. Leaf blast severity was recorded on 0- 5 scales (Mackill and Bonman 1992). Whereas, neck blast and finger blast incidence was recorded by counting the number of infected panicles and fingers from total population (Mackill and Bonman 1992). Disease severity scoring for leaf blast was recorded at the seedling and booting stage, whereas for neck blast and finger blast at the physiological maturity and at harvest. Further per cent disease index (PDI) for leaf blast was

calculated (Dubey 1995).The grain yield was recorded after harvesting of crop from individual plots. The per cent disease control was worked out using the formula given by Abbott's (1925),

Percentage reduction = C – T/C x 100, where, C is the population of control and T is the population of treated plots.

RESULTS AND DISCUSSION

In vitro efficacy of plant extracts on the growth and sporulation of *Pyricularia grisea*

In vitro the data on efficacy of plant extracts against growth and sporulation of *Pyricularia grisea* are presented in Fig.1. The figure

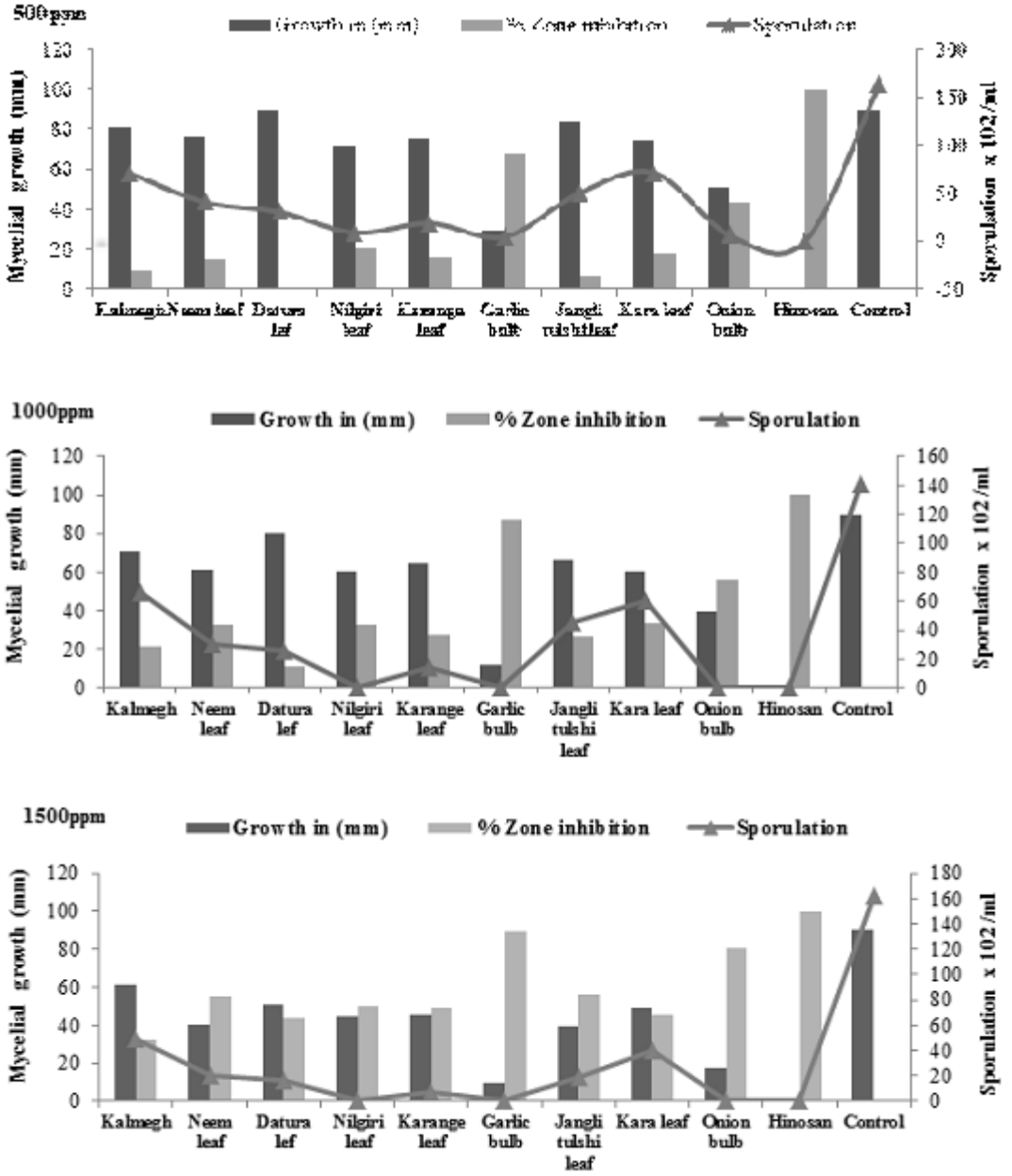

Fig. 1. Efficacy of plant extracts and their concentrations on the growth and sporulation of *Pyricularia grisea*

showed that as there was increase in concentration of extract from 500-1500 ppm, mycelial growth and sporulation was significantly reduced in all the treatment over control. The mycelial growth was significantly lowest in garlic (*Allium sativum*) bulb extract (9.33 mm) at 1500 ppm compared to control (90 mm), whereas, mycelial growth did not start in standard fungicide control check (0.00 mm). Maximum per cent zone inhibition of 67.41%, 87.04% and 89.63% was recorded in garlic (*Allium sativum*) bulb extract at 500, 1000 and 1500 ppm concentrations respectively. Sporulation did not occur in garlic (*Allium sativum*) bulb, onion (*Allium cepa*) bulb and nilgiri (*Eucalyptus citriodora*) extracts at 1000 and 1500 ppm concentrations. Whereas poor sporulation was recorded in garlic (*Allium sativum*) and onion (*Allium cepa*) bulb extract at 500 ppm concentration. Jagannathan and Narashimhan, (1988) reported the effectiveness of synthetic product from neem leaf and garlic bulb extracts in inhibiting spore germination and growth of *P. grisea.* Effectiveness of neem (*Azadirachta indica)* extract prepared in water and ethanol against radial growth of *Pyricularia oryzae* and the development and spread of blast disease in rice plants under greenhouse was reported by Amadioha (2000).

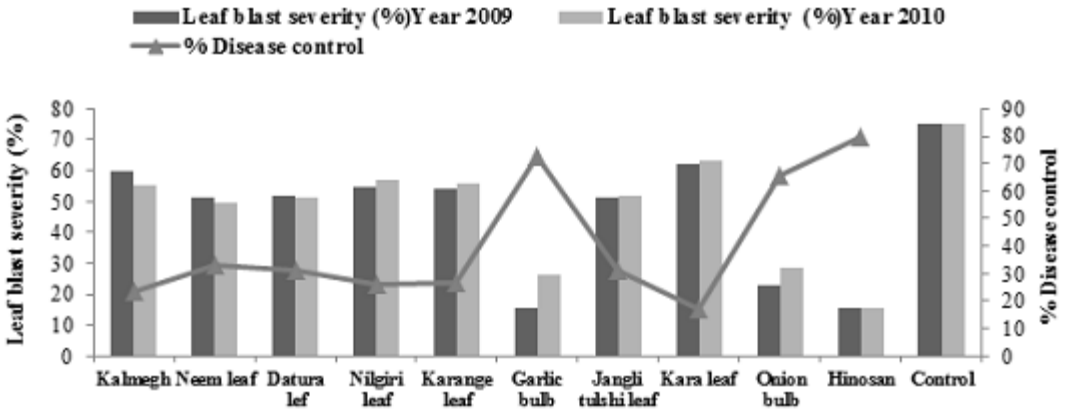

Fig. 2. Efficacy of plant extracts against leaf blast disease severity of finger millet caused by *Pyricularia grisea*

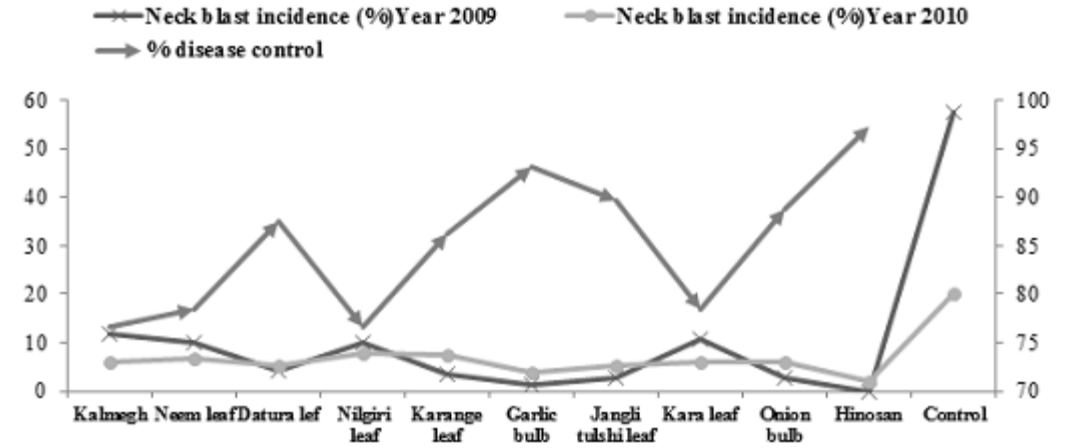

Fig. 3. Efficacy of plant extracts against neck blast disease incidence of finger millet caused by *Pyricularia grisea*

***In vivo* efficacy of plant extracts of *Pyricularia grisea* causing finger millet blast disease**

The leaf blast severities were recorded from different treatments and are presenting in Fig.2. Figure indicated that the leaf blast severity was found to be significantly less in all treated plots over check. Among different plant extracts used as foliar spray, garlic (*Allium sativum*) bulb extract was found to be the most effective extract showing significantly less disease severity of 22.94 per cent and 30.62 per cent respectively during 2009-10 and 2010-11 and was at par with standard check Ediphenphos. A range of 16.81 to 79.65 per cent disease control was noticed in different plant extracts and maximum per cent disease control was recorded by garlic (*Allium sativum*) bulb extracts.

Similarly, garlic (*Allium sativum*) bulb extract was also found effective in controlling neck blast incidence during 2009-10 (3.85%) and during 2010-11 (11.28%) over control (49.22% and 26.45%). A range of 76.72 to 93.10 per cent disease control was noticed in different treatments. The of onion (*Allium cepa*) bulb and jangli tulsi leaf extract were also effective and next to garlic bulb extract. The lowest neck blast incidence and maximum per cent disease control was recorded in garlic bulb extract and at par with Ediphenphas (fungicides check) (Fig.3).

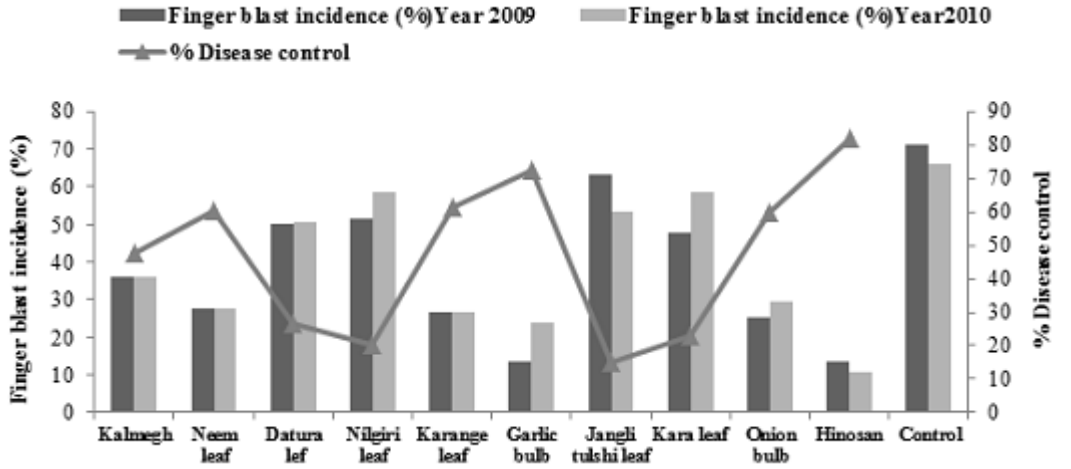

Fig. 4. Efficacy of plant extracts against finger blast disease incidence of finger millet caused by *Pyricularia grisea*

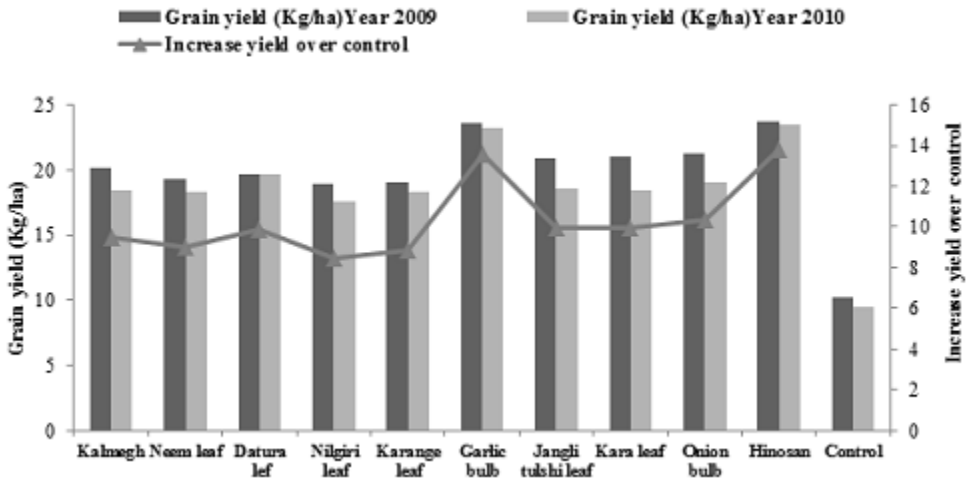

Fig. 5. Effect of plant extracts on grain yield of finger millet

Finger millet blast incidence of 21.64 and 32.94 per cent was recorded from garlic (*Allium sativum*) bulb extract during 2009-10 and 2010-11 respectively followed by Ediphenphos (check fungicide). Maximum per cent disease controls of 72.64 per cent were noticed from garlic bulb extract followed by Ediphenphos (82.18%) (Fig.4).

Data indicated that leaf blast severity and neck blast and finger blast incidence significantly affected the yield of finger millet. Data on grain yield revealed that the grain yield was significantly higher in Ediphenphos (23.62 q/ha) and garlic (*Allium sativum*) bulb extract (23.43 qt/ha) and Increase yield over control of 13.60qt/ha were recorded in garlic (*Allium sativum*) bulb extract treated plot. (Fig.5). Effectiveness of garlic (*Allium sativum*) bulb extract as foliar spray @ 20 ml/l water in controlling the rice blast disease was reported by Netam, *et al*., (2011). Effectiveness of neem extracts and garlic extracts against *Bipolaris oryzae* was reported by (Ahmed *et al*., 2002).

REFERENCES

1. Abbott's, W.S. A method of computing the effectiveness of an insecticide. *J.Eco. Ent*., 1925; **18**:265-267.
2. Amadioha, A. C. and Obi, V. I. Fungicidal activity of *Azadirachta indica* and *Xylopia acthiopica* on *Colletotrichum lindemuthianum*. *J. Herbs, Spice Med. Plants.*, 2000; **6**, Pp 33-40.
3. Amadioha, A. C. and Obi, V. I. Fungicidal activity of *Azadirachta indica* and *Xylopia acthiopica* on *Colletotrichum lindemuthianum*. *J. Herbs, Spice Med. Plants*, 2000; **6**, Pp 33-40.
4. Anonymous, Result of kharif, IGKV, S.G. College of agriculture & Research station kumhrawand, Jagdalpur, 2006; Pp183.
5. Anonymous, Result of kharif, IGKV, S.G. College of agriculture & Research station kumhrawand, Jagdalpur., 2004; Pp25-30.
6. Dubey, S. C. Banded blight of finger millet caused by *Thanatephorus cucumris*. *Indian J. Mycol. Pl. Pathol*., 1995; **25**: 315-16.
7. Farid Ahmed, K. M., Khaequzzaman, Md. Nazrud Islam, M.K. Anam and M. Tahasinul Islam. Effect of plant extracts agaist Bipolaris oryzae of rice under In vitro conditions, Pakistan *journal of biological sciences*, 2002; **5**(4): 442-445.
8. Govindu and Shivanandappa, N. Studies on the epiphytotic ragi diseases in Mysore State. *Mysore J. agric.Sci*, 1967; **1**:142-149.
9. Grover and Moore, Toximetric studies of fungicides against brown rot organisms, *Sclerotia fructicola* and *S. laxa*. *Phytopathol*, 1962; **52**: 876-880.
10. Jagannathan, R. and Narashimhan, V. Effect of plant extract/products on two fungal pathogens of fingermillet. *Indian J. Mycol Pl. Pathol*. 1988; **18**: 250-54.
11. Mackill, D. J. and Bonman, J. M. Inheritance of blast resistance in near-isogenic lines of rice. *Phytopathology*, 1992; **82**: 746-749.
12. Mishra, M. and Tiwari, S.N. Toxicity of *Polyathia longifolia* against fungal pathogens of rice. *Indian Phytopath*., 1992; **45**: Pp.56-61.
13. Nene, Y.L. and Thapliyal, N. Poisoned food technique of fungicides in plant disease control (3rd edition). *Oxford and IBH publishing Company, New Delhi* 2000.
14. Netam, R. S., Bahadur, A.N., Tiwari U. and Tiwari, R. K. S. Efficacy of plant extracts for the control of (*Pyricularia grisea*) blast of rice under field condition of Bastar, Chhatisgharh. *Research journal of Agricultural Sciences*, 2011; **2**(2): Pp 269-271.
15. Tiwari, R. K. S., Chandravanshi, S. S. and Ojha, B.M. Efficacy of extracts of medicinal plant species on growth of *Sclorotium rolfsii* root rot in tomato. *J.Mycol. Pl. Pathol*, 2005; **34**(2): Pp 461-464.
16. Verma C. Vijay and Kharwar Ravindra, N. Efficacy of neem leaf extracts against its own fungal endophyte *Curvularia lunata*. *Journal of Agricultural Technology*. 2006; Pp 329-335.
17. Viswanath, S., Mantur, S.G. and Lucy Channamaa, K. A. Recent approaches in the management of finger millet diseases. In: *National seminar on Small millets*,23-24 April 1997, TNAU, Coimbatore, 1997; Pp 30.