International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS
International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2019; 6(4): 105-108
Received: 15-05-2019
Accepted: 18-06-2019

Kalpana Yadav
Department of Plant Pathology, MPUAT, Udaipur, Rajasthan, India

NL Meena
Assistant Professor, Department of Plant Pathology, MPUAT, Udaipur, Rajasthan, India

Rajendra Prasad Jat
Department of Plant Pathology, MPUAT, Udaipur, Rajasthan, India

Correspondence
Kalpana Yadav
Department of Plant Pathology, MPUAT, Udaipur, Rajasthan, India

Management of *Fusarium oxysporum* f. sp. *radicis cucumerinum* causing root and stem rot of cucumber: A review

Kalpana Yadav, NL Meena and Rajendra Prasad Jat

Abstract
Stem and Root rot is one of the major constraints in production and productivity of Cucumber. The causative organism, *Fusarium oxysporum* f. sp. *radicis cucumerinum* is widespread in cucumber growing areas resulting in considerable economic losses. The importance, symptomatology, and management is hereunder reviewed briefly.

Keywords: *Fusarium oxysporum* f. Sp. *radicis cucumerinum* (FORC), fungicide efficacy, plant extract, bio agents etc.

Introduction
Cucumber (*Cucumis sativus* L.) belongs to family cucurbitaceae and most important vegetable, which is a major source of human edible products and useful fibers. Cucumber probably originated in the foothills of the Himalayas and have been cultivated for at least 3,000 years (Kroon *et al.*, 1979) [18]. Fusarium root and stem rot of cucumbers caused by *Fusarium oxysporum* f. sp. *radicis-cucumerinum* (T. D. Vatchev, 2015, Vakalounakis, 1996) [44, 45]. FORC is a relatively new disease first reported in Greece by Vakalounakis (1996) [45] who described it in detail. The disease has also been reported from Canada, China, France, Israel, The Netherlands, Spain and United States (Punja and Parker, 2000; Cercauskas *et al*., 2001; Moreno *et al*., 2001; Rose and Punja, 2004; Pavlou and Vakalounakis, 2005) [27, 5, 20, 33, 26]. in China in 1999, and in Spain in 2000, causing significant losses in the yield (Punja & Parker, 2000) [27]. Symptoms of Fusarium root and stem rot include large basal stem lesions on which abundant sporulation is often observed, particularly under very humid conditions, consisting of pale salmon-pink masses of Fusarium oxysporum macro- and microconidia (Vakalounakis, 1996; Rose *et al*., 2003) [45, 28]. Sporulating conidial layers produced on the stems and spread of spores as airborne inoculum has been reported for several formae specialis of *Fusarium oxysporum*, such as *F. oxysporum* Schlechtend. Fr. f. sp. *radicis-lycopersici* Jarvis & Shoemaker which causes crown and root rot of tomato (Rowe *et al*., 1977) [32], as well as *F. oxysporum* Schlechtend. Fr. f. sp. *basilici*, the causal agent of wilt and crown rot of sweet basil (Gamliel *et al*., 1996) [10] and *F. oxysporum* Schlechtend. Fr. f. sp. *lycopersici* (Sacc.) W.C. Snyder & H.N. Hans. 1940 [36], the vascular wilt pathogen of tomato (Katan *et al*., 1997) [16]. The objective of this study was to evaluate the potential of single and multiple applications of fungicides used alone, plant extracts and bio agents to reduce the impact of *F. oxysporum* f.sp. *radicis-cucumerinum* and associated soilborne pathogenic fungi on greenhouse and cage house cucumber.

1. *In vitro* efficacy of fungicides against *Fusarium oxysporum* f. sp. *radicis cucumerinum*
Six fungicides *viz*. hexaconazol ((RS)-2-(2,4-dichlorophenyl)-1-(1H-1,2,4-triazol-1-yl)hexan-2-0l), Contaf 5 EC; Mancozeb 75%WP (manganese ethylenebis (dithiocarbamate) (polymeric) complex with zinc salt); Copper oxychloride 50 WP (Dicopper (2+) ion chloride trihydroxide), Axoxystrobin; (Methyl (2*E*)-2-(2-{[6-(2-cyanophenoxy) pyrimidin-4-yl]oxy}phenyl)-3-methoxyacrylate), SAAF (Carbendazim 12% + Mancozeb 63% WP), and Carbendazim 50 %WP (Methyl 1-2, benzimidazole carbamate) were evaluated *in vitro* against *Fusarium sp.*by employing poison food technique (Nene and Thapliyal, 1993) [22]. The per cent inhibition of the growth over control was calculated by following the Formula given by Vincent (1927) [46] as:

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

Where,
I = Percent inhibition
C = colony diameter in control;
T = colony diameter in treatment

Bavistin [carbendazim at 100 ppm] and Cercobin [thiophanate methyl at 100 ppm] were the most effective systemic fungicides tested in inhibiting of germination of spore and growth of *F. oxysporum in vitro* and wilt disease *in vivo* (Gaikwad and Sen, 1987) [9]. Seven fungicides, *viz*., Thiram, Bavistin (carbendazim), Blitox [copper oxychloride], Captaf [captan], Indofil M-45 [mancozeb], Ridomil MZ [mancozeb+ metalaxyl] and Kitazin evaluated against chickpea wilt (*F. oxysporum* f. sp. *ciceris*) *in vitro* (each at 1% concentration) in Pusa, Bihar. Thiram and Bavistin proved the most effective fungicides in inhibiting the growth of *F. oxysporum* f. sp. *ciceri in vitro* (Singh and Jha, 2003, Musmade, N.A., Pillai, Tini and Thakur, K.D., 2009) [34, 21]. Harender Raj *et al*. (2005) [13] evaluated the efficacy of Quintal (carbendazim 25% + iprodione 25%), Bavistin (carbendazim), SAAF (carbendazim 12% + mancozeb 63%), Thiram 75 DS (thiram) and Hilnate 70 WP (thiophanate-methyl) against *Fusarium oxysporum* f. sp. *gladioli* under *in vitro* conditions and observed that Quintal recorded the lowest disease incidence followed by carbendazim and SAAF. Chhata and Jeewa Ram (2006) [7] found that out of 4 fungicides tested, Bavistin (carbendazim; 0.2%) and TopsinM (thiophanate-methyl; 0.2%) were more effective than other seed dresser fungicides and showed least seedling mortality (2-4 and 4-6%, respectively). Sunita and Manica (2007) evaluated the efficacy of fungicides, i.e. carbendazim, thiophanate-methyl, thiram, 25% carbendazim + 25% iprodione (Quintal) and 12% carbendazim + 63% mancozeb. Systemic fungicides *viz*, carbendazim, propiconazole, difenoconazole and thiophanate methyl reported at 50 ppm completely inhibit the growth of *F. moniliforme var. subglutinans* and *F. oxysporum* (Amipara, 2008) [2]. Raju *et al*. (2008) [30] evaluated carbendazim, captan, Dithane Z-78, thiophanate-methyl and thiram against F. oxysporum f. sp. udum under *in vitro* and found that carbendazim completely inhibited the growth of the pathogen at all concentrations (100, 250 and 500 ppm). Singh (2009) [34] found that carbendazim (0.1%) and mancozeb (0.25%) was effective against *Fusarium oxysporum* f. sp. *coriandrii* causing coriander wilt. *In vitro* and *in vivo*, six fungicides tested against tomato fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici*) at seven different concentrations (0.0001, 0.001, 0.01, 0.1, 1, 10, 100 µg/ml) for their inhibitory activities. Among them, Prochloraz and bromuconazole were the most effective fungicides, followed by benomyl and carbendazim (Amini and Sidivich, 2010) [1]. The efficacy of three fungicides tested either alone or in combinations of 0.1% Topsin M 70WP (thiophanate-methyl 700 g kg^{-1}) plus 0.15% Previcur 607SL (607 g L^{-1} propamocarb hydrochloride), or 0.1% Benomyl 50WP (benomyl 50 g kg^{-1}) plus 0.15% Previcur 607SL though drip irrigation against green house cucumber infested with crown and root disease caused by *F. oxysporum* f. sp. *radicis cucumerinum*. Plant mortality was reduced by 11.1% 84.8% and 23.8% 77.7% when plants were drenched with Topsin M 70WP in combination with Previcur 607SL or Benomyl 50WP plus Previcur 607SL, respectively. In comparison, significantly lower levels of disease control were achieved when these fungicides were applied individually (Vatchev *et al.* 2012) [43]. Dar *et al.* 2013 [8], Singh, R.N., Upadhyay J.P. and Ojha, K.L., 1993) [39] tested five systemic fungicides with different concentrations, among them carbendazim at 50 ppm were found achieve cent per cent inhibition the mycelial growth of the *Fusarium oxysporum* isolated from Himalaya. *In vitro*, reported the efficacy of four fungicides (Mancozeb, SAAF, Carbendazim and Cuprozin) in three different concentrations (0.01%, 0.02% and 0.03%) and one biocontrol agent, *Trichoderma viride* by dual culture technique against the mycelial growth of the *Fusarium oxysporum* f. sp. c*ubense* caused wilt in banana. Among the fungicides, Carbendazim at its all concentrations was found to be the most effective against the pathogen followed by SAAF. The biocontrol agent (*T. viride*) completely inhibited mycelial growth of the pathogen (Kumari *et al.* 2014, Poddar, R.K., Singh, D.V. and Dubey, S.C. 2004) [17, 4].

2. *In vitro* evaluation of plant extracts

Tariq and Magee (1990) [42] showed that volatile components of crude aqueous extracts of garlic bulb (500 mg/n concentration) inhibited the germination of micro conidia and hyphal extension of *Fusarium oxysporum* f. sp. *lycopersici* in axenic culture. Patil (2003) [23] tested various botanicals *in vitro* against *F.oxysporum* causing wilt of patchouli, 76.72 per cent inhibition was achieved with garlic extract (10%) and tulsi leaf extract (10%). Thakare (2003) [41] tested various botanicals *in vitro* against *Fusarium oxysporum*, 100 per cent mycelial growth inhibition was obtained with *Allium sativum* (0.1 per cent) followed by 100 percent with *Azadirachta indica* (10 per cent), 37.48 percent in *Oscimum sanctum* (10 per cent) and 47.97 percent was with *Gliricidia maculata* (10 per cent) respectively. Riaz *et al.* (2008) [31] *in vitro* tested of some leaf extracts (*Triticum aestivum, Zea mays, Helianthus annus, Capsicum annum*, *Allium cepa* and *Tagetes erectus*) for antifungal activity at different concentrations (2, 4, 6 and 8% w/v) against *Fusarium oxysporum* f. sp. *gladioli* caused corm rot disease of gladiolus in Pakistan. They observed that extract of *Tagetes erectus*, *Helianthus annus* and *Capsicum annum* were found highly effective where all the employed extract concentrations significantly reduced fungal biomass by 54-79%, 33-85% and 45-57%, respectively. Abu-Tahon *et al*. (2014) [14] *in vitro* studied the efficacy of 5 medicinal plant extract *i.e., Eucalyptus globules, Lantana camera, Nerium oleander* and *Ocimum basilicum* against *F. oxysporum* f. sp. *lycopersici* race 3 in Egypt and found that cold distilled water extract of *O. basilicum and E. globulus* were most effective to inhibiting the growth of the pathogen. Ramaiah *et al*. (2015) [29] tested fifteen Phyto extracts by posion food technique for their antifungal activities against *Fusarium oxysporum* f. sp. *lycopersici* (FOL), Out of them, three phytoextracts proved to be potential in inhibiting the growth of the FOL *viz*., *Solanum indicum* (78.33%), *Azadirachta indica* (75.00%), *Oxalis latifolia* (70.33%) Antifungal potency was compared with three chemical fungicides namely *viz*., Mancozeb (82.66%) Copper oxychloride (79.33%) and Copper sulphate (82.33%) in different concentration.

3. *In vitro* evaluation of bio-agents / bio control

Sonawane and Pawar (2001) [40] reported that *T. harzianum* gave maximum reduction 73.16 per cent of *F. oxysporum* (Chickpea wilt). Gurjar *et al*., (2004) [11] reported that

Trichoderma harzianum and *T. viride* gave effective management of *Fusarium* sp. in okra. Pandya *et al*. *(*2009) studied the efficacy of bioagents, organic extracts and phyto extracts against *Fusarium solani* causing wilt in muskmelon. They observed that *Trichoderma viride*, FYM extract and *Ocimum sanctum* extract were more superior in antagonistic activity (*in vitro* and *in vivo*) over the rest bioagents.

Choudhary and Mohanka (2012) evaluated different isolates of *T. harzianum* (Th), *T. viride* (Tv) and *T. koningii* (Tk) against the *Fusarium oxysporum* f. sp. *lentis* causing wilt of lentil and proved that Th-5 gave maximum inhibition (82.8%) followed by Th-7 (82.3%), Tv-2 (79.2%), Tv-18 (74.4%) and Tk-9 (71.0%) under *in vitro* condition. Pagoch and Raina, (2013) *in vitro* evaluated seventeen isolates of *Trichoderma* against *F, oxysporum* f. sp. *cucumerinum* by dual culture technique and it was found that all the *Trichoderma* isolates inhibited the mycelial growth of *F.oxysporum* f.sp.*cucumerinum*. Hossain *et al*. (2013) [12] tested 20 different isolates of *Trichoderma harzianum* against *Fusarium oxysporim* f.sp. *ciceri,* causal organism of wilt disease in chickpea and found that *T. harzianum* isolate T-75 showed the highest (75.89%) inhibition of radial growth of *Fusarium oxysporim* f. sp. *ciceri* in dual culture assay on PDA. Yadav and Anadani (2013) [43] tested five *Trichoderma spp*. *viz*. *T. harzianum* – I, *T. harzianum* – II, *T. hamatum*, *T. koningi* and *T. viride* against *Fusarium oxysporum* f.sp. *ciceri* causing chickpea wilt and found that maximum growth inhibition (84.76%) through *T. harzianum* – II. Barhate *et al*. (2015) [3] tested *in vitro* the efficacy of eight fungicides and six bio agents and ten varieties of tomato in green house against *Fusarium* wilt of tomato (*Fusarium oxysporum* f.sp. *lycopersici*) in Maharastra. Among the fungicides, Mancozeb + Carbendazim (0.125 + 0.05 %) had completely inhibited (100 %) mycelial growth of the pathogen followed by Thiram + Carbendazim (0.15 + 0.05 %), Carbendazim (0.1 %), Thiram (0.3 %), Carboxin (0.2 %), Captan (0.25 %), Propiconazole (0.2 %), Mancozeb (0.25 %) with 93.75, 92.50, 90.00, 87.50, 81.25, 67.50 and 62.50 per cent growth inhibition over control, respectively. Among the four *Trichoderma* species, *Trichoderma viride* recorded highest mycelial growth inhibition (85.00 %) of the pathogen followed by *T. harzianum*, *T. hamatum*, *T. koningii* with 72.50, 70.00, 61.12 per cent growth inhibition over control, respectively and among two bacterial bioagents, *Bacillus subtillis* was found more effective than *Pseudomonas fluorescens* with 79.2 and 62.5 per cent growth inhibition over control.

Javid *et al*. (2016) demonstrated the effect of three isolates (T22, T9 and T6) of *Trichoderma harzianum* against isolate F 42 of *Fusarium oxysporum* f. sp. *radicis-cucumerinum* under greenhouse conditions, it was found that isolate T 22 of *T. harzianum* had the greatest effect on controlling the pathogen. Barari (2016) [4] observed bioefficacy of the native isolates of *Trichoderma* species against *F. oxysporum* f. sp. *lycopersici* caused *Fusarium* wilt disease in tomato under *in vitro* and *in vivo* condition. Under *in vitro* condition, isolate N-8 of *T. harzianum* gave 68.22 percent mycelial growth inhibition of the pathogen and under *in vivo* condition it exhibited least disease incidence (14.75%). Srivastava, (2017) [38] reported a significant reduction of growth of *Fusarium oxysporum* f.sp. *cucumerinum* when tested in dual culture technique with *Trichoderma* sp. In field condition positive correlation between added and percentage of healthy cucumber seedlings were detected.

References

1. Amini J, Sidovich DF. The effect of fungicides on *Fusarium oxysporum* f. sp. *lycopersici* associated with *Fusarium* wilt of tomato. J Pl. Protec. Res. 2010; 50:172-178.
2. Amipara JD. Physiochemical and pathological studies of mango malformation in Saurashtra region. Ph.D. Thesis submitted to Junagadh Agricultural University, Junagadh, 2008.
3. Barhate BG, Musmade NA, Nikhate TA. Management of *Fusarium* wilt of tomato by bioagents, fungicides and varietal resistance. International Journal of plant protection. 2015; 8:49-52.
4. Barari H. Biocontrol of tomato *fusarium* wilt by *Trichoderma* species under *in vitro* and *in vivo* conditions. Cercetari Agronomice in Moldova, 2016; 1:91-98.
5. Cercauskas RF, Brown J, Ferguson G. First report of stem and root rot of greenhouse cucumber caused by *Fusarium oxysporum* f. sp. *radicis-cucumerinum* in Ontario. Plant Disease. 2001; 85:1028.
6. Choudhary S, Mohanka R. *In vitro* antagonism of indigenous *Trichoderma* isolates against phytopathogen causing wilt of lentil. Int. J Life Sci. and Pharma Res. 2012; 2:196-202.
7. Chhata LK, Jeewa Ram. Evaluation of fungicides, bio-agents and oilcakes against *Fusarium oxysporum* f. sp. *cumini* wilt of cumin. Current Agriculture. 2006; 30(1):111-113.
8. Dar WA, Ganie SA, Bhat JA, Shabir-u-Rehman, Razvi SM. *In vitro* study of fungicides and biocontrol agents against *Fusarium oxysporum* f. sp. *pini* causing root rot of western Himalayan fir (Abies pindrow). Academic journals. 2013; 8:1407-1412.
9. Gaikwad SJ, Sen B. Chemical control of cucurbit wilt caused by *Fusarium oxysporum* Schlecht. Vegetable Sci., 1987; 14:83-91.
10. Gamliel A, Katan T, Yunis H, Katan J. *Fusarium* wilt and crown rot of sweet basil: involvement of soilborne and airborne inoculum. Phytopathology. 1996; 86:56-62.
11. Gurjar KL, Singh SD, Raval P. Management of seed borne pathogen of okra with bio-agents. Pl. Dis Res., 2004; 19(1):44-46.
12. Hossain M, Hossain N, Sultana F, Naimul Islam M, Islam S, Alam Bhuiyan K. Integrated management of *Fusarium* wilt of chickpea (*Cicer arietinum* L.) caused by *Fusarium oxysporum* f. sp. *Ciceri* with microbial antagonist, botanical extract and fungicide. Academic Journals. 2013; 12(29):4699-4706.
13. Harender Raj, Suneel Anand, Sachin Upmanyu. Evaluation of fungicides for efficacy against *Fusarium* yellows in gladiolus. Journal of Ornamental Horticulture (New Series). 2005; 8(4):320-321.
14. Isaac GS, Abu-Tahon MA. *In vitro* antifungal activity of medicinal plant extract against *F. oxysporum* f. sp. *lycopersici* race 3 the causal agent of tomato wilt. Canadian Journal of Plant Science. 2014; 65:107-180.
15. Jalander V, Gachande BD. Effect of aqueous leaf extracts of datura sp. against two plant pathogenic fungi. International Journal of Food, Agriculture and Veterinary Sciences ISSN: 2277-209X. 2012; 2:131-134.

16. Katan T, Shlevin E, Katan J. Sporulation of *Fusarium oxysporum* f. sp. *lycopersici* on stem surfaces of tomato plants and aerial dissemination of inoculum. Phytopathology. 1997; 87:712-719.
17. Kumari A, Kumar R, Kumar H. Efficacy of fungicides and *Trichoderma viride* against *Fusarium oxysporum* f. sp. *Cubense in vitro.* The Bioscan. 2014; 9:1355-1358.
18. Kroon GH, Custers JBM, Kho YO, Den Niris APM, Varekamp HQ. Intraspecific hybridization in *Cucumis* (L.) need for genetic variation, biosystematic relations and crossability barriers. Euphytica. 1979; 28:723-728.
19. Moosa A, Sahi ST, Imran-Ul- Haq, Farzand A, Khan SA, Javaid K. Antagonistic potential of *Trichoderma* isolates and manures against *Fusarium* wilt of tomato. International Journal of Vegetable Science. 2017; 23:207-218.
20. Moreno A, Alferez A, Aviles M, Dianez F, Blanco R, Santos M, Tello JC. First Report of *Fusarium oxysporum* f. sp. *radicis-cucumerinum* on Cucumber in Spain. Plant Disease. 2001; 85:1206.
21. Musmade NA, Pillai Tini, Thakur KD. Biological and chemical management of tomato wilt caused by *Fusarium oxysporum* f. sp. *lycopersici*. J Soils & Crops. 2009; 19(1):118-121
22. Nene YL, Thapliyal PN. Fungicides in plant disease control. Oxford and IBH Publishing Company. New Delhi. 1993; 3:531.
23. Patil RN. Studies on wilt and root rot complex of patchouli. M.Sc. (Agri.) Thesis submitted to Dr. B.S.K.K.V., Dapoli, M.S., India, 2003.
24. Pagoch K, Raina PK. Screening of *Trichoderma* sp. of Jammu region against *Fusarium oxysporum* f.sp. *Cucumarinum* causing wilt in cucumber. National symposium on Emerging Issues in Plant Haelth Management and annual meetings of IPS (NZ), 2012.
25. Poddar RK, Singh DV, Dubey SC. Management of chickpea wilt through combination of fungicides and bioagents. Indian Phytopath. 2004; 57(1):39-43.
26. Pavlou GC, Vakalounakis DJ. Biological control of root and stem rot of greenhouse cucumber, caused by *Fusarium oxysporum* f. sp. *Radicis-cucumerinum*, by lettuce soil amendment. Crop Protection. 2005; 24:135-140.
27. Punja ZK, Parker M. Development of *Fusarium* root and stem rot, a new disease on greenhouse cucumber in British Columbia, caused by *Fusarium oxysporum* f. sp. *Radicis-cucumerinum*. Canadian Journal of Plant Pathology. 2000; 22:349-363.
28. Rose S, Parker M, Punja ZK. Efficacy of biological control and chemical treatments for control of *Fusarium* root and stem rot on greenhouse cucumber. *Plant* Disease. 2003; 87:1462-1470.
29. Ramaiah AK, Kumar R, Garampalli H. *In vitro* antifungal activity of some plant extracts against *Fusarium oxysporum* f. sp. *Lycopersici.* Pelagia Research Library. Asian Journal of Plant Science and Research. 2015; 5:22-27.
30. Raju GP, Rao SVR, Gopal K. *In vitro* evaluation of antagonists and fungicides against the red gram wilt pathogen *Fusarium oxysporum* f. sp. *udum* (Butler) Snyder and Hansen. Legume Research. 2008; 31(2):133-135.
31. Riaz TK, Nawaz S, Javaid A. Antifungal activity of plant extracts against *Fusarium oxysporum* – the cause of corm-rot disease of Gladiolus. Mycopath. 2008; 6:13-15.
32. Rowe RC, Farley JD, Coplin DL. Airborne spore dispersal and recolonization of steamed soil by *Fusarium oxysporum* in tomato greenhouses. Phytopathology. 1977; 67:1513-1517
33. Rose S, Punja ZK. Greenhouse cucumber cultivars differ in susceptibility to *Fusarium* root and stem rot. Hort. Technology. 2004; 14:240-242.
34. Singh AK. Integrated management of wilt, *Fusarium oxysporum* f. sp. *Coriandrii* of coriander. Indian Journal of Plant Protection. 2009; 37(2):132-133.
35. Singh DK, Jha MM. Effect of fungicidal treatment against chickpea wilt caused by *F. oxysporum* f. sp. *ciceris*. Journal of Applied Biology. 2003; 13(2):41-45.
36. Snyder WC, Hansen HN. The species concept in Fusarium. Journal of Botany. 1940; 27:64-67.
37. Sharma SN, Sunita Chandel, Manica Tomar. Integrated management of Fusarium yellows of gladiolus caused by *Fusarium oxysporum* f. sp. *gladioli* Snyder & Hans. under Polyhouse conditions. Integrated plant disease management. Challenging problems in horticultural and forest pathology, Solan, India. 2003, 2005, 221-229.
38. Srivastava MP. Biological control of soil borne pathogen *F. oxysporum* f. sp. *cucumerinum* of cucumber (*Cucumis sativus*) by Trichoderma sp. International Journal of Advanced Research (IJAR). 2017; 5:1-9.
39. Singh RN, Upadhyay JP, Ojha KL. Management of chickpea wilt by fungicides and Gliocladium. J Appl, 1993, 46-47.
40. Sonawane SS, Pawar NB. Studies on biological management of chickpea wilt. J Maha. Agric Univ. 2001; 26(2):215-216.
41. Thakare YM. Studies on leaf spot and blight of golden champa (*Michelia champaca* L.) caused by *Fusarium oxysporum* Schl. and *Botryodiplodia theobromae* Pqt. M.Sc. (Agri.) thesis submitted to Dr. B.S.K.K.V., Dapoli (M.S.), 2003.
42. Tariq VN, Magee AC. Effect of volatiles from garlic bulb extract on *Fusarium oxysporum* f. sp. lycopersici. Mycological Research. 1990; 94:617-620.
43. Vatchev T, Maneva S. Chemical control of root rot complex and stem rot of greenhouse cucumber in straw-bale culture. Crop Protection. 2012; 42:16-23.
44. Vatchev TD. *Fusarium* root and stem rot of greenhouse cucumber, aerial distribution of inoculum. Bulgaria Journal of Agriculture Science. 2015; 21:65.
45. Vakalounakis DJ. Root and stem rot of cucumber caused by *Fusarium oxysporum* f. sp. *radicis cucumerinum* f. sp. Nov. Plant Disease. 1996; 80:313-316.
46. Vincent JM. Distortion of fungal hyphae in the presence of certain inhibitions. Nature. 1927; 59:85.
47. Yadav PM, Anadani VP. Antagonistic Effect of Fungal Bioagents Against *Fusarium oxysporum* f. sp. *Ciceri in vitro*. Trends in Biosciences. 2013; 6(5):538-539.