



RESEARCHING BIOCONTROL OF *TRICHODERMA VIRIDE*, *PAECILOMYCES LILACINUS* IN CONTRADICTION OF EFFECTIVENESS OF FUNGI INSULATED AS OF SELECTED THERAPEUTIC HERBALS

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Abstract

Concluded present examination, diverse parasites confined as of soil contradiction by three restorative Herbals including *Malva parviflora*, *Alhagi graecorum* and *Achyranthus aspera*, were gathered as of three better regions in Iraq [Dayalla, Kut, Hilla]. Aimed at supplementary bio control assessments (*T. viride*, *P. lilacinus*) utilized as bio control operators in contradiction of tomato sicknesses produced by *A. solani*, *F. chlamyosporum*, now neighborhood assortment as of tomato. *T. viride*, *P. lilacinus* estimations of inhibitory zones in contradiction of disconnected growth, organic control corrections *T. viride*, which framed 83.9%, 78.8% inhibitory locale in contradiction of *F. solani* and *A. humicola*, separately. *P. lilacinus* framed 83.1%, 77.9% restraint territory in contradiction of *F. chlamyosporum*, *A. solani* individually in double culture inspections. Accommodation tow bio control specialists additionally totally influenced the yield, biomass and catalyst movement, fresh, dry weight, tomato stature, tomato organic products tomato, Peroxidase action, Phenyl alanine action and protein.

Key words : *Solanum lycopersicum*, *T. viride*, *Fusarium*, *Alternaria*, *P. lilacinus*, biocontrol.

Overview

Restorative plants are interesting wellspring of bioactive composites (Toussaint *et al.*, 2007) these should be innocuous to human presences and earth contrasted with fake medications for treatment of malignancy and various different sicknesses (Nema *et al.*, 2013). Anther investigation (Lobo *et al.*, 2017a) establish that calming activity of fluid, ethologic by *T. tormentors* selections *in vitro* methods through Reserve protein denaturation, extra penalties [Richard Lobo *et al.*, 2017b) originate expectedly used restorative *A. indica* herbal container stay advantageous in contradiction of sickness starting instinctive fungi. Outcomes acquired by Anther investigation (Al-Dabbagh *et al.*, 2017) approximation antimicrobial possessions of as many home grown concentrates (*Cinnamomum zelanicum*, *Camellia sinensis*, *Zingiber officinale*, *Rhuscoriaria*) in microorganisms. With the expanded populace weight,

costs, symptoms and the development of protection from allopathic prescriptions for irresistible maladies, the utilizations of drugs of plant hotspots for broad assorted variety of human sicknesses are aggregate. In this way, extensive scale produces of therapeutic plants utilizing current development innovations are being experienced crosswise over numerous countries, to experience the demand of restorative plants. Soil covers herbal roots or close-by earth going with bacteriological greenery. Real objective besides thorough border happen among herbal and micro flora (Gans and Dunbar, 2005). Assortment besides elements of organisms in soil associated by root exudates, bio geochemical reactions besides complaint (Narula *et al.*, 2007).

Attributable toward gigantic establishment capacity besides obsession of nitrogen microbe establishment in soil as of restorative herbals contrasted with endosymbiosis relatives remain perceived after soil

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incoming (Saharan and Nehra *et al.*, 2011), revives plant development radiate supporting resources like gibberellins, vitamins, kinetin bolster total amount besides nature of produces. Assortment besides capacities organisms in soil associated with root exudates, bio geochemical responses besides breath (Narula *et al.*, 2009). Soil involves inexhaustible microbes, growths, nematodes (Smith and Read, 2008). Root made associations amongst shrubberies besides living beings in soil to great degree partial by EDAPHIC influences (Bafana and Lohiya, 2003). These connotations contain sign activity among foundations of contending shrubberies besides earth microorganisms and unique technique flags portray the idea of synthetic besides physical belonging to roots (Lugo *et al.*, 2013) fungal populace in soil exhibition subjective adjustment through time of floraes furthermore laterally through evolving condition. Another study, Moore *et al.* (2004), Andrade *et al.* (1998) empirical repeating changes in creation of AM organisms like *T. viride*, *P. oxalicum*, besides microscopic organisms like *B. subtilis* identified by way of valuable microbes, Trichoderma, Gliocladium, Rhizobacteria specific added sterilized parasites obligate remained concentrated toward build floraes development (Alexander, 1978). Supplements dispersion toward floraes enhanced because of exercises of soil microbes (Strange, 1993). Resistor of floraes malady remains an industrious basic aimed at horticulture in last period. The aggregate demand aimed at stable, sound nourishment source through developing humanoid populace determination require regulatory ailments that diminishing crop. Additionally, expanded weight aimed at nourishment fabricate determination reinforce weights on horticultural creation frameworks, which in circumstantial, might build infection weight on collect floraes. Flow hones for plant ailment regulator were established predominantly on hereditary protection in parasites, relationship of herbal besides disorder, manufactured insecticides (Agrios, 2005).

Solanum lycopersicum exists extraordinary best widely developed plant sustenance gathers on planet, additional just en route for potato through domain fabricate. *Solanum lycopersicum* reprimanded since various attentive illnesses below nursery besides ground environments. Various noteworthy maladies of as *Solanum lycopersicum* diminish gather harvest besides best overpowering vegetable parasites organisms (Mathur and Shekhawat, 1986). On behalf of instance, initial curse illness produced via *Fusarium* and *Alternaria* can remain seriously harmed bringing about lost many on *Solanum lycopersicum* powerless cross breeds (Biondi *et al.*, 2004). *Solanum lycopersicum* collect

critically lessened by *Fusarium* furthermore *Alternaria* sp, since it dismiss obliterate underlying foundations of as *Solanum lycopersicum*. Numerous designs obligate forthcoming for controller these parasitic fungi (Ahmed, 2011). Presently, best real strategy happening preventing *Solanum lycopersicum* from *Fusarium shrivel* mixing of as *Solanum lycopersicum* seed by substance antifungal. However, utilization of as substance antifungal remain harming for additional dynamic creatures additionally markdown of rhizosphere microbes (Lewis, 1996). Use of compounds to regulatory ailments have no efficient or natural well disposed inconvenience to regulatory like maladies takes stimulated examiners for movement organic regulator specialists.

Procedures and supplies

Present examination manages the examination of parasitic populace in the roots territory of *Malva parviflora*, *Achyranthus aspera*, *Alhagi graecorum* rhizosphere from therapeutic herbal gathered from Dayalla, kut, Hilla. The examples remained gathered via gently dislodging herbs utilizing sterilized spade, soil took after root gathered to sterilized packs.

Blustery sifting, torrential system to separates

System assigned via (Daniels and Skipper, 1982) to separation of as soil parasites remained followed. 100 g of soil was taken as of every one from examples placed in suitable flask, 1.5 liter of water included to make suspension and make four repetitions.

50 percent sucrose answer for additionally purge spores filtering. The filtering motivated to axis containers 10 ml, centrifugation 2000 rpm for to 5 minutes. Supernatants disconnected by maintenance deprived of stressing pellet. Dirt atoms postponed in laid-back (50%) sucrose, substance blended, examples centrifuged (2000 rpm) to 2 minutes. Supernatant filtered over little work strainer, spores confined to sifter judiciously flushed by water, spores washed and gathered to plates holding by 10ml of PDA. Every weakening repeated four periods, kept in hatchery to 6 days at 30°C.

Conduction fungal segregates to inhibition actions

For identify bio control capability of *P. lilacinus*, *T. viride* double culture technique utilized, in dish *P. lilacinus* or on the other hand *T. viride* placed on sideways, pathogen on opposite sideways. Immunized plates experimental to arrangement restraint zones include following treatments (Control, *Fusarium*, *Fusarium* + *T. viride*, *Fusarium* + *T. viride* + *P. lilacinus*, *T. viride*, *P. lilacinus*, *Alternaria*, *Alternaria* + *T. viride*, *Alternaria* + *P. lilacinus*, *Alternaria* + *T. viride* + *P.*

ilacinus, *T.viride* + *P. lilacinus*).

Looking at biocontrol capability of *P. lilacinus*, *T. viride*

Inferable from the most astounding zone of restraint outlined via *P. lilacinus*, *T.viride* in contradiction of *F. chlamydosporum* and *A. solani*, shade household investigation directed in contradiction of tomato infection produced via *F. chlamydosporum* and *A. solani* fashionable Native assortment tomato. Spore suspension of bio control specialists, pathogenic fungi readied, centralizations of bio control operators [1×10^5] readied. seeds plunged in conidial grouping of as bio control operators for 12 minutes took after by pathogens with a 12 min, soften up among medicines. At that point seeds sown in containers having sanitized soil.

Chemicals ponders

Action of oxidative compounds, peroxidase, phenyl alanine–layase steadfast by 6 timeworn leaves, aggregate protein resolved in the 13 timeworn leaves. Examine of Peroxidase movement completed by way of assigned through Hassan (2013). 1g from it crushed in of [0.1] M(1ml) of phosphate cradle utilizing cool pounder and grout. Homogenate exchanged to 1.5 ml rotator cylinder, centrifuged for (15.000) on 4°C for 10 minutes. Supernatant quickly utilized. Phenylalanine layase action steadfast by way of assigned by way of Narwal *et al.* (2009).

Reaction blend controlled (0.1 ml) from phenyl alanine, (0.2 ml) catalyst separate in an aggregate (2.5 ml) from sodium borate cradle. The blend as put in water shower to 36°C to 60 min. 0.5 ml from 1 M trichloro acidic corrosive included. Measure of trans-cinnamic corrosive framed of L-phenylalanine estimated spectro photometrically at 280 nanometer. Compound movement communicated by way of μg from Trans – cinnamic corrosive h-1 g-1 protein. Whole protein contented enduring by way of portrayed via Scheffelen *et al.* (1961).

Results and Discussion

In current experimentation different creatures were withdrawn from the rhizosphere of three remedial plants (*Malva parviflora*, *Achyranthus aspera*, *Alhagi graecorum*), obtainable from three helpful herbal an whole amount 14 kinds from developments inaccessible. Identified done via perceiving assembly from spores, state morphology.

Different parasites inaccessible commencing soil of three therapeutic plants. *T. viride* and *P. lilacinus* was allotted as potential biocontrol administrator inferable from support in soil of each remedial plant. *T. viride*, *P.*

lilacinus surrounded diverse estimation of as limitation areas in contradiction of different disengaged life forms. Fashionable bio control revisions, *T. viride* encircled 83.9%, 78.8% impediment zone in contradiction of *F. chlamydosporum* and *A. solani* independently.

P. lilacinus confined 83.1%, 77.9% limitation zone in contradiction of *F. chlamydosporum*, *A. solani* exclusively two fold culture investigations recycled [figure1]. Natural controller administrators like parasites, recommendation superfluous excellent for crushed settlement, however development of possible bioprocess aimed at lucrative influence isn't to an easygoing mission.

Different microorganisms have revealed amplex in consistent irregularity of fungal pathogens, nematodes by writing last time. Several of them remain active constituents of several present bio pesticides. Devices of achievement of infectious bio control authorities in irregularity of vegetal pathogens comprise facilitate antibiotic, hyper parasitism, overview of security, antagonism for universe besides supplements. Some infective masters likewise beguilement by way of bio fertilizer or possibly vegetal advancement organizers through settling solubilizing Nitrogen and Potassium, influencing hormone-to similar resources, ruining 1-aminocyclopropane-1-carboxylate deaminizes, spoiling regular issue besides release supplements trendy soil. Bio control pros as of now supposed by way of a naturally big-hearted particular to elements aimed at vegetal affliction relationship in agribusiness (Alabouvette *et al.*, 2006; Fravel, 2005). Trichoderma anticipating between best certified pathogenic fungi. Different fungi for instance, *T. harzianum*, *T. viride*, *T. virens* previously long in moneymaking formation for controller of vegetal pathogenic life forms in cultivating besides farming (Harman *et al.*, 2004; Howell, 2003). Number of as trainings must seen psychrophilic arrangement constraints bio control ability of many *Trichoderma* species (Kredics *et al.*, 2003; Hudec, 2000). *P. lilacinus* is perceived soil hyphomycete, besides parasitizes RKN eggs introduction countless antinematoda accomplishment. Improvement working of growths remains critical impact sighted produce as bio control agent. parasite *P. lilacinus* accounted for toward situated a genuine natural controller moderator of these attacks of soil by organism in crushed besides nursery investigations portrayed to limit insights of nematode nerves besides growth vegetal harvests (Cabanillas and Barker, 1986; Candanedo *et al.*, 1983; Dube and Smart, 1987).

Seeds saved by spore suspension to *T.viride*, *P. lilacinus* produced trendy vital malady diminishment of

F., A. wither of tomato trim. Many infection markdown was unique at divergent medicines by biocontrol operators utilized as a part of the experimentation. No infection manifestations were seen in charge treatment while in the event of seeds treated with Fusarium the malady seriousness was 29.9%, while the illness seriousness was diminishing to 9.1 on the off chance that preserved seeds by F. + *T.viride* + *P. lilacinus* in the event that treared seeds by Alternarea sickness seriousness verified 17.9% reduction to 11.1 on the off chance that preserved seeds via A. + *T.viride* + *P. lilacinus* (fig. 2).

Crisp root weightiness correspondingly seen toward examinations impact of control specialists arranged change movement Statistics appeared in figure 2 displays root weightiness 3.0 g verified in charge vegetal , whereas base new root weightiness 2.1 , 2.4 verified in usage seeds by F. , A. autonomously upper root weightiness 3.5 g verified trendy cured seeds via *T. viride* + *P. lilacinus*. Dissimilar usage blend impacts of pathogens, bio control experts on dry root weightiness of plant adjust remains assumed fashionable (fig. 2).

Results gotten in this instruction set up clearly the immense activity of controller operators in contradiction of vegetal pathogens, central director of plant shrink infection, besides improved tomato development by way of appeared by snowballing the dry weight of protected tomato, related through controller. impact of *T. viride* + *P. lilacinus* off pathogenic fungi strength remain conventional through rivalry on behalf of supplements, or antagonism .that depicted various straining of soil organisms disconnected starting clearly infection abusive soil must remained presented toward support vegetal development via overwhelming earth allowed pathogens (Choudhary and Johri, 2009; Houssien *et al.*, 2010). Most significant dry root weight 2.4 g was checked whether there ought to be an event of plants with *T. viride* + *P. lilacinus* in spite of the fact that the most negligible dry root weight was recorded if there ought to emerge an event of tomato cured by F. \ A. 1.4, 1.5 independently. Fashionable situation seeds cured by pathogens, vegetable stature verified most lessened tomato height (33.1, 34.9) exclusively. Most dumbfounding tomato height [43.1] checked whether there ought to emerge an event of seeds cured by *T. viride* + *P. lilacinus*. Fashionable controller management crop was 70.1 g plant⁻¹, whereas if there ought to emerge an event of seeds cured by F. \ A., crop reducing 60.1, 64.7 g plant⁻¹ independently. Advanced crop (76.9 g plant⁻¹) verified if there ought to be an event of tomato cured by *T.viride* + *P. lilacinus*. Conduct of tomato by blend of *T.viride* + *P. lilacinus* start extra real ,at that point every one of them particularly

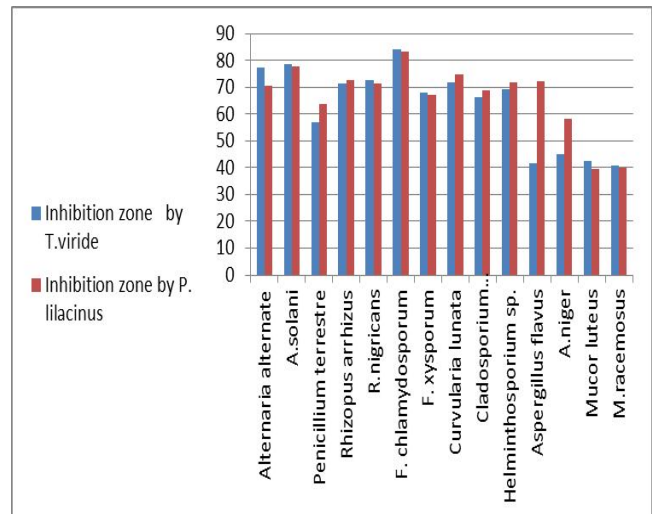


Fig. 1 : Consequence of *P. lilacinus*, *T. viride* of development in assorted fungi organisms in double culture investigation.

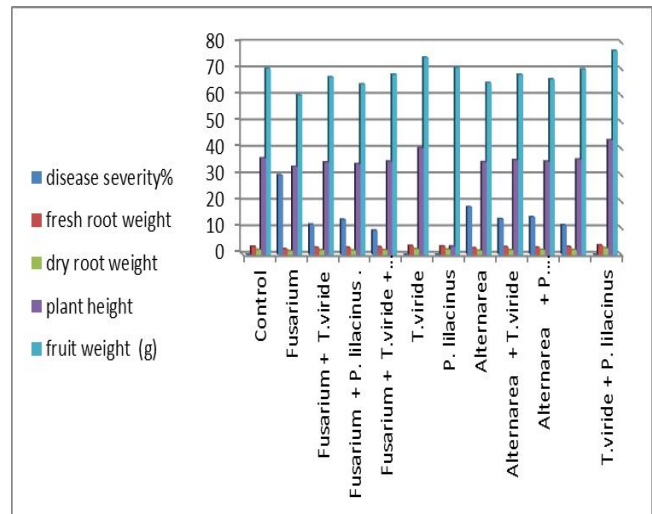


Fig. 2 : Consequence action of pathetic fungi and bio control specialists arranged infection seriousness in tomato.

,in diving illness seriousness in tomato contaminated with pathogens this may began from the detail that using in excess of one control specialists with different instrument of accomplishment versatility an additive impact to pathogenic fungi .that depicted giving florae by in excess of unique controller operators would major be able toward additional increment fashionable plant development besides markdown fashionable vegetal disease by root pathogenic fungi (Siddiqui and Sakhtor, 2007). Rise of tomato development started generally starting triumph of sickness and also the control specialists mark some component more accessible to be intrigued by plant (Quecin *et al.*, 2009; Validov *et al.*, 2005).

Peroxidase action in *S. lycopersicum* was likewise seen to investigations the impact of pathogens and biocontrol operators catalyst action. Information displayed

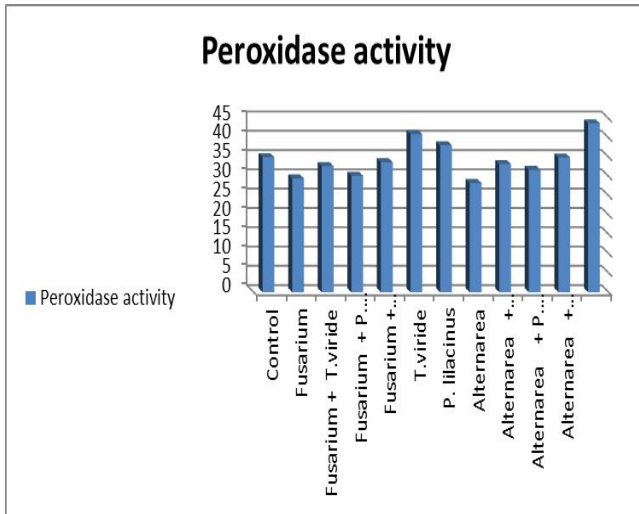


Fig. 3 :Result for usage of pathogenic fungi besides bio control managers proceeding PO action in tomato.

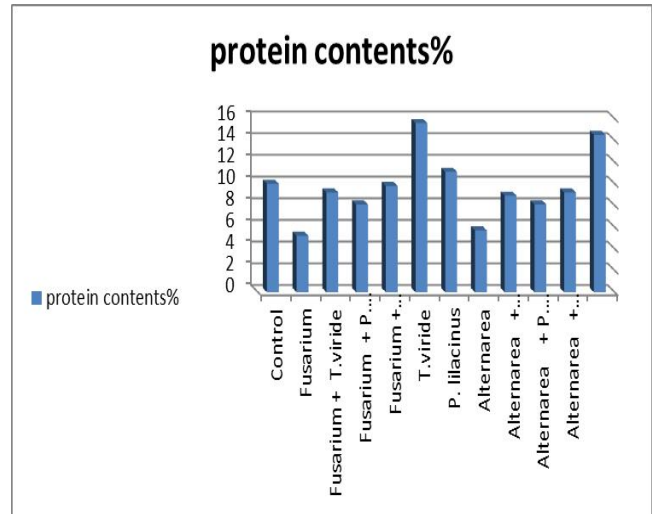


Fig. 5 :Consequence usage pathogenic fungi, controller managers proceeding protein substances fashionable tomato.

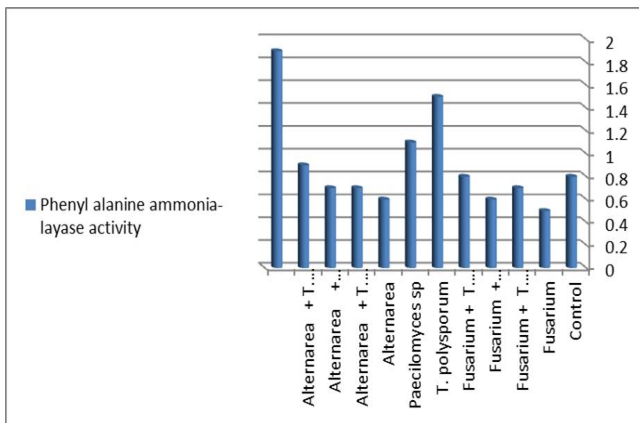


Fig. 4 : Conclusion of behavior for pathogenic fungi besides controller managers arranged (PAL; E.C.4.3.1.5) action in *S. lycopersicum*.

in figure 3 demonstrates that the Peroxidase action 35 U/ml was recorded in charge plant, while the most reduced chemical action 29.5 U/ml and 28.3U/ml was recorded in treatment seeds with Fusarium and Alternaria individually. brings about figure 3 demonstrated that all settled biocontrol specialists indicated expanded the action of oxidative protein Peroxidase in tomato leaves related for developed commencing untouched seeds . movement of Peroxidase exhibited most elevated increment once blend of *T.viride* + *P. lilacinus* 43.8 U/ml.

The impact for usage of fungi besides bio control operators on [PAL; E.C.4.3.1.5] action fashionable *S. lycopersicum* remained depict trendy (fig. 4), it is evident behavior *S. lycopersicum*, seeds by pathogens determination diminish fashionable [PAL; E.C.4.3.1.5] action remained 0.4, 0.5 fashionable F., A. behavior individually. Although, behavior seed by controller composed chronicled 1.9 catalyst movement

compartment by 0.8 fashionable controller behavior (Kessman *et al.*, 1994).

Results possible in fig. 5 assigned that, add up to proteins detectably greater fashionable tomato leaves developed fashionable soil preserved using controller operator contrasted and controller usage. Most astounding protein substance supported by blend of *T. viride* + *P. lilacinus*, it 15.6% contrasted and 11.1% in control treatment. The most minimal protein substance 5.2 and 5.7% noted fashionable management seeds by F., A. separately.

Critical increases in peroxidase, phenyl alanine require empirical associated by controller operators conduct fashionable cured tomato that assigned toward presentation of fundamental protection in contradiction of pathogenic fungi. Various exercises portrayed fundamental protection remains marked through start various formation PRs besides possessed by way of sign of energized protection (Hoffland *et al.*, 1995).

References

Agrios, G. (2005). *Plant pathology*, 5th: New York: Elsevier.

Ahmed, M. (2011). Management of *Fusarium* wilt of tomato by soil amendment with *Trichoderma koningii* and a white sterile fungus. *Indian J. Res.*, **5** : 35-38 .

Alabouvette, C., C. Olivain and C. Steinberg (2006). Biological control of plant diseases: the European situation. *European Journal of Plant Pathology*, **114(3)** : 329–341.

Al-Dabbagh, N., I. Abdul, E. Al- janabi and W. Obead (2007). Comparison of antimicrobial activity of four herbal extracts against streptococcus mutans isolated from dental diseases *in vitro*. *Pak. J. Biotechnol.*, **14 (4)** : 35-45.

- Alexander, M. (1978). *Introduction of soil Microbiology*. John Wiley and sons, Inc. New York.
- Andrade, G., F. Deleij and J. M. Lynch (1998). Plant mediated interactions between *Pseudomonas fluorescens*, *Rhizobium leguminosarum* and arbuscular mycorrhizae on pea. *Letters in Applied Microbiology*, **26** : 311-316. ,
- Bafana, A. and R. Lohiya (2003). Comparative Soil Nutrient Status and Microbiota Associated in the Rhizosphere of *Oroxylum indicum* growing in Different Natural Habitat in North East India. *World J Microbiol Biotechnol.*, **29** : 63-74.
- Biondi, N., R. Piccardi, M. C. Margheri, L. Rodolfi, G. D. Smith and M. R. Tredici (2004). Evaluation of Nostoc strain ATCC 53789 as a potential source of natural pesticides. *Appl. Environ. Microbiol.*, **70** : 3313-3320 .
- Cabanillas, E. and K. R. Barker (1986). Effects of fungal inoculum density and time of application of *Paecilomyces lilacinus* in controlling *Meloidogyne incognita* on tomato. *Journal of Nematology*, **18** : 602-612.
- Candanedo-Lay, E., J. Lara P. Jatala and F. Gonzales (1982). Preliminary evaluation of *Paecilomyces lilacinus* as a biological control of root-knot nematode *Meloidogyne incognita* in industrial tomatoes. *Nematropica*, **12** : 154 -160.
- Choudhary, D. K. and B. N. Johri (2009). Interactions of *Bacillus* spp. and plants-with special reference to induced systemic resistance (ISR). *Microbiological Rese.*, **164** : 493-513 .
- Daniels, B. A. and H. D. Skipper (1982). Methods for the Recovery and quantitative estimation of propagules from soil. In : N. C. Schenck, (ed.), *Methods and Principles of Mycorrhizal Research. American Phytopathological Society*, St Paul, Minnesota, 24.
- Dube, B. and G. C. Smart (1987). Biological control of *Meloidogyne incognita* by *Paecilomyces lilacinus* and *Pasteuria penetrans*. *Journal of Nematology*, **19** : 222-227.
- Fravel, D. R. (2005). Commercialization and implementation of biocontrol. *Annu Rev Phytopathol.*, **43** : 337-359.
- Gans, J., M. Wolinsky and A. Dunbar (2005). *J. Science*, **309** : 1387-1390.
- Harman, G. E., C. R. Howell, A. Viterbo, I. Chet and M. Lorito (2004). *Trichoderma* species opportunistic, avirulent plant symbionts. *Nature Rev Microbiol.*, **2** : 43-56 .
- Hassan, A. K. (2013). Evaluate the efficiency of some biological and chemical agents in controlling damping off and root rot caused by *Pythium aphanidermatum* in pepper', A thesis for the Degree of Doctor of Agriculture Science Philosophy. Agriculture University of Baghdad. Iraq. 141pp.
- Hoffland, E., C. M. J. Pieterse, L. Bik and J. A. Vanpelt (1995). Induced systemic resistance in radish is not associated with accumulation of pathogenesis-related proteins. *Physiol. Mol. Plant Pathol.*, **46** : 309-320 .
- Houssien, A. A., S. M. Ahmed and A. A. Ismail (2010). Activation of Tomato Plant Defense Response against *Fusarium* Wilt Disease Using *Trichoderma harzianum* and Salicylic Acid under Greenhouse Conditions. *J. of Agri. and Bio. Sciences*, **6(3)** : 328-338.
- Howell, C. R. (2003). Mechanisms Employed by *Trichoderma* species in the Biological Control of Plant Diseases: The History and Evolution of Current Concepts. *Plant Dis.*, **87** : 4-12 .
- Hudec, K. (2000). Influence of temperature on *Trichoderma harzianum* antagonistic activity against *Microdochium nivale*, *Fusarium culmorum* and *F. equiseti* under "in vitro" conditions. *Acta Fytotechnica et Zootechnica*, **3** : 98-100.
- Kessman, H., T. Staub, J. Ligon, H. Oostendorp and J. Ryals (1994). Activation of systemic acquired disease resistance in plants. *Eur. J. Plant Pathol.*, **100** : 359-369.
- Kredics, L., Z. Antal, L. Manczinger, A. Szekeres and F. E. N. Kevei (2003). Influence of environmental parameters on *Trichoderma* strains with biocontrol potential. *Food Tech Biotechnol.*, **41** : 37-42.
- Lewis, J. A., R. D. Lumsden and J. C. Locke (1996). Biocontrol of damping-off diseases caused by *Rhizoctonia solani* and *Pythium ultimum* with alginate prills of *Gliocladium virens*, *Trichoderma hamatum* and various food bases. *Biocontrol Sci. Technol.*, **6** : 163-17.
- Lugo, M. A., M. E. Gonzalez Maza and M. N. Cabello (2003). Arbuscular mycorrhizal fungi in a mountain grassland II: Seasonal variation of colonization studied, along with its relation to grazing and metabolic host type. *Mycologia*, **95(3)** : 407-415.
- Mathur, K. and K. Shekhawat (1986). Chemical control of early blight in kharif sown tomato. *Indian Journal of Mycology and Plant Pathology*, **16(2)** : 235-236.
- Moore, M., M. Opik and R. Sen (2004). Native arbuscular mycorrhizal fungal communities differentially influence the seedling performance of rare and common *Pulsatilla* species. *Funct. Ecol.*, **1(4)** : 554-562.
- Narula, N., E. Kothe and R. K. Behl (2009). Role of root exudates in plant-microbe interactions. *J. Appl. Bot. Food Qual.*, **82** : 122-130 .
- Narwal, S. S., R. B. Bogatek, B. M. Zaydanska, D. A. Sampietro and M. A. Vattuone (2009). *Plant biochemistry* ' Studium Press, LLC. USA. Thomson Press (India) Ltd. 632pp.
- Nema, R., S. Khare, P. Jain, A. Pradhan, A. Gupta and D. Singh (2013). Natural products potential and scope for modern cancer research. *Am. J. Plant Sci.*, **4** : 1270-1277.
- Quecin, M. C., T. A. Kidorsa, M. D. Henkels and B. T. Shaffer (2009). Role of rhizoxin and 2,4-diacetyl phoroglucinol in suppression *Fusarium* spp. by the rhizobacterium *Pseudomonas fluorescens* Pf-5. *Phytopathology*, **99** : 106-113.
- Reddy, J., L. Richard, D. Prasanthi and C. S. Shreedhara (2017a). Investigation of Anti-Inflammatory Potentials of

- Terminalia tomentosa* Wight & Arn. Bark - An *In-Vitro*. Approach *Journal of Global Pharma Technology*, **08(9)**: 01-05.
- Richard, L., H. Mishra, H. D. Abdulrahman and N. Felizatto (2017b). Evaluation of Antimicrobial Activity of *Acalypha indica* Against Various Enteric Gut Pathogens. *Journal of Global Pharma Technology*, **08(9)**: 06-10.
- Saharan, B. S. and V. Nehra (2011). Plant Growth Promotion Rhizobacteria : A Critical Review. *Life Science and Medical Research*, **21**.
- Scheffelen, A. C., A. Muller and J. G. Vanschoenbury (1961). Quick test for soil and plant analysis used by small laboratories. *J. Agric. Sci.*, **9**: 2-16.
- Siddiqui, Z. A. and M. Sakhtor (2007). Biocontrol of a chickpea root-rot disease complex with phosphate solubilizing microorganism's. *J. of Plant Pathology*, **89**: 67-77.
- Smith, S. E. and D. J. Read (2008). *Mycorrhizal symbiosis*. Academic, London. p 800.
- Strange, R. N. (1993). *Plant Disease Control: Towards Environmentally Acceptable Methods*, 354 pp. Chapman and Hall, New York.
- Toussaint, J. P., F. A. Smith and S. E. Smith (2007). Arbuscular mycorrhizal fungi can induce the production of phytochemicals in sweet basil irrespective of phosphorus nutrition. *Mycorrhiza*, **17**: 291-297.
- Validov, S., O. Marrodi, L. Delafuente, A. Boronin, D. Weller, S. Thoma and D. Mavrodi (2005). Antagonistic activity among 2,4-diacetyl phlorolucinol producing fluorescens *Pseudomonads* sp., *Microbiology*, **3**: 242-249.