

USE OF *AVICENNIA MARINA* IN THE CONTROL OF ROOT INFECTING FUNGI ON OKRA AND MASH BEAN

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Abstract

Use of leaves, stem and pneumatophore of *Avicennia marina* in the control the root infecting fungi viz., *Fusarium* spp., *Macrophomina phaseolina* and *Rhizoctonia solani* on mash bean and okra plants was observed. Germination of seeds, shoot length, root length, shoot weight and root weight were significantly increased in both okra and mash bean where *A. marina* plant parts viz., stem and pneumatophore powder was used @ 5% w/w. Infection of *Fusarium* spp., *R. solani* and *M. phaseolina* was significantly reduced in okra and mash bean plants where soil was amended with *A. marina* plant parts powder @ 5% w/w. *A. marina* leaves powder was more effective in control of root infecting fungi followed by stem and pneumatophore.

Introduction

Mangroves are widespread in tropical and sub tropical regions, growing in the saline intertidal zones of sheltered coast lines. Pakistan has a coastline of about 1,000 km. The Indus River delta extends over 250 km from Sir Creek at the Indian Border and Karachi in the west with about 250,000 ha of mangroves (Khan, 1966; Mirza *et al.*, 1983) and therefore it ranks as the fifth or sixth largest single mangrove area in the world (Snedaker & Snedaker, 1984). In Pakistan direct utilization of mangroves is restricted to only few types, of these fuel and fodder are the major ones. Plant disease causing organisms produces serious losses to crop plants and adversely affect the agricultural economy of a country (Hafeez, 1986). The primary diseases threatening crop production are due to fungi, actinomycetes, bacteria and nematodes. These are ubiquitous soil borne plant pathogens, which infect roots of plant, resulting in the death of plants. Since damage to plants by soil borne pathogens results from below ground infection, losses to crop plants from such diseases are underestimated and generally go unnoticed (Baker & Cook, 1974). The soil borne root-infecting fungi, *M. phaseolina* is reported to produce charcoal rot over 500 species of plants (Sinclair, 1982). *R. solani* exists as active mycelium in the soil, attacks over 2000 species of plants (Parmeter, 1970) and *Fusarium* species are known to attack a wide range of host plants in different parts of the world (Booth, 1971). Soil borne root infecting fungi cause seed decay, root rot and stem rot on crop plants. The association of root knot nematode and *Fusarium* spp., in tomato and papaya has often resulted in complete destruction of crop in Karachi and Malir area (Saeed & Ashrafi, 1971) because many crop plants have little or no resistance to certain pathogens. For the control of root rot root-knot disease complex, a combined use of fungicides and nematicides has been reported which decreases severity and only produce short term control (Easton *et al.*, 1975).

Organic amendments are generally used for the improvement of crop plants and increasing agricultural productivity. Stone *et al.*, in 2000 showed that addition organic matter amendments (organic wastes and plant residues) to field soils suppress a variety of soil borne diseases. Various organic amendments have a suppressive effect on plant parasitic nematodes (Alam, 1976, 1990). Of the organic substrates, neem cake (Alam,

1990; Abid *et al.*, 1992) brown seaweed viz., *Stoechospermum marginatum* and *Sargassum tenerrium* (Siddiqui *et al.*, 1998) and datura powder (Shahwar *et al.*, 1994) have shown promising results in the control of root infecting fungi. Mehdi *et al.*, (1999 and 2000) showed that *Avicennia marina* and *Rhizophora mucronata* used alone or in combination with *Paecilomyces lilacinus* significantly suppressed root infecting fungi. Combs & Anderson (1949) have reported the presence of compounds like tannins, alkaloids, and polyphenols in mangroves which play an important role in the suppression of deleterious microorganisms (Jamale & Joshi 1998; Nishiyama *et al.*, 1978; Ross *et al.*, 1980). Experiments were therefore carried out to study the effect of *Avicennia marina* in the control of root rot disease of okra and mash bean.

Materials and methods

Avicennia marina plant parts viz., leaves, stem and pneumatophore were collected from Sandpits, dried and ground in a grinder @ 0.1, 1 and 5% w/w. Soil used for the experiment was obtained from the experimental plots of the Department of Botany, University of Karachi and sieved through 2mm sieve to discard particles. The soil was transferred in 8cm diam., plastic pots @ 300gm/pot soil. The soil was sandy loam (Sand, Silt, Clay; 70, 19, 11%), pH range from 7.5-8.1 with moisture holding capacity (MHC) of 24% (Keen & Raczkowski, 1922), total nitrogen 1.5% (Mackenzie & Wallace, 1954), total organic matter 2.4%. Soil had natural infestation of 1-3 sclerotia of *Macrophomina phaseolina*/g as found by wet sieving dilution technique (Sheikh & Ghaffar, 1975), 5-10% colonization of *Rhizoctonia solani* on sorghum seeds used as baits (Wilhelm, 1955) and 3000cfu of *Fusarium* spp., as assessed by soil dilution technique (Nash & Snyder, 1962). After ten days of soil amendment, 5 seeds of okra and mash bean were sown in each pot. Soil without plant parts served as control. There were three replicates of each treatment and pots were kept randomized in a screen house bench of the Department of Botany, University of Karachi, where soil was kept at 50% M.H.C (Keen & Raczkowski, 1922). After 30 days, plants of okra and mash bean were uprooted and root were washed in a running tap water, surface sterilized in 1% Ca (OCl)₂ for 3 min., and then five 1cm long root pieces were transferred on PDA plates containing penicillin @100,000/litre and streptomycin @ 20mg/l. Petri dishes were incubated for 5 days at room temperature to confirm infection of root infecting fungi.

Data were analyzed and subjected to analysis of variance (ANOVA) following the procedure as given by Gomez & Gomez (1984).

Results and Discussion

Germination of seeds mash bean and okra showed significant increased where *A. marina* plant parts powder was used @ 5% w/w (Table 1). Greater plant height was observed in okra and mash bean where *A. marina* plant parts powder @ 5% w/w was used (Table 1). *A. marina* plant parts significantly increased the fresh weight of mash bean (Table 1) where as shoot length, shoot weight, root length and root weight of okra plants were significantly increased ($p<0.001$). Maximum shoot and root weight were observed in okra where *A. marina* used @ 1, 5% w/w. *A. marina* @ 1, 5% w/w was more effective in the suppression of *Fusarium* spp., infection on mash bean and okra ($p<0.001$) (Table 1). There was complete suppression of *R. solani* infection in mash bean and okra ($p<0.05$) where soil was amended with *A. marina* stem powder used @ 5% w/w (Table 1). Similarly infection of *M. phaseolina* was significantly reduced when soil was amended

with *A. marina* plant parts viz., leaves, stem and pneumatophore powder used @ 5% w/w in mash bean and okra (p<0.001) (Table 1). Present results showed that *A. marina* plant parts viz., leaves, stem and pneumatophore were more effective in the control of *R. solani* infection in mash bean and okra used @ 0.1, 1 and 5 % w/w. Of the different plant parts of *A. marina* used, leaves were more effective in the control of root infecting fungi viz., *Fusarium* spp., *M. phaseolina* and *R. solani* followed by pneumatophore and stem. Similarly Mehdi *et al* (2000) showed that *Rhizophora mucronata* used alone or in combination with *Paecilomyces lilacinus* significantly suppressed root infecting fungi. Mehdi *et al.*, (2001) reported that *A. marina* and *R. mucronata* with or without *Pseudomonas aeruginosa* significantly reduced the root knot infection in tomato. There are reports where soil amendments with oil cakes like cotton cake and neem cake showed significant results in the control of root infecting fungi viz., *F. solani*, *M. phaseolina* and *R. solani* (Ehteshamul-Haque *et al.*, 1995). Similarly Ehteshamul-Haque *et al* in 1998 used seaweeds *Stoechospermum marginatum*, neem cake and cotton cake which showed promising results in the control of root infecting fungi on sunflower. There is need for large scale use of *Avicennia marina* in the control of root rot disease of crop plants.

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References

Abid, M., S. Ehteshamul-Haque, M.A. Maqbool and A. Ghaffar. 1992. Effect of oil cakes, *Bradyrhizobium* sp., *Paecilomyces lilacinus* and Furdan on root nodulation and Root-knot nematodes in mung bean. *Pak. J. Nematol.*, 10: 145-150.

Alam, M.M. 1976. *Organic amendments in relation to nematodes*, Ph.D. thesis, Aligarh Muslim University. Aligarh. 150 pp.

Alam, M.M. 1990. Neem in nematode control. In: Nematode Biocontrol (Aspects and Prospects). (Eds.): M.S. Jairajpuri, M.M Alam and I. Ahmed. BS Publishers and Distributors (Pvt.) Ltd. Delhi-110032, India. 51-55 pp.

Baker K.F. and R.J. Cook. 1974. *Biological control of plant pathogen*. W.H. Freeman press, San Francisco.

Booth, C. 1971. *The genus Fusarium*. Common Wealth Mycological Institute, Kew Surrey, England, pp.237.

Combs. C.A. and H. Anderson. 1949. *Use of mangrove bark, Australian leather trade Rev.* 43: 270-274.

Easton, G.D., M.E. Nagle and D.L. Bailey. 1975. Residual effect of soil and fumigation and vine burning for control of *Verticillium* wilt of potato. *Phytopath.*, 65: 1419-422.

Ehteshamul-Haque, S., M. Abid and A. Ghaffar. 1995. Efficacy of *Bradyrhizobium* spp., and *Paecilomyces lilacinus* with oil cakes in the control of root rot of mung bean. *Tropical Science*, 35: 294-299.

Ehteshamul-Haque, S., M.J. Zaki, A.A. Validy and A. Ghaffar. 1998. Effects of organic amendments in the efficacy of *Pseudomonas aeruginosa* in the control of root rot disease of sunflower. *Pak. J. Bot.*, 30: 45-50.

Gomez, K.A. and A.A. Gomez. 1984. *Statistical procedures for Agricultural Research* 2nd ed. Willey, New York, pp. 680.

Hafeez, A. 1986. *Plant diseases*. Pakistan Agricultural Research Centre (PARC), Islamabad. pp 552.

Jamale. B.B. and G.V. Joshi. 1998. Effect on age of mineral constituents. Polyphenoloxides and peroxides in mangrove leaves. In. *J. Exp. Biol.*, 16(1): 117-120.

Keen, B.A and H. Raczkowski. 1921. Clay contents and certain physical properties of soil. *J. Agric. Sci.*, 11: 441-449.

Khan, S.A. 1966. Working plan of the Coastal Zone Afforestation Division from 1963-64 to 1982-83. Government of West Pakistan, Agriculture Dept., Lahore.

Mackenzie, H.A and H.S. Wallace. 1954. The kjeldahl determination of nitrogen: A critical study of digestion conditions, temperature, Catalyst and oxidizing agents. *Aust. J. Chem.*, 7: 55-70.

Mehdi, F.S., I.A. Siddiqui, S. Erum and A. Rajab. 1999. Effect of *Avicennia marina* and *Paecilomyces lilacinus* on root rot-root knot diseases of tomato. *Pakistan Journal of Biological Sciences*, 2(4): 1462-1466.

Mehdi, F.S., I.A. Siddique, A. Sajjad and M. Afzal. 2000. Effect of *Rhizophora mucronata* in the control of Root-knot and root infecting fungi of tomato. *Pakistan Journal of Biological Sciences*, 3(8): 1308-1310.

Mehdi, F.S., I.A. Siddique, T. Zia and N.I. Ali. 2001. Use of mangrove for the control of *Meloioyge javanica* in tomato. *Nematol. Medit.*, 29: 127-129.

Mirza, M.I., M.Z. Hassan, S. Akhtar and J. Ali. 1983. *Identification and area estimation of mangrove vegetation on Indus Delta using Landsat data*. In: Proc. Nat. Workshop of Mangroves, Karachi. Pak. Agri. Council, Islamabad. p. 19-21.

Nash, S.M. and W.C. Snyder. 1962. Quantitative estimations by plate counts of propagules of the bean root rot, *Fusarium* in field soils, *Phytopath.*, 52: 567-572.

Nishiyama, Y. Ryuzo, P.C. Sanchez and M. Kozaki. 1978. Inhibitory functions of Mangrove bark towards cell growth of microorganisms. *Hakko, Kogaku, Kaishi*, 56: 712-717.

Parmeter, J.R. 1970. *Rhizoctonia solani Biology and Pathology*. Univ. of California Press, Berkeley Los Angeles and London.. 255 pp.

Ross, S.A., S.E. Megalla, D.W. Bisby and A.H. Awad. 1980. Studies for determining some antibiotic substance in some Egyptian plants. Screening of some Antimicrobial activity. *Fitoterapia*, 51: 303-308.

Saeed, M. and S.M. Ashrafi. 1971. The influence of rainfall on the population of nematodes in banana fields, *Pak. J. Sci. Ind. Res.*, 14: 403-404.

Shahwar, B., M. Abid, Atta-ur-Rehman, M.A. Maqbool and M.I. Choudhary. 1994. Nematicidal compounds from *Datura fastuosa*. In: Proceedings of 4th I.U.P.A.C Symposium on the Chemistry of Natural Products, H.E.J. Research Institute of Chemistry, University of Karachi, Karachi-75270, Pakistan.

Sheikh, A. and A. Ghaffar. 1975. Population study of sclerotia of *Macrophomina phaseolina* in cotton field. *Pak. J. Bot.*, 7: 13-17.

Siddiqui, I.A., S. Ehteshamul-Haque, M.J. Zaki and A. Ghaffar. 1998. Effect of brown seaweeds (*Stoechospermum mordinatum* and *Sargassum tenerium*) and *Rhizobia* in control of root-knot disease and control of mung bean. *Pak. J. Nematol.*, 16: 145-149.

Sinclair, J.B. 1982. *Compendium of soybean diseases*. 2nd ed. American Phytopathological Society, pp. 104.

Snedaker, S.C. and J.G. Snedaker. 1984. The mangrove ecosystem; research methods. In: *The mangrove ecosystem: research methods*, pp. 251. UNESCO, Paris.

Stone, A.G., G.E. Vallad, L.R. Cooperband, W.R. Stevenson and R.M. Goodman. 2000. Impact of annual organic amendment on disease incidence in a three year vegetable rotation. *Soil science*, 85. pp.

Wilhem, S. 1955. Longevity of the *Verticillium* wilt fungus in the laboratory and field *Phytopathology*, 45: 180-181.

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