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FUNGICIDAL POTENTIAL OF SOME LOCAL TREE SEEDS FOR CONTROLLING ROOT ROT DISEASE

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Abstract

Effect of seeds powder of *Azadirachta indica* A. Juss, *Adenanthera pavonina* L., *Leucaena leucocephala* (Lam.) de Wit and *Eucalyptus* spp., in the control of root rot diseases caused by *Macrophomina phaseolina* (Tassi) Goid, *Rhizoctonia solani* Kühn and *Fusarium* spp., on mung bean (*Vigna radiata* L.) and chick pea (*Cicer arietinum* L.) plants were examined. The results obtained from screen house application of *A. pavonina, L. leucocephala* and *Eucalyptus* spp., @ 0.1 and 1% w/w showed significant control of root rot fungi viz., *M. phaseolina, R. solani* and *Fusarium* spp., and enhanced plant growth in term of shoot length, shoot weight, root length and root weight on mung bean and chick pea. There was complete suppression of *Fusarium* spp., and *R. solani* infection on mung bean when soil was amended with seeds powder of *A. pavonina* @ 1% w/w. Of the four local trees seed powder used, *A. pavonina* and *Eucalyptus* spp., @ 0.1 and 1% w/w reduced the infection of root infecting fungi followed by *L. leucocephala* and *A. indica.*

Introduction

Root rot caused by soil borne root infecting fungi is found in both indoor and outdoor plants, although more common in indoor plants with poor drainage. The roots of the plant rot usually as a result of overwatering. Soil borne fungal diseases are among the most important factors, limiting the yield of legume crops in many countries worldwide. Root rot caused by *Aphanomyces euteiches, R. solani, Fusarium* spp., *Sclerotium rolfsii* are the most destructive soil-borne diseases of pea, chickpea, lentil, faba bean and lupine (Abou-Zeid *et al.*, 1997; Abdel-Kader *et al*., 2002; Infantin *et al.*, 2006). *Fusarium* wilt disease caused by pathogenic form of the soil inhabiting fungus *Fusarium oxysporum* can cause severe losses in a wide variety of crop plants (Larkin & Fravel, 1998). Losses to the crop plants through such diseases are underestimated and generally go unnoticed (Baker & Cook, 1974). Of the soil borne root infecting fungi, *Macrophomina phaseolina* (Tassi) Goid is reported to produce charcoal rot, seedling blight, root rot, stem rot, pod rot on more than 500 species of plants (Dhingra & Sinclair, 1978) where at least 72 hosts have been reported from Pakistan (Mirza & Qureshi, 1978; Shahzad *et al*., 1988). *Rhizoctonia solani* exists as active mycelium in soil and is known to produce seed rot, damping off of seedling, wilt and root rot on over 2000 plant species (Parmeter, 1970), of which at least 63 hosts have been reported from Pakistan (Mirza & Qureshi, 1978; Ghaffar, 1988). *Fusarium solani* and *Fusarium oxysporum*, which are very common in agriculture fields of Pakistan, are known to cause root rot, stem rot and wilt disease on a wide range of plants (Nelson *et al*., 1983; Ghaffar, 1992). Root rot disease caused by *Rhizoctonia solani* Kühn; *Fusarium solani* (Mart) Sacc., and *Sclerotium rolfsii* Sacc., is the most destructive disease of tomato (Benhamou *et al.*, 1994; El-Mougy *et al.*, 1995). Control of such diseases mainly depend on fungicidal treatments (Rauf, 2000). However, fungicidal applications cause hazards to human health and increase environmental pollution. Therefore, alternative treatments for control of plant diseases are needed (El-Mougy *et*

al., 2004). It was interesting to note that increase in sclerotial population of *M. phaseolina* in soil resulted in great root infection by *M. phaseolina* (Dawar & Ghaffar, 1998). Such similar result have been reported by Meyer *et al.* (1974) on soybean where roots were infected by *Macrophomina phaseolina* which increased with increase in inoculum of *M. phaseolina* in soil. Cook *et al*., (1973) also reported that colonization of corn root with *M. phaseolina* increased with the increase in time due to the increase in sclerotial population in soil. Maximum 30% of root part of medicinal plant is used in different practices in comparison to other plant parts (Ved *et al*., 1998). In Nigeria, lemongrass powder and essential oil have effectively protected melon seeds against toxigenic *Aspergillus flavus* (Banjolo & joda, 2004). *Adenanthera pavonina* L., of the family Leguminosae, has long been an important tree in Southeast Asia and the Pacific Islands (Burkill, 1966). There are historical accounts from Southeast Asia and Africa of using all parts of tree for traditional medicines (Burkill, 1966; Watt & Brandwijk, 1962). The genus *Eucalyptus* (Myrtaceae) forms an integral part of the Australian flora, including >800 species that dominate most forest types, from coastal to subalpine habitats (Williams & Brooker, 1997). Present investigation was carried out on fungicidal potential of seeds of local trees in the control of root infecting fungi.

Materials and Methods

Seeds of *A. indica* A. Juss, *A. pavonina* L., *L. leucocephala* (Lam.) de Wit and *Eucalyptus* spp., were collected from Karachi University campus. Seeds were washed with tap water and dried under sunlight. Dried seeds were powdered in an electric blender and stored in air tight bottles for further studies. Sandy loam soil (sand, silt, clay, 60, 29, 11%), pH 8.05, moisture holding capacity of 40% (Keen & Raczkowski, 1922), total nitrogen 0.077-0.099 % (Mackenzie & Wallace, 1954) obtained from the experimental field of the Department of Botany, University of Karachi was transferred in 8 cm diam., plastic pots @ 300 g^{-1} pot. The soil had a natural infestation of 4-8 sclerotia of *M. phaseolina* g^{-1} of soil as estimated by wet sieving and dilution technique (Sheikh & Ghaffar, 1975), 6 % colonization of *R. solani* on sorghum seeds used as baits (Wilhelm, 1955) and 2900 cfu g^{-1} of soil of a mixed population of *Fusarium* spp., as assessed by soil dilution technique (Nash & Synder, 1962). Soil was amended with dried seeds powder *A. indica, A. pavonina, L. leucocephala* and *Eucalyptus* spp., @ 0.1 and 1% w/w and allowed to decompose. After 2 weeks of decomposition, seeds of mung bean (*Vigna radiata* L.) and chick- pea (*Cicer arietinum* L.) was sown @ 5 seeds per pot. The pots were placed in complete randomized design in a screen house and watered daily. Non amended soil served as control. Treatment and control were replicated thrice.

After 4 week of germination, plants were removed from pots and growth parameters in terms of shoot length, shoot weight, root length and root weight were taken. To determine the incidence of fungi, one-cm-long root pieces after washing in tap water were surface sterilized with 1% $Ca(OCl)_2$ and transferred on to Potato Dextrose Agar plates supplemented with penicillin @ (100,000 units/litre) and streptomycin sulfate @ (200 mg/litre) @ 5 pieces per plate. Plates were incubated at room temperature (28˚C) and after one week, infection of roots by fungi was recorded.

Data were subjected to analysis of variance (ANOVA) followed by least significant difference (LSD) test at $p = 0.05$ and Duncan's multiple range test to compare treatment means, using statistica software according to Sokal & Rohlf (1995).

Results and Discussion

Use of *A. pavonina* seed powder @ 0.1 and 1% w/w showed an increase in shoot length and root weight whereas *L. leucocephala* @ 0.1% w/w showed maximum shoot weight in mung bean plant in contrast to unamended soil (Table 1). Root length of chick pea plant increased when soil was amended with *Eucalyptus* spp., seeds powder @ 1% w/w (Table 1). Dawar *et al.*, (2007) observed a significant increase in plant growth parameters with *Eucalyptus* spp., plant parts viz., stem, leaves, bark and fruit tested on chick pea and mung bean plants. A maximum increase in root and shoot weight was observed when stem and pneumatophore powder of *Avicennia marina* and leaves and stem powder of *Rhizophora mucronata* were used @ 1 and 5% w/w on potato plants (Tariq *et al.*, 2008). Results of present observations, suggested that *A. pavonina* @ 0.1 and 1% w/w showed good results followed by *Eucalyptus* spp., *L. leucocephala* and *A. indica*.

Organic amendments are generally used for the improvement of crop plants and for increasing agricultural productivity. Amendment of seeds powder of local trees not only enhanced the plant growth but also reduced the infection of pathogenic fungi like *Fusarium* spp., *R. solani* and *M. phaseolina* present in soil which cause root rot disease in plants. Infection of *M. phaseolina* was significantly ($p<0.01$) reduced in mung bean when *A. pavonina*, *L. leucocephala* and *Eucalyptus* spp., seed powder was used @ 0.1 and 1% w/w and complete reduction was observed in chick pea (Table 1). *M. phaseolina* which produces charcoal rot disease in plants is reported to be suppressed by *Avicennia marina* plant parts like leaves, stem and pneumatophore when amended in soil @ 5% w/w on okra and mash bean plants (Tariq *et al.*, 2006). Suratuzzaman (1995) observed excellent inhibitory effect of *Allium sativum* and *Zingiber officinale* to control seed-borne fungi viz., *Colletotrichum dematium* var. *truncatum*, *Macrophomina phaseolina* and *Colletotrichum kikucchii* on soybean seed. In the present studies seeds powder of *A. pavonina* @ 1%, *Eucalyptus* spp., @ 0.1, 1% w/w and *L. leucocephala* @ 0.1% w/w completely suppressed *R. solani* ($p<0.05$) and *Fusarium* spp., ($p<0.01$) infection on mung bean plants (Table 1). Basak & Lee (2001 & 2002) reported that fresh cow urine and cow dung has positive response in suppression of mycelial growth of *F. solani*, *F. oxysporum* and *S. sclerotiorum.* Jabin (2003) reported that cow urine has inhibitory activity against *F. semitectum* and cow urine mixed with leaf extracts of *Calotropus procera*, *V. negundo* and *C. alata* completely (100%) inhibited the mycelial growth of the pathogen.

Results of the present studies showed that *A. pavonina* and *Eucalyptus* spp @ 0.1 and 1% w/w reduces the infection of root infecting fungi followed by *L. leucocephala.* All parts of the *Leucaena* plants including roots and root nodules, contain a toxic compound called mimosine, [ß-N-(3-hydroxy-4-pyridone)-*a*-aminopropi-onic acid], which is known to have antimitotic activity (Soedarjo & Borthakur, 1996). The valuable medicinal properties of different plants are due to presence of several constituents i.e. saponines, tannins, alkaloids, alkenyl phenols, glycoalkaloids, flavonoids, sesquiterpenes lactones, terpenoids and phorbol esters (Tiwari & Singh, 2004). In particular, the powder of these local tree seeds need to be incorporated into fields so that larger scale field analysis can be undertaken.

Table 1. Effect of dried seeds powder of local trees on growth parameters and infection % of mung bean and chick pea.

Treatments	Shoot length (cm)	Shoot weight (g)	Root length (cm)	Root weight (g)	*Fusarium* spp. Infection %	*R. solani* Infection %	*M. phaseolina* Infection %
				Mung bean			
Control	34.7	3.28	11.6	0.5	66.6	100	100
Azadirachta indica @ 0.1 %	32.0	2.81	10.8	0.3	22.2	88.8	33.3
Azadirachta indica @ 1 %	34.3	2.95	9.88	0.33	44.4	66.6	66.6
Adenanthera pavonina @ 0.1 %	35	3.47	11.5	0.46	11.1	77.7	77.7
Adenanthera pavonina @1 %	20.9	2.31	10.0	0.68	0	0	11.1
Leucaena leucocephala @ 0.1 %	32.9	3.58	12.4	0.63	0	44.4	77.7
Leucaena leucocephala @ 1 %	26.8	2.17	11.5	0.39	11.1	55.5	66.6
Eucalyptus spp. @ 0.1 %	30.6	3.12	12.0	0.44	0	77.7	66.6
Eucalyptus spp. @ 1 %	28.1	2.12	14.5	0.42	0	77.7	33.3
$LSD_{0.05}$ =	10.69	1.59	5.67	0.35	40.0	42.84	30.92
				Chick pea			
Control	42.0	3.23	18.8	1.58	88.8	100	66.6
Azadirachta indica @ 0.1 %	22.2	1.2	8.4	0.7	44.4	22.2	22.2
Azadirachta indica @ 1 %	33.3	2.5	16.0	1.2	55.5	33.3	44.4
Adenanthera pavonina @ 0.1 %	34.0	1.7	15.2	1.2	44.4	22.2	0
Adenanthera pavonina @ 1 %	28.3	2.79	14.9	1.4	44.4	22.2	0
Leucaena leucocephala @ 0.1 %	29.9	2.7	13.3	1.1	77.7	77.7	0
Leucaena leucocephala @ 1 %	29.3	2.1	10.9	0.77	55.5	22.2	0
Eucalyptus spp. @ 0.1 %	29.2	2.2	12.3	0.98	66.6	77.7	0
Eucalyptus spp. @ 1 %	27.6	1.3	19.8	0.49	22.2	33.3	11.1
$LSD_{0.05}$ =	12.57	1.43	9.45	0.87	72.26	49.77	35.05

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