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FORMULATION OF *AVICENNIA MARINA* PELLETS AND ITS APPLICATION IN CONTROLLING ROOT DISEASES IN LEGUMINOUS AND NON LEGUMINOUS PLANTS

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Abstract

After slight modification, pellets of *Avicennia marina* (Forsk.) Vierh plant parts viz., leaves, stem and pneumatophore were prepared from pyrophyllite at two different ratios 50:50 and 25:75 and incorporated in soil @ 3, 5, 7 and 10 pellets/pot. A pot experiment was designed to assess its effectiveness in promoting plant growth and suppression of root rot diseases. Observation showed that 5 leaves and stem powder pellets with 50:50 ratio gave significant results in increasing plant weight, height and controlling root rot diseases caused by pathogenic fungi viz., *Rhizoctonia solani* Kühn, *Macrophomina phaseolina* (Tassi) Goid and *Fusarium oxysporum* Schlecht on cowpea (*Vigna unguiculata* [L.] Walp) and brinjal (*Solanum melongena* L.) plants. Of the different dosages used, 5 pellets/pot were found to be best followed by 3 and 7 in controlling root rot diseases and promotion of growth parameters.

Introduction

Avicennia marina (Forsk.) Vierh also called as timmar, classified in the plant family Avicenniaceae is considered to be the dominant species which occurs on 95% of the area of Indus River Delta (Harrison *et al.*, 1994; Saifullah *et al.*, 1994). It is the most saline tolerant species and cannot withstand salt concentration greater than 90% (Macnae, 1966; Burchett *et al.*, 1984, 1989). Han *et al.*, (2007) reported seven new naphthoquinone derivatives like avicennone A, avicennone B, avicennone C, avicennone D, avicennone E, avicennone F, avicennone G. Beside these new compounds, some known compounds like avicequinone A, stenocarpoquinone, stenocarpoquinone B, avicequinone C, avicenol A and avicenol C which has a moderate cytotoxic activity as well as antibacterial effects were also isolated.

The soil borne fungal pathogens like *Rhizoctonia solani, Macrophomina phaseolina, Fusarium solani, F. oxysporum, Pythium* spp., causing various root rot disease complex on many horticultural crops, results in death of plants. Various techniques including crop rotation, planting of resistant cultivars, fungicide application have been used. Of these organic amendments with plant materials are generally used for the improvement of crop plants and increasing agricultural productivity. Tariq *et al.*, (2006) used leaves, stem and pneumatophore of *A. marina* for suppression of root infecting fungi on okra and mash bean plants.

Despite the use of organic amendments for controlling root rot diseases, very little information is known about the formulation of pellets using pyrophyllite, hydrous aluminum silicate ($AlSi2O_5OH$). Appearance of pyrophyllite is soft with talc-like slipperiness having specific gravity of 2.8 to 2.9 (Ciullo, 1996). It is insoluble in water and used in pharmaceutical industry as a diluents in tablets and capsule formulations (Ciullo, 1996). The present study examines the modification of the pellet preparation and its application in soil for observing its efficacy towards controlling root diseases on cowpea (*Vigna unguiculata* [L.] Walp) and brinjal (*Solanum melongena* L.).

Materials and Methods

Plant collection: *Avicennia marina* (Forsk.) Vierh plant parts viz., leaves, stem and pneumatophore were collected from Sandspit, Karachi Pakistan. Plant materials were air dried under shade with occasional shifting and finely powdered using electric blender.

Preparation of pellets: Lewis & Papavizas (1985) used method for preparation of pellets. After slight modification, equal amount of leaves, stem and pneumatophore of *A. marina* and pyrophyllite were mixed separately using sterilized distilled water. Pellets were prepared with the help of multiple pellet sampler. Equal size and weight (0.4 g) of *A. marina* pellets were prepared in a ratio of 50:50. For 25:75, 75% of plant parts powdered was mixed with 25% of pyrophyllite using distilled water. The pellets were air dried in a laminar air flow hood (Fig. 1).

Experimental design: Pot experiment was conducted at the screen house bench of Department of Botany, University of Karachi in natural sunlight in a randomized design. Sandy loam soil 350 g with pH 8.5, water holding capacity 35% (Keen & Raczkowskii, 1922), total nitrogen 0.083-0.10% (Mackenzie & Wallace, 1954) were placed in 8 cm diam., plastic pots. Natural population of fungi in soil consist of *R. solani* 7-12% (Wilhelm, 1955), 5-7 sclerotia of *M. phaseolina* g^{-1} (Sheikh & Ghaffar, 1975), *F. oxysporum* 4500 cfu g^{-1} (Nash & Synder, 1962). The design of experiment included (I) different plant parts pellets with ratio of 50:50 and 25:75 incorporated in soil @ 3, 5, 7 and 10 pellets/pot, (II) only pyrophyllite pellets @ 3, 5, 7 and 10 pellets/pot, (III) pots without pellets acted as control. Each treatment was replicated thrice. The pots were watered daily to facilitate decomposition of pellets. Two weeks after inoculation, 5 seeds of cowpea and 2 seedlings of brinjal were transplanted in each pot separately. After 4 weeks of growth, plants were gently removed from pots for observing growth parameters. The roots were carefully washed in running tap water for estimation of colonization of roots by pathogenic fungi.

Statistical analysis: Data obtained were analyzed using Statistica. Treatments and means were compared using Duncan's Multiple Range Test (DMRT) (Sokal & Rohlf, 1995).

Results

Effect of pellets on growth parameter: When pyrophyllite pellets of *A. marina* plant parts like leaves, stem and pneumatophore were inoculated in soil @ 3, 5, 7 and 10 /pot resulted in increased growth parameters of cowpea and brinjal plants as compared to control. Treatment with 10 pellets of *A. marina* plant parts was not considered further due to plant mortality. Five pellets of leaves powder /pot when used at the ratio of 50:50 gave significant ($p<0.001$) increase in shoot length and weight of cowpea and brinjal (Fig. 2). When 5 stem pellets/pot were inoculated in soil at ratio of 50:50, both cowpea and brinjal showed significant ($p<0.001$) increase in root length and weight. Out of 3 dosages of pellets used, 5 pellets/pot exhibited more significant results followed by 3 and 7 pellets. Only pyrophyllite pellets in soil subjected little or no effect on growth parameters compared to control (Fig. 2).

Fig. 1. *A. marina* plant part pellets.

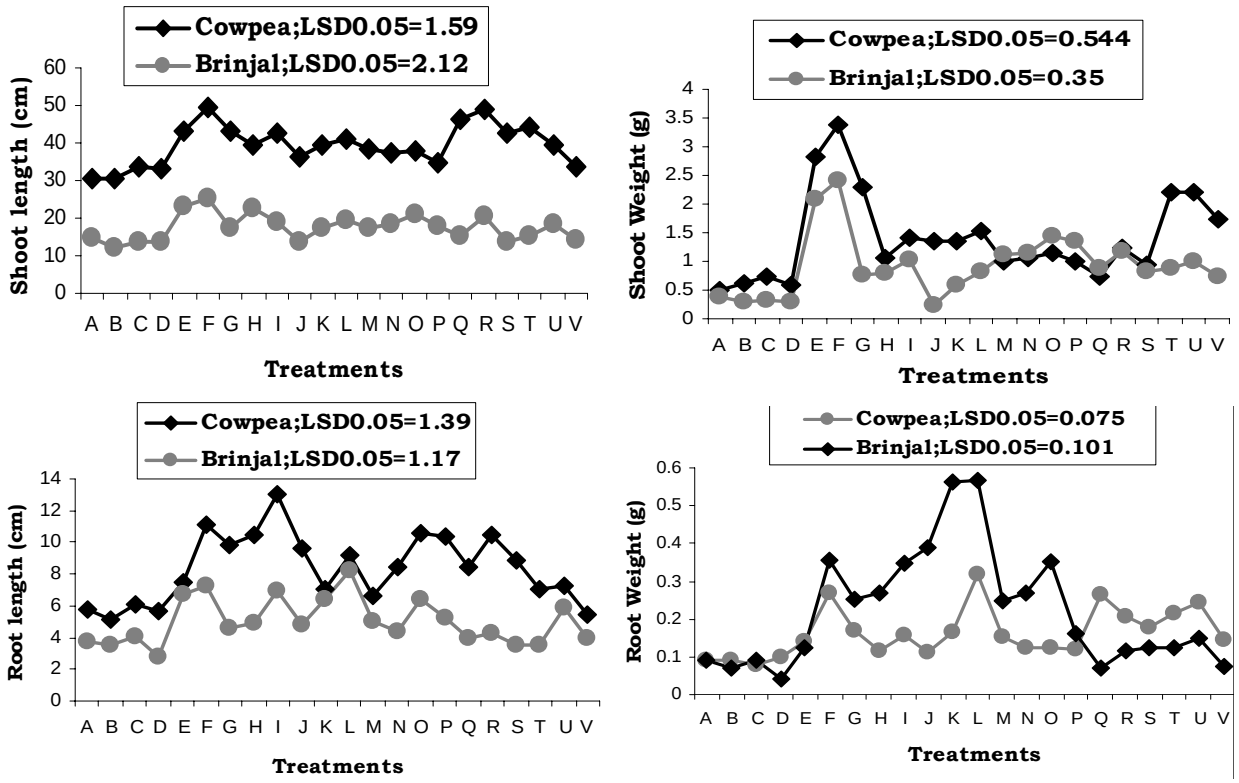

Fig. 2. Effect of different dosages of *A. marina* plant parts pellets at different ratios on growth parameters of cowpea and brinjal.

A= Control, B=3 Pyrophyllite pellets, C= 5 Pyrophyllite pellets, D= 7 Pyrophyllite pellets, E= 3 leaves pellets @ 50:50, F= 5 leaves pellets @ 50:50, G= 7 leaves pellets @ 50:50, H=3 leaves pellets @ 25:75, I=5 leaves pellets @ 25:75, J=7 leaves pellets @ 25:75, K=3 stem pellets @ 50:50, L=5 stem pellets @ 50:50, M=7 stem pellets @ 50:50, N=3 stem pellets @ 25:75, O=5 stem pellets @ 25:75, P=7 stem pellets @ 25:75, Q= 3 pneumatophore pellets @50:50, R= 5 pneumatophore pellets @50:50, S= 7 pneumatophore pellets @50:50, T= 3 pneumatophore pellets @25:75, U= 5 pneumatophore pellets @25:75, V= 7 pneumatophore pellets @25:75.

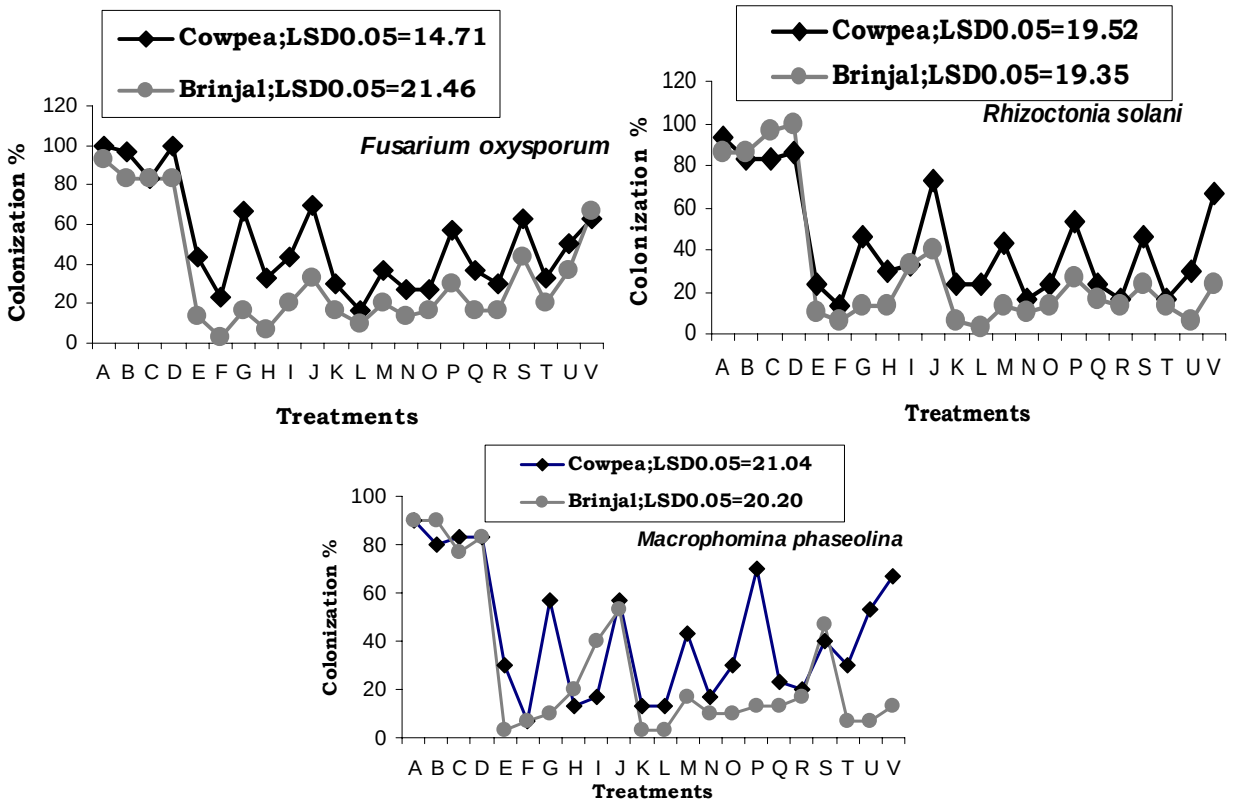

Fig. 3. Effect of different dosages of *A. marina* plant parts pellets at different ratios on colonization of root infecting fungi on cowpea and brinjal.

A= Control, B=3 Pyrophyllite pellets, C= 5 Pyrophyllite pellets, D= 7 Pyrophyllite pellets, E= 3 leaves pellets @ 50:50, F= 5 leaves pellets @ 50:50, G= 7 leaves pellets @ 50:50, H=3 leaves pellets @ 25:75, I=5 leaves pellets @ 25:75, J=7 leaves pellets @ 25:75, K=3 stem pellets @ 50:50, L=5 stem pellets @ 50:50, M=7 stem pellets @ 50:50, N=3 stem pellets @ 25:75, O=5 stem pellets @ 25:75, P=7 stem pellets @ 25:75, Q= 3 pneumatophore pellets @50:50, R= 5 pneumatophore pellets @50:50, S= 7 pneumatophore pellets @50:50, T= 3 pneumatophore pellets @25:75, U= 5 pneumatophore pellets @25:75, V= 7 pneumatophore pellets @25:75.

Effect of pellets on colonization of roots: Colonization of *F. oxysporum*, *M. phaseolina* and *R. solani* were observed when roots of brinjal and cowpea were plated on potato dextrose agar (PDA) poured plates. Pyrophyllite pellets with different dosages viz., 3, 5, 7/pot showed little or no effect over control when subjected to soil. Leaves, stem and pneumatophore pellets with 50:50 and 25:75 ratios markedly suppressed root infecting fungi. Colonization of brinjal and cowpea roots by *F. oxysporum* and *R. solani* were significantly reduced when 5 pellets/pot of stem and leaves was introduced in soil with ratio of 50:50. *M. phaseolina* which is the causal agent of charcoal rot was significantly ($p<0.001$) reduced on both hosts when 3, 5 leaves and stem pellets/pot were introduced in soil (Fig. 3).

Discussion

The incorporation of pyrophyllite pellets of *A. marina* plant parts had a marked effect on soil borne root infecting fungi. Five pellets/pot prepared from leaves and stem powder gave a tremendous effect on increasing growth parameters and suppressing *F. oxysporum*, *M. phaseolina* and *R. solani* on brinjal and cowpea plants. Many researcher used Sodium alginate based pellets. Ghaffar (1995) observed significant decrease in *M. phaseolina* infection on mung bean and chickpea when alginate pellets were mixed in soil @ 1 and 10 pellets per 250 g of soil. Walker & Connick (1983) used alginate type pellets

in formulations of chemical and microbiological herbicides. Pyrophyllite is a secondary mineral containing 28.3% Al_2O_3, 66.7% SiO_2 and 5% H_2O. It is identical to talc and is slippery in touch and used as a diluent in tablet formulation (Ciullo, 1996). Lewis & Papavizas (1991) observed that Pyrax/biomass and alginate pellet preparations did not reduce pathogenic saprophytic activity. The present approach sheds new light on the role of pyrophyllite pellets of *A. marina* plant parts like leaves, stem and pneumatophore in suppression of disease caused due to root infecting fungi. However, further research is needed to explore the interaction of *A. marina* and root infecting organisms.

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