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FERTILIZERS IN COMBINATION WITH *AVICENNIA MARINA* IN THE CONTROL OF ROOT ROT DISEASES OF OKRA AND MUNG BEAN

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Abstract

Efficacy of different fertilizers alone or in combination with *Avicennia marina* plant parts viz., leaves, stem and pneumatophore powder in the control of root rot diseases of okra and mung bean was examined. Maximum shoot length and shoot weight were observed on okra when frutan and urea were used @ 0.1% w/w in combination with pneumatophore and leaves powder whereas urea used @ 0.1% w/w in combination with leaves on mung bean plants. Urea and frutan used @ 0.1% w/w in combination with stem and pneumatophore powder showed maximum root length and weight on okra and mung bean plants**.** Significant suppression of *Rhizoctonia solani* was observed when DAP was used @ 0.1% w/w with stem and frutan @ 0.1% w/w with pneumatophore powder on mung bean plants whereas all fertilizers with all parts of *A. marina* showed complete suppression of *R. solani* on okra. There was complete suppression of *Macrophomina phaseolina* when urea and DAP were used @ 0.01 and 0.1% w/w with *A. marina* leaves powder on okra. All fertilizers and all parts of *A. marina* showed significant suppression of root infecting fungi on mung bean and okra.

Introduction

Use of fertilizers in the control of soil borne root rot diseases of crop plants is a common practice. Different fertilizers are used for better plant growth. Major portion of applied Phosphorus (P) is converted to forms not available to plants and it is attributed to high P fixing capacity, high pH and activity of $CaCO_3$. Therefore, in view of low soil fertility status, nutrient management based on utilization of various resources viz., soil, organic, biological and mineral fertilizer with particular references to arid conditions is necessary, not only in sustaining productivity and soil health but also in meeting fertilizer requirement of different crops (Hedge & Dwived, 1993). The synergistic use of organic and mineral fertilizers increase each other's efficacy (Hussain *et al.*, 1992). Nitrogen present in the fertilizer is absorbed by the plant which is utilized in protein synthesis and seed production where as potassium is involved in many cellular functions including photosynthesis, phosphorylation, water maintenance, reduction of nitrates and reproduction. Potassium is also known to reduce *F. oxysporum* infection on tomato (Ellet, 1973) and *R. solani* infection on hemp (Pal & Choudhary, 1980). Urea also inhibits soil borne root-infecting fungi on mung bean (Dawar & Ghaffar, 2003).

Avicennia marina (Forsk.) Vierh., also called as grey mangrove or white mangrove of the family Avicenniaceae are evergreen shrub or small tree 1–10 m high with trunk upto 40 cm in diameter. Numerous upright pneumatophores are10–15 cm high and 6 mm in diameter (Little, 1983). Crop plants have great importance in political, social and agricultural economy of a country. Diseases of crop plants adversely affect the agricultural economy of countries depending upon the severity of diseases. Of the disease

causing organisms, the soil borne pathogens viz., *Macrophomina phaseolina* (*T*assi) Goid, *Rhizoctonia solani* (Kühn) and *Fusarium* spp., attack roots, limiting nutritional uptake and produce root rot disease complex resulting in the death of plants. The genus *Fusarium* contains a number of species, which have been recognized for a long time as being important plant pathogens (Booth, 1971; Nelson *et al*., 1983). An average yield loss of 2.2 ha in pea was observed in Ontario due to root rot diseases caused by *F. solani* and *F. oxysporum* with complete loss in many cases (Tu, 1987). Similarly, *M. phasoelina* is reported to produce charcoal rot of over 500 species of plants (Sinclair, 1982), where at least 72 hosts have been reported from Pakistan (Mirza & Qureshi, 1978; Shahzad *et al*., 1988). *R. solani* exists as active mycelium in soil and attacks more than 2000 species of plant (Parmeter, 1970), of which at least 63 hosts have been reported from Pakistan (Mirza & Qureshi, 1978). The aim of the present investigation was to determine the effectiveness of fertilizers amendment in soil alone or in combination with *A. marina* plant parts viz., leaves, stem and pneumatophore powder for the control of root rot diseases on mung bean (*Vigna radiata* L.) and okra (*Abelmoschus esculentus* L.) plants.

Materials and Methods

Different nursery fertilizers viz., frutan, urea and DAP which contains several essential micro and macronutrients in their composition were purchased from the local market and used for the control of root infecting fungi on okra and mash bean. *A. marina* (Forsk.) Vierh plant parts viz., leaves, stem and pneumatophore were collected from coastal areas, air-dried and powdered in an electric grinder.

Soil used for the experiment was obtained from the experimental plots of the Department of Botany, University of Karachi and sieved through 2 mm sieve to discard particles. The soil used was sandy loam soil (sand, silt, clay; 70, 19, 11% respectively) of pH 8.1 and transferred into 8 cm diameter plastic pots @ 300 g/pot. The moisture holding capacity (MHC) of soil was 40% (Keen & Raczkowski, 1922), total nitrogen 0.077-0.099% (Mackenzie & Wallace, 1954), total organic matter 4.17-4.59%. Soil had natural infestation of 4-6 sclerotia/g soil of *Macrophomina phaseolina* as estimated by wet sieving dilution technique (Sheikh & Ghaffar, 1975); 5-7% colonization of *Rhizoctonia solani* on sorghum seeds used as baits (Wilhelm, 1955) and $8x10^6$ cfu/g soil of *Fusarium* sp, as assessed by soil dilution technique (Nash & Snyder, 1962). The soil was amended with nursery fertilizers viz., DPA, frutan and urea @ 0.01 and 0.1 % w/w as a separate dosage and as combined with *A. marina* plant parts viz., leaves, stem and pneumatophore. The soil was watered daily for the decomposition of organic substrate. After 7 days of soil amendment, 5 seeds of okra and mung bean were sown in each pot. Treatments were replicated three times and the pots without fertilizers and *A. marina* plant parts powder served as control. Pots were kept randomized in a screen house of the Department of Botany, University of Karachi, where soil was kept at 40 % M.H.C (Keen & Raczkowski, 1922).

To determine the infection of pathogenic fungi on roots, the method used by Short *et al*., (1980) was modified where plants were uprooted after 30 days. Data on germination, plant height, shoot weight and root weight was recorded. Roots were washed under running tap water and surface sterilized in 1 % Ca $(OCl)_2$ for 3 min., and then five 1 cm long root pieces was transferred on PDA plate containing penicillin @ 100,000/L and streptomycin @ 20 mg/L. Petri dishes were incubated for 5 days at room temperature to confirm infection of roots caused by root rot fungi.

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

Results and Discussion

All nursery fertilizers when used alone or in combination with *A. marina* plant parts showed significant increase in seed germination and plant growth parameters on both mung bean and okra plants as compared to control (Table 1). Maximum germination of seeds, plant height and root weight were observed on okra whereas shoot weight and root length in mung bean plant ($p<0.001$) (Table 1). Urea @ 0.01 and 0.1 % w/w in combination with *A. marina* leaves and stem powder showed maximum germination on okra whereas on mung bean frutan and urea @ 0.01 and 0.1 % w/w with *A. marina* leaves, stem and pneumatophore showed maximum germination as compared to control ($p<0.001$). Maximum shoot length and shoot weight were observed when frutan and urea were used @ 0.1% w/w in combination with pneumatophore and leaves powder on okra whereas urea used @ 0.1% w/w in combination with leaves on mung bean plant ($p<0.001$) (Table 1). Urea and frutan used @ 0.1% w/w in combination with stem and pneumatophore powder showed maximum root length and weight on okra and mung bean plants ($p<0.001$) (Table 1)**.** A significant suppression of *R. solani* was observed where DAP was used @ 0.1% w/w in combination with stem and frutan @ 0.1% w/w combined with pneumatophore powder on mung bean plant whereas on okra all fertilizers with all parts of *A. marina* showed complete suppression of *R. solani* ($p<0.001$) (Table 2). Complete suppression of *M. phaseolina* was observed when urea and DAP were used @ 0.01 and 0.1% w/w in combination with *A. marina* leaves powder on okra ($p<0.001$) (Table 2).

Huber, 1980 observed that control of root infecting fungi with the use of mineral fertilizers could presumably be due to the increase in tolerance with the development of thicker cuticle and cell wall or more schlerenchyma tissue with different nutrient regimes which has been correlated with the difficulty in penetration of pathogen. Present result showed complete suppression of *M. phaseolina* when urea and DAP were used @ 0.01 and 0.1 % w/w in combination with *A. marina* leaves powder on okra. Similarly Dawar & Ghaffar (2003) reported that urea showed significant reduction in *M. phaseolina* infection on mung bean. Similar results were observed by Siddiqui *et al*., (1999) that root rot diseases in mung bean caused by root infecting fungi viz., *Fusarium* spp., *M. phaseolina* and *R. solani* also reduced by the addition of urea and potash. Toxicity of ammonia ion released during degradation of urea exerted an adverse effect on soil borne pathogen (Oteifa, 1953).

Root rot diseases caused by *F. oxysporum* and *R. solani* were reduced by the addition of mineral fertilizers (Pal & Choudhary, 1980). The plants with proper nutrients are able to produce new roots to replace the older roots, which are destroyed by soil borne pathogens. The best root and shoot growth requires a balanced level of the major nutrients. The newly developed roots have the capacity to become more resistant against root infecting fungi. Present result showed that there was significant increase in germination of seeds, plant height and weight, root length and weight on okra and mung bean plants when fertilizers in combination with *A. marina* plant parts viz., leaves, stem and pneumatophore were used. Similarly Sheikh *et al.*, (2006) observed that *B. thuringiensis* and *R. meliloti* with and without locally available nursery fertilizers viz., flourish, frutan, NPK, urea and fish meal applied as seed dressing and soil drenching showed a significant increase in plant growth parameters of okra and mung bean. Use of *A. marina* in combination of nursery fertilizers could therefore be used in the control of soil borne root infecting fungi and increase the crop production.

Table 1. Effect of fertilizers alone or in combination with different plant parts of *Avicennia marina* on plant growth of okra and mung bean.

Treatments	Okra					Mung bean				
	Germination %	Shoot length (cm)	Shoot weight (g)	Root length (cm)	Root weight (g)	Germination %	Shoot length (cm)	Shoot weight (gm)	Root length (cm)	Root weight (gm)
Control	60.0	18.31	0.25	2.49	0.126	53.33	19.15	0.71	2.82	0.146
1% *A. marina* leaves alone	93.33	19.96	0.55	3.00	0.143	86.66	22.32	1.62	3.71	0.156
Urea 0.01% alone	86.66	19.75	0.89	2.74	0.180	86.66	22.88	1.24	5.45	0.193
Urea 0.1% alone	93.33	20.76	0.94	3.33	0.173	93.33	23.02	1.88	5.42	0.206
1% *A. marina* leaves+ urea 0.01%	100.0	21.03	1.26	3.37	0.210	93.33	24.42	2.83	5.82	0.216
1% *A. marina* leaves+ urea 0.1%	100.0	21.05	1.28	3.76	0.24	93.33	24.69	2.88	5.9	0.223
DAP 0.01%	80.0	19.72	0.33	2.70	0.160	86.66	20.19	1.72	4.14	0.15
DAP 0.1%	86.66	20.06	0.48	3.34	0.193	86.66	20.92	1.75	4.12	0.153
1% *A. marina* + DAP 0.01%	93.33	20.62	0.58	4.00	0.233	93.33	21.46	1.96	5.06	0.176
1% *A. marina* + DAP 0.1%	93.33	20.95	0.96	4.25	0.250	93.33	21.62	1.99	5.12	0.193
Frutan 0.01%	73.33	19.62	1.17	3.00	0.136	80.0	19.72	1.16	3.62	0.173
Frutan 0.1%	86.66	19.74	1.21	3.05	0.153	86.66	20.38	1.60	3.68	0.183
1% *A. marina* + Frutan 0.01 %	93.33	20.76	1.30	3.64	0.196	100.0	21.08	2.36	5.21	0.196
1% *A. marina* + Frutan 0.1 %	93.33	22.40	1.33	4.34	0.206	100.0	21.39	2.74	5.48	0.21
1% stem	86.66	20.98	0.82	2.93	0.213	93.33	19.72	1.98	4.32	0.156
1% *A. marina* stem+ urea 0.01 %	100.0	23.99	0.85	3.28	0.420	100.0	21.76	2.35	4.93	0.193
1% *A. marina* stem + urea 0.1 %	100.0	23.12	0.87	3.35	0.466	100.0	22.75	2.85	5.67	0.206
1% *A. marina* stem + DAP 0.01 %	80.0	22.11	0.88	2.95	0.303	93.33	20.19	2.05	5.01	0.193
1% *A. marina* stem+ DAP 0.1 %	86.66	23.08	0.90	2.99	0.396	93.33	20.95	2.20	5.19	0.20
1% *A. marina* stem+ Frutan 0.01 %	80.0	21.73	0.89	3.44	0.396	86.66	21.12	2.34	5.61	0.216
1% *A. marina* stem+ Frutan 0.1 %	93.33	22.51	0.90	3.75	0.406	93.33	21.29	2.59	5.98	0.213
1% pneumatophore only	86.66	20.05	0.53	3.19	0.193	100.0	20.12	1.96	3.76	0.17
1% *A. marina* pneumatophore+ urea 0.01%	93.33	23.00	0.69	3.60	0.243	100.0	20.58	2.13	4.92	0.18
1% *A. marina* pneumatophore + urea 0.1%	93.33	24.13	0.72	4.55	0.253	100.0	20.95	2.22	5.03	0.2
1% *A. marina* pneumatophore + DAP 0.01%	86.66	21.45	0.60	4.18	0.256	86.66	20.85	2.08	5.68	0.21
1% *A. marina* pneumatophore + DAP 0.1%	93.33	22.72	0.61	4.33	0.276	93.33	21.18	2.30	5.72	0.216
1% *A. marina* pneumatophore + Frutan 0.01%	93.33	24.79	0.94	3.48	0.326	100.0	20.82	2.67	4.94	0.246
1% *A. marina* pneumatophore + Frutan 0.1%	93.33	25.40	1.35	4.01	0.410	100.0	21.22	2.76	5.52	0.256
LSD 0.05=	**22.00**	**01.36**	**0.83**	**0.88**	**0.09**	**16.04**	**01.25**	**0.80**	**0.98**	**0.05**

Table 2. Effect of nursery fertilizers alone or in combination with *A. marina* in the control of root rot fungi on okra and mung bean.

Treatments	Okra			Mung bean		
	***Fusarium* spp**	***R. solani***	***M. phaseolina***	***Fusarium* spp**	***R. solani***	***M. phaseolina***
Control	100	88.88	77.77	100	100	88.88
1% *A. marina* leaves alone	55.55	77.77	55.55	77.77	88.88	55.55
Urea 0.01% alone	55.55	66.66	44.44	66.66	55.55	33.33
Urea 0.1% alone	22.22	33.33	33.33	55.55	55.55	22.22
1% *A. marina* leaves + urea 0.01%	22.22	11.11	0.00	33.33	33.33	11.11
1% *A. marina* leaves+ urea 0.1%	11.11	22.22	0.00	33.33	22.22	11.11
DAP 0.01%	66.66	55.55	33.33	66.66	88.88	66.66
DAP 0.1%	44.44	22.22	11.11	55.55	66.66	55.55
1% *A. marina* + DAP 0.01%	33.33	11.11	0.00	22.22	55.55	33.33
1% *A. marina* + DAP 0.1%	11.11	0.00	0.00	11.11	44.44	22.22
Frutan 0.01%	77.77	66.66	44.44	66.66	88.88	55.55
Frutan 0.1%	55.55	22.22	11.11	55.55	66.66	33.33
1% *A. marina* + Frutan 0.01%	44.44	11.11	22.22	44.44	44.44	11.11
1% *A. marina* + Frutan 0.1%	22.22	0.00	11.11	22.22	33.33	11.11
1% stem	77.77	66.66	55.55	66.66	77.77	55.55
1% *A. marina* stem+ urea 0.01%	55.55	33.33	22.22	44.44	55.55	55.55
1% *A. marina* stem + urea 0.1%	44.44	22.22	11.11	22.22	33.33	11.11
1% *A. marina* stem + DAP 0.01%	11.11	44.44	22.22	44.44	22.22	44.44
1% *A. marina* stem+ DAP 0.1%	11.11	22.22	11.11	11.11	0.00	11.11
1 % *A. marina* stem+ Frutan 0.01%	77.77	55.55	22.22	55.55	66.66	44.44
1% *A. marina* stem+ Frutan 0.1%	22.22	33.33	11.11	33.33	44.44	33.33
1% pneumatophore only	55.55	66.66	66.66	55.55	55.55	66.66
1% *A. marina* pneumatophore + urea 0.01%	66.66	0.00	11.11	44.44	55.55	44.44
1% *A. marina* pneumatophore + urea 0.1%	33.33	0.00	0.00	44.44	22.22	11.11
1% *A. marina* pneumatophore + DAP 0.01%	55.55	55.55	66.66	44.44	33.33	33.33
1% *A. marina* pneumatophore + DAP 0.1%	33.33	44.44	55.55	33.33	22.22	11.11
1% *A. marina* pneumatophore + Frutan 0.01%	44.44	22.22	44.44	11.11	11.11	44.44
1% *A. marina* pneumatophore + Frutan 0.1%	33.33	11.11	33.33	11.11	0.00	33.33
LSD 0.05 =	**40.06**	**38.76**	**36.50**	**37.72**	**38.82**	**44.12**

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