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COMBINED EFFECTIVENESS OF FERTILIZERS IN THE CONTROL OF ROOT ROT AND ROOT KNOT DISEASE COMPLEX OF MUNG BEAN AND OKRA

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ABSTRACT

An experiment was carried out to check the efficacy of different nursery fertilizers as separate dosage and also as combined dosage against the root rot fungi viz., *Macrophomina phaseolina, Rhizoctonia solani* and *Fusarium* spp., and root knot nematode (*Meloidogyne javanica*) on mung bean and okra. Nursery fertilizers showed a significant increase in the plant growth parameters and significant decrease in the infection caused by root infecting fungi and root knot nematodes. Nursery fertilizer NPK was found best in the combination with all other fertilizers like flourish with frutan, flourish with NPK, flourish with urea, frutan with NPK, frutan with urea and NPK with urea to increase the plant growth as well as in the control of root rot and root knot of mung bean and okra plants. Use of nursery fertilizers is necessary for the plants as a food source through which they showed a better plant growth and control the infection of root rot fungi and root knot nematodes.

Key words: Fertilizers, different dosage, root rot-root knot disease complex, mung bean and okra.

INTRODUCTION

The soil borne pathogens play a major role in the development of root rot and root knot diseases complex of crop plants. These soil borne diseases-causing fungal pathogens are difficult to eliminate, since they produce resting structure like sclerotia, chlamydospores, which are well adopted to survive for longer periods under adverse environmental conditions. Of the various diseases, primary diseases threatening crop productions are due to fungi, actinomycetes, bacteria and nematodes. These pathogens infect roots of the plants, limiting nutrient uptake by plants and produce root rot and root knot diseases complex resulting in death of the plant and this damage is result from below ground infection, losses to the crop plants through such disease are underestimated and generally go unnoticed (Baker and 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 and Sinclair, 1978) where at least 72 hosts have been reported from Pakistan (Mirza and Qureshi, 1978; Shahzad *et al*, 1988). *Rhizoctonia solani* exists as active mycelium in soil which is known to produce seed rot, damping off of seedling, wilt and root rot on over 2000 species of plant (Parmeter, 1970), of which at least 63 hosts have been reported from Pakistan (Mirza and Qureshi, 1978; Ghaffar, 1988). *Fusarium solani* and *F. 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 (Booth, 1971; Ghaffar, 1992).

Apart from root infecting fungi, the plant parasitic nematodes also produce serious losses to crop plants. Root knot nematode *Meloidogyne* spp., are world wide in distribution and are known to attack a wide variety of crops (Goodey *et al*, 1965).The various species of *Meloidogyne* induce major morphological and physiological changes within roots attack nearly every crop sown where yields and quality are reduced (Sasser, 1980). In Pakistan root knot nematodes, *Meloidogyne* spp., are recognized as important parasites of vegetable crops. About 100 plants have been found infested with root knot nematode from different cultivated zones of Pakistan (Maqbool, 1988; Zaki, 2000). Damage caused by root-knot nematode is much higher in tropical and sub tropical countries (Taylor and Sasser, 1978).

Control of these root infecting pathogen has been accomplished through the use of nematicides, crop rotation, destruction of residual infected roots and fungal biocontrol agents (Stephan *et al*, 1977, 1988). Use of fungicides, fertilizers and bacteria in the control of soil borne root rot and root knot of crop plants is a common practice. Different fertilizers are used for better plant growth. Nitrogen present in the fertilizer is absorb by the plant which is utilized in a 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 and Choudhary, 1980). Urea also inhibits soil borne root-infecting fungi. The aim of the present investigation was to determine the effectiveness of fertilizers amendment in soil for the control of root rot and root knot disease complex on mug bean (*Vigna radiata* L.) and okra (*Abelmoschus esculentus* L.) plants.

MATERIALS AND METHODS

ROOT ROT FUNGI

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 the non-soil particles. The soil used was sandy loam (Sand, Silt, Clay; 70, 19 11%), pH range from 7. 5 - 8.1 with moisture holding capacity (MHC) of 24.04 % (Keen and Raczkowski, 1922), total nitrogen 1.5 % (Mackenzie and Wallace, 1954), total organic matter 2.4 %, soil had natural infestation of 1-3 sclerotia of *M. phaseolina* as found by wet sieving dilution technique (Sheikh and Ghaffar, 1975), 5-10% colonization of *R. solani* on sorghum seeds used as baits (Wilhelm, 1955) and 3000cfu *Fusarium* spp, as assessed by soil dilution technique (Nash and Snyder, 1962).

The soil was amended with nursery fertilizers viz., flourish, frutan, NPK, urea @ 0.01% w/w as a separate dosage and as combine dosage of fertilizers @ 0.05%+ 0.05% w/w. After seven days of soil amendment, five seeds of okra and mung been were sown in each pot. Soil without fertilizer served as control. There were three replicates of each treatment and pots were kept randomized on screen house at Department of Botany, University of Karachi, where soil was kept at 50% M.H.C (Keen and Raczkowski, 1922). After 30 days plants were uprooted and data on shoot length, shoot weight, root length and root weight were collected. Roots were washed in running tap water, surface sterilized in 1% $Ca(OCl)_2$ for 3 mins and then cut five, 1cm root pieces and 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 roots by root infecting fungi.

ROOT KNOT NEMATODES

The roots of brinjal (*Solanum melongena*) infested with root knot nematode *M. javanica* were collected from the experimental plot of Department of Botany, University of Karachi. The roots were washed under running tap water and cut into small pieces then dipped in 100ml of 1% $Ca(OCl)_2$ in a bottle and mouth was tightly closed then shake vigorously by hands for 5min and content was poured on to 100 mesh sieve fitted over a 400 mesh sieve, washed the roots under running tap water for 1 min, the residues from 400 mesh sieve were transferred into 250ml beaker. No of eggs and larvae/ml of suspension were determined with the help of counting dish (Hussey and Barker, 1973).

The soil was amended with nursery fertilizers viz, flourish, frutan, NPK, urea @ 0.01% w/w as a separate dosage and as combine dosage of fertilizers @ 0.05%+ 0.05% w/w., and were kept in 8cm diam, plastic pot. After seven days of soil amendment, five seeds of okra and mung been were sown in each pot. Soil without fertilizer served as control. There were three replicates of each treatment each pot containing 300gm soil. Soil moisture was adjusted at 40% M.H.C. (Keen and Raczkowski, 1921), after 2 weeks of plant growth add 1000eggs/ pot. After 45 days plants were uprooted and data on plant growth and number of knots per plant was collected. Infection of roots by root knot nematodes was estimated by using the following 0-5 scale (Taylor and Sasser, 1978).

0	0
1-2	1
3-10	2
11-30	3
31-100	4
> 100	5

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

RESULTS AND DISCUSSION

ROOT ROT FUNGI

In the present studies the best results observed where NPK was used separately and in combination with other fertilizers viz., flourish, frutan and urea. All combinations of fertilizers enhanced plant growth as compared to control. The nursery fertilizers significantly increased the mung bean shoot and root at ($P<0.01$), (*Table1*) where as root length and shoot length of okra plants were significantly increased ($P<0.05$) (*Table2*). There was a significant decrease in *Fusarium* infection. Urea showed much suppression of *Fusarium* infection ($P<0.05$) (*Table1*). Infection of *M. phaseolina* was significantly suppressed by all the combinations but especially where NPK used in combination with other fertilizers but complete suppression of *M. phaseolina* was observed in NPK with urea @ 0.01% (*Table1*). All the nursery fertilizers inhibited more than 60% infection of *R. solani*. Where as NPK showed complete suppression of *R. solani* infection (*Table1*). In okra NPK and urea showed complete suppression of *M. phaseolina* and *R. solani* infection. Similar results were observed by Irshad *et al*. (2006).

Table 1. Effect of separate and combined dosage of nursery fertilizers in the control of root rot of crop plants.

MUNG BEAN

PLANT GROWTH PARAMETERS					INFECTION %		
Treatments	Shoot length (cm)	Shoot weight (gm)	Root length (cm)	Root weight (gm)	*Fusarium* spp	*Macrophomina phaseolina*	*Rhizoctonia solani*
Control	13.83	0.796	10.76	0.12	100	66.6	44.4
Flourish@0.0%	15.49	1.126	4.21	0.12	55.53	44.4	22.2
Flourish+Frutan	13.06	0.86	4.12	0.11	55.56	22.2	22.2
Flourish+NPK	16.72	1.126	4.22	0.13	66.6	11.1	44.4
Flourish+Urea	18.58	1.09	5.40	0.14	33.3	22.2	33.3
Frutan@ 0.01%	19.96	1.42	4.57	0.1	55.56	33.3	33.3
Frutan+NPK	20.14	1.51	6.98	0.186	44.4	11.1	44.4
Frutan+Urea	20.24	1.21	4.44	0.09	66.6	44.4	11.1
NPK@0.01%	20.22	2.05	5.14	0.2	22.2	44.4	33.3
NPK+Urea	19.22	1.96	5.05	0.17	55.5	0	11.1
Urea@0.01%	18.31	1.193	4.59	0.13	11.1	11.1	11.1
LSD 0.05=	4.230	1.015	1.552	0.115	43.51	45.49	64.60

OKRA

PLANT GROWTH PARAMETERS					INFECTION %		
Treatments	Shoot length (cm)	Shoot weight (gm)	Root length (cm)	Root weight (gm)	*Fusarium* spp	*Macrophomina phaseolina*	*Rhizoctonia solani*
Control	10.05	1.33	2.98	0.1	88.6	100	66.6
Flourish@0.01%	13.14	2.34	4.31	0.18	66.6	66.6	55.53
Flourish+Frutan	14.2	1.99	4.79	0.14	66.6	33.3	55.5
Flourish+NPK	12.94	1.70	4.26	0.11	44.4	11.1	33.3
Flourish+Urea	16.6	2.11	5.19	0.15	22.4	0	11.1
Frutan@ 0.01%	14.63	2.16	3.89	0.34	55.53	11.1	22.2
Frutan+NPK	14.07	2.83	5.15	0.16	66.6	11.1	22.2
Frutan+Urea	12.43	2.09	3.32	0.14	66.6	0	22.2
NPK@0.01%	12.56	1.29	4.11	0.2	44.4	0	0
NPK+Urea	10.73	1.82	3.9	0.17	22.2	11.1	0
Urea@0.01%	15.36	1.91	4.36	0.18	11.1	0	0
LSD 0.05=	1.552	1.264	1.981	0.91	44.256	55.78	42.34

ROOT KNOT

Combined use of nursery fertilizers enhanced plant growth in both okra and mung bean plants. A significant reduction in knots/plant was observed. In mung bean there was a significant increased ($P<0.001$) in the shoot length, root length (*Table2*), shoot weight and root weight (*Table2*) and in okra plants there was a significant increase in the shoot length, shoot weight, and root length ($P<0.001$) and root weight ($P<0.05$).

Present study describes the combined efficacy of nursery fertilizers for the control of root infecting fungi viz., *Fusarium* spp, *M. phaseolina* and *R. solani* and root knot nematode (*M. javanica*) on mung bean and okra plants. Main purpose of the control of plant pathogens is to improve growth quality and yield. This can be achieved by the reduction of plant parasitic pathogens to a low and safe level to reduce economic losses. The root knot species caused severe damage to the most important vegetable crop grown under green house condition and in open fields

(Al-Saeedy, 1985: Stephan *et al*, 1988). Control of plant parasitic nematode is difficult because of the enormous variety of suitable host (Goodey *et al.*, 1965).

Table 2. Effect of separate and combined dosage of nursery fertilizers in the control of root knot of crop plants

	MUNG BEAN					OKRA				
Treatments	Shoot length (cm)	Shoot weight (gm)	Root length (cm)	Root weight (gm)	R.K.I	Shoot length (cm)	Shoot weight (gm)	Root length (cm)	Root weight (gm)	R.K.I
Control	12.8	0.5	2.24	0.09	3	10.7	2.33	3	0.16	4
Flourish@0.01%	15.27	1.66	3.33	0.21	2	15.9	2.32	4.23	0.35	3
Flourish+Frutan	15.73	1.28	3.9	0.23	2	16.36	1.69	4.63	0.27	2
Flourish+NPK	17.26	1.84	4.36	0.27	2	18.6	2.2.15	5.16	0.44	2
Flourish+Urea	17.03	1.18	4.7	0.19	1	17.36	2.35	5.1	0.33	1
Frutan@ 0.01%	16.73	1.84	4	0.25	2	14.63	1.66	4.73	0.39	3
Frutan+NPK	17.16	2.11	4.93	0.31	1	18.6	2.99	5.06	0.39	2
Frutan+Urea	15.32	1.41	4.76	0.25	1	15.66	2.23	5.86	0.4	2
NPK@0.01%	22.4	2.32	6.86	0.39	1	19.6	3.34	6.23	0.53	1
NPK+Urea	20.65	1.86	6.06	0.26	1	18.6	2.24	5.36	0.18	2
Urea@0.01%	18.66	1.63	4	0.21	0	15.5	1.36	4.33	0.32	1
LSD 0.05=	9.83	1.54	3.502	0.46	0.86	7.700	1.34	7.805	0.283	1.5

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 (Huber, 1980). Siddiqui *et al.*, (1999) also reported 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, 1995). Pal and Choudhary (1980) also found that root rot disease caused by *F. oxysporum* and *R. solani* reduced by the addition of mineral fertilizers. Present observations showed that root infecting fungi viz., *Fusarium* spp., *M. phaseolina* and *R.solani* distributed worldwide and have a collection host range that include variety of crop plants (Sasser, 1977; Ehtesham-ul-Haque and Ghaffar, 1994). Experiments for the control of root rot fungi showed that growth of *Fusarium* spp., *M. phaseolina* and *R. solani* were significantly reduced by nursery fertilizers. NPK @ 0.01% increased the plant height and weight as compared to untreated control where as urea and frutan decrease the infection of soil borne root infecting fungi. Similarly in root knot nematodes nursery fertilizers significantly decrease the formation of knots in both mung bean and okra plants.

Presence of root knot nematode *Meloidogyne* spp., is known to increase the severity of *R. solani* root rot in many plants (Shahzad and Ghaffar, 1992). Most of the plants that accounted for the majority of human and animal food supply are susceptible to one or more of the root knot (*Meloidogyne*) species (Taylor and Sasser, 1978). In addition these nematodes have the ability to interact synergistically with other plant pathogens and cause up to 5-34 % yield losses in vegetables in tropical climates (Sasser, 1989). Root knot nematode, especially *M. incognita* (Kofoid and White) Chitwood is the most abundant and damaging nematode in Pakistan infecting about 102-plant spp (Maqbool and Shahina, 2001). Results obtained showed that NPK with all other fertilizers significantly control the plant parasitic nematodes and fungi. Similarly Dawar and Ghaffar (2003) reported that urea showed the significant reduction in *M.phaseolina* infection on mung bean. Similar results was observed by Siddiqui *et al*, (1999) who found that root infection caused by *Fusarium* spp, *M. phaseolina* and *R solani* and the root knot nematode *M.javanica* significantly suppressed by the applications of urea and potash in mung bean. Similarly, farmyard manure has been reported to reduce *Fusarium* wilt of cotton by correcting potassium deficiency and providing more balance nutrition (Mc New, 1953). Root rot diseases caused by *F. oxysporum* and *R. solani* reduced by the addition of mineral fertilizers (Pal and 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 nematodes and fungi.

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