Int. J. Biol. Res., 3(2): 109-111, 2015.

EFFECT OF ORGANIC SOIL AMENDMENT ON GROWTH OF PLANTS AND IN THE CONTROL OF PATHOGENIC FUNGI IN *ABELMOSCHUS ESCULENTUS* (L.) MOENCH (OKRA).

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Abstract

Soil amendments with plant powders of *Solanum nigrum* L., followed by *Euphorbia hirta* L., and *Eucalyptus* sp., @ 1% respectively was found effective in the germination and growth of okra plants. As compared to control, 100% germination was observed in seeds sown in soil amended with plant powders. *S. nigrum*, *Eucalyptus* sp., and *E. hirta* promoted shoot length, shoot weight, root length, and root weight of okra plants. Both *E. hirta* and *Eucalyptus* sp., were found to be the most effective against *Fusarium oxysporum* Schlecht; *S. nigrum* completely controlled the colonization of roots due to *Macrophomina phaseolina* (Tassi) Goid. Soil amendment with plant powders of *S. nigrum*, *E. hirta*, and *Eucalyptus* sp., was found effective in the control of pathogenic fungi besides enhancing the of growth in okra plants.

KEYWORDS: *Fusarium oxysporum*, *Macrophomina phaseolina,* Okra, Plant powder, Soil amendment.

Introduction

Soil amendment is a method of enhancing soil performance by enriching its nitrogen, potassium, and phosphorous content through organic fertilizers. Adding plant manure or by adding plant materials to the soil, not only increase the fertility of soil, but also various chemical compounds of plants acts as a bio-control agent against plant pathogenic organisms. *Fusarium oxysporum* Schlecht. Emend. Sny. & Hans., and *Macrophomina phaseolina* (Tassi) Goid, are responsible for causing diseases in wide range of host plants. *Solanum nigrum*, *Euphorbia hirta*, and *Eucalyptus* sp., are known to have antifungal properties. Ethanolic extract of *E.hirta* leaves was found effective against *Staphylococcus aureus, Bacillus ceresus, Salmonella typhi, Klebisiella pneumonia, Pseudomonas aeuroginosa, Aspergillus niger, A. fumigatus, A. flavus* and *Rhizopus oryzae* (Rao *et al.*, 2010). Root extracts of *Solanum nigram* is an effective control agent against *Alternaria brassicicola,* causal agent of black leaf spot of cabbage (Muto *et al*., 2006). However, leaf extract of *S.nigram* has good antimicrobial properties but poor antifungal activities (Zubair *et al.,* 2011). *Eucalyptus camaldulensis* leaf oil has shown significant inhibition of *Thanatephorus cucumeris* and *Chaetomium globosum* while low inhibitory effects were observed against *F. oxysporum, Penicillium citrinum, Cladosporium cladosporioides* etc (Siramon *et al*., 2013). In the present studies, using soil amendment method, antifungal activity of these plants powders has been checked against the pathogenic fungi in okra plants; also efficacy of plant powders in the enhancement of growth of okra plants has also been analyzed.

MATERIALS AND METHODS

Soil sample obtained from the experimental plots of Department of Botany, University of Karachi were analyzed for the soil-borne mycoflora, *Fusarium oxysporum,* and sclerotia of *Macrophomina phaseolina*. Using serial dilution technique, conidial population of *F. oxysporum* and other soil-borne mycolfora were detected (Aneja, 2003); for *M. phaseolina*, number of sclerotia/gram of soil was detected using wet sieving technique (Sheikh and Ghaffar, 1975). Whole plants of *Solanum nigrum* and *Euphorbia hirta,* while branches and leaves of *Eucalyptus* sp. were collected from Karachi University campus. The plant parts were dried and ground into powder and soil was amended with plants powder @ 1 % w/w. Each pot contained 300 g of soil. After one week of amendment, five seeds infested with *F. oxysporum* @ 50 % (4.4 x 104) and *M. phaseolina* @ 0.01% (10-15 sclerotia/seed) respectively were sown in each pot, using 2% gum Arabic as sticking agent. Artificially infested seeds of okra were allowed to grow for thirty days in soil amended with plant powders. The experiment was performed in replicates of three. Non-infested seeds served as control. Three plants per pot (8.1 cm diameter) were allowed to grow. After thirty days, the plants were up-rooted; Shoot length, shoot weight, root length, and root weight were recorded. Root pieces (1cm) were placed on PDA to check for colonization of roots due to plant pathogenic fungi.

Data was analyzed, using one way ANOVA (Zar, 2009). Colonization percentage was determined by using the following formula:

$$\text{Colonization (\%)} = \frac{\text{Number of root pieces infected with test fungus}}{\text{Total number of root pieces}} \times 100$$

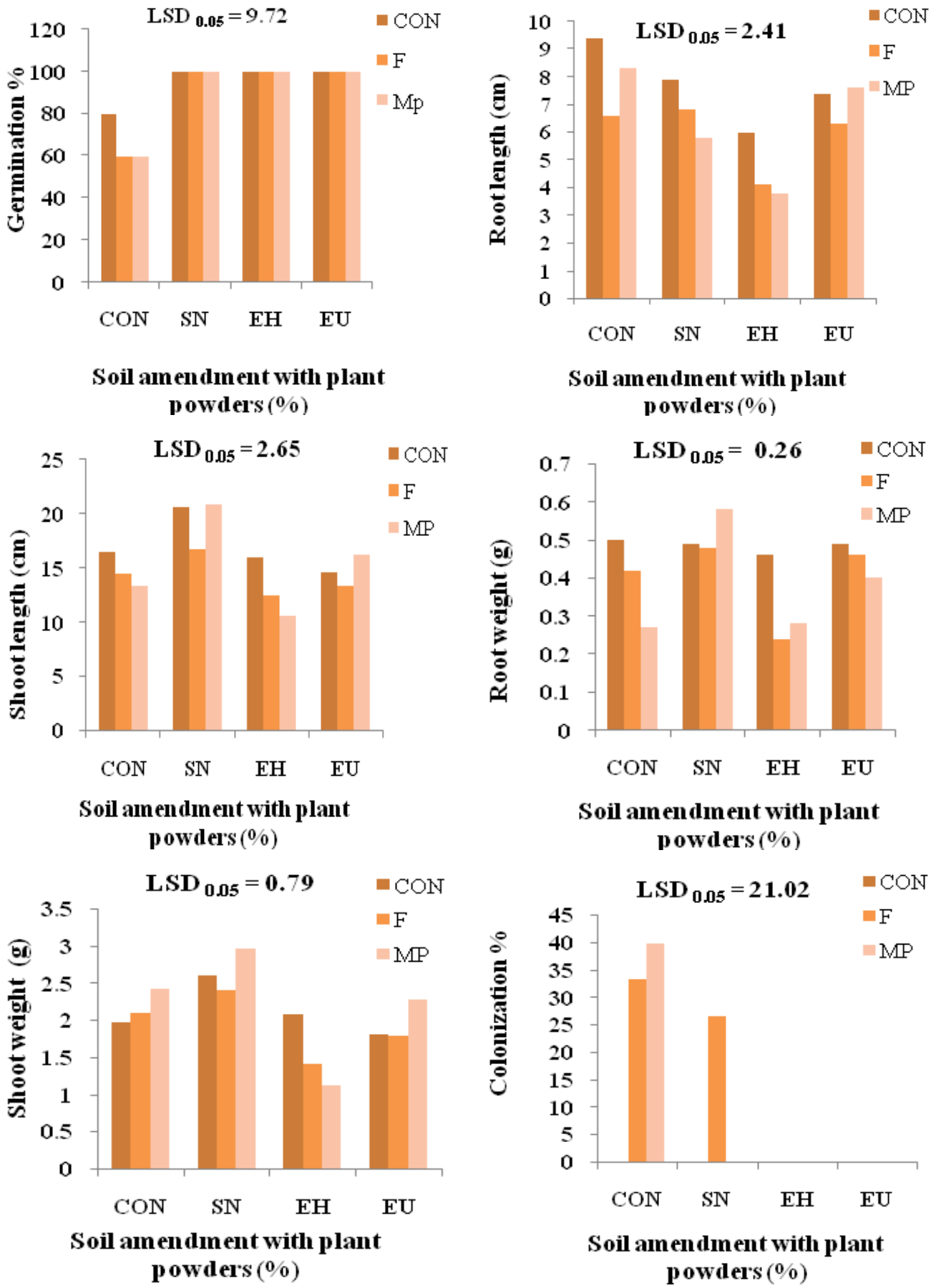

Fig 1. Effect of soil amendments on growth of plants and control of pathogenic fungi artificially infested in okra seeds.
Con = control/non-amended soil; F = *Fusarium oxysporum*; Mp = *Macrophomina phaseolina*; SN = *Solanum nigrum*; EH = *Euphorbia hirta*; EU = *Eucalyptus* sp.

Results

Soil used for pot experiment was analyzed. Using serial dilution technique, soil borne mycoflora was assessed. Species of *Acremonium*, *Alternaria*, *Aspergillus*, *Drechslera*, *Fusarium*, *Macrophomina*, *Penicillium*, *Rhizopus*, and *Trichoderma* etc., were isolated from the soil sample.

Soil amendment with plant powders greatly enhanced the germination, shoot length, shoot weight, root length, and root weight of okra plants as compared to control (untreated seeds). 100% germination was observed for seeds sown in soil amended with plant powders ($p<0.001$) as compared to seeds sown in non-amended soil (control). Soil amendment with *S. nigrum* and *Eucalyptus* sp., was found very much effective in promoting plant growth followed by *E. hirta*. Highest colonization of roots was observed in plants growing in non-amended soil, soil amendment has greatly controlled the colonization of roots ($p<0.01$). Soil amendment with plant powders of *E. hirta* and *Eucalyptus* sp., has completely controlled the colonization of roots due to pathogenic fungi. Soil amendment with *S. nigrum* completely controlled the colonization of roots due to *M. phaseolina* while it has greatly reduced the colonization of roots due to *F. oxysporum* (Fig. 1).

Discussion

Soil mixed with plant powders of *S. nigrum*, *E. hirta* and *Eucalyptus* sp., has greatly enhanced the plant growth parameters like shoot length, shoot weight, root length, and root weight of okra. Soil amendment suppresses the growth of pathogens because of its components or indirectly by enhancing the microbial activity (Sun and Huang, 1985). Colonization percentage due to pathogenic fungi was reduced in soil amended with *S. nigrum* followed by *E. hirta* and *Eucalyptus* sp. Efficacy of these plant powders have also been reported previously. Radwan *et al*. (2012) reported seed powder of *S. nigrum* to be effective in the control of nematodes. Also the tomato plants growing in soil amended with seed powder of *S. nigrum* had more shoot length as compared to control. Dawar *et al*. (2007) reported soil amendment with the leaves, stem, bark, and fruit of *Eucalyptus* sp., effective in the control of *Rhizoctonia solani*, *Fusarium* sp., and *M. phaseolina* in mung bean and chick pea.

Conclusion

The present study was found effective; it not only improved the overall growth of plants but also prevented the colonization of roots by pathogenic fungi. Soil amendment with plant powders is a low cost eco-friendly method of increasing soil fertility and can work as a pesticide against various micro biota.

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(Received July 2015; Accepted August 2015)