MANAGEMENT OF ROOT ROT FUNGI BY USING SEED PRIMING AND SEED PELLETING METHODS

Naheed Ikram and Shahnaz Dawar

Department of Botany, University of Karachi, Karachi-75270, Pakistan.
shahnaz_dawar@yahoo.com

ABSTRACT

In the present study we investigated the effectiveness of seed priming and seed pelleting with *Prosopis juliflora* (Sw) Dc. parts on plant growth and suppression of root rot fungi, *Fusarium* spp., *Rhizoctonia solani* and *Macrophomina phaseolina* infestation under field condition. Seed pelleting with *P. juliflora* leaves powder showed significant ($P<0.001$) increase in both growth parameter and plants yield. Whereas seed priming resulted in complete suppression of root rot fungi *R. solani* and *M. phaseolina.* Our study suggests that seed pelleting is the best strategy over seed priming because it protects seeds from soil borne pathogens.

Key words: Seed priming, seed pelleting, root rot fungi, plant growth, *Prosopis juliflora*.

INTRODUCTION

Seed pelleting is a physiological strategy which improves seed performance and provides faster germination of seeds. It is a physical alteration of seed which improves the water absorption capacity of seed (Suma, 2005). Some of the common benefits of seed pelleting are uniformity in seed size, disease resistance, better performance under stress conditions and provision of additional nourishment to the seedlings (Peterhalmer, 2003). In additional seed pelleting is also employed to add substance to the individual seed so that the seeds get invigorative effect on absorption of such materials, at initial watering by enriching the rhizosphere region of each individual. Seed as nutritive not by physiological modification of seed but by simple physical alterations of the seed (Suma, 2005). Whereas seed priming speedup seed germination as well as establishment of the seedlings. Seed pelleting with plant parts increases the seed quality, improves seedling value and reduces the cost of transplanting (Govinden and Levantard, 2008).

Plant extracts are good source for seed and foliar treatments against pathogens (Babu *et al*., 2008). For instance, Deepa *et al.* (2013) have found a significant greater antifungal activity of *P. juliflora* alkaloidsas compared to chemical fungicides. Recently, antifungal potential of *P. juliflora* against phytopathogens and its biological activity has gained importance in agriculture farming. Aqueous extract of the plant helped in the preliminary program of the antifungal activity (Javaraska, 1978). Moreover, aqueous extracts of *P. juliflora* leaves alone or in combination with synthetic fungicides have shown great potential in suppressing fungal populations (Toteja *et al*., 2003).

Prosopis juliflora leaves are rich source of nitrogen and thus it is used as green fertilizer. Many alkaloids such as juliflorine, julifloricine and julifloridine that have been isolated from leaves have shown strong antibacterial and antifungal activities (Aqeel *et al*., 1989; Ahmad *et al*., 1978). Aqueous extract of the *P. juliflora* leaves have also been used to control many pathogenic fungi (Toteja *et al*., 2003).

Plant diseases caused by microorganisms negatively affect the crop productivity. It is interesting that most disease-causing microorganisms are the soil borne pathogens including *Macrophomina phaseolina*, *Rhizoctonia solani* and *Fusarium* spp. These microorganisms attack on roots, which may limit nutrition uptake and may also cause root rot diseases leading to the death of affected plants. The genus *Fusarium* contains a number of species which have been recognized as important plant pathogens (Booth, 1971; Nelson *et al*., 1983). While *Rhizoctonia solani* a root rot fungus causes yield losses in many crops (Garett, 1970). *Macrophomina phaseolina* a charcoal rot fungus attacks on roots and basal stems (Sackston, 1981).

In present study we tested the efficacy of seed priming and seed pelleting with *Prosopis juliflora* on growth and in the control of root rot fungi under field condition.

MATERIALS AND METHODS

SEED PELLETING

Cowpea and mungbean seeds were pelleted with equal mixed ratio (50:50 ≈ 0.5mg) of pyrophyllite powder along with stem and leave powder of *P. juliflora* respectively, were coated with 2% gum arabic solution and left it

for 4-5 hours in the laminar flow hood for dryness, while the seeds pelleted with only pyrophyllite and gum arabic solution regarded as control.

SEED PRIMING

Seeds after surface sterlization with 1% calcium hypochlorite, were treated with 50% v/w aqueous extract of *P. juliflora* (stem and leaves) respectively, for 10-15 mins and dried under the laminar flow hood aseptically. Seeds primed with sterlized distilled water were taken as control.

FIELD EXPERIMENTS

Field experiments were performed in small plots at the Department of Botany, University of Karachi. Both seed pelleting and seed priming, were applied in field experiments. Pelleted and primed seeds were planted in each plot and data were collected on the growth and colonization of root rot fungi.

ISOLATION OF FUNGI FROM ROOTS

The roots of treated and non-treated plants after washing in running tap water (to remove adhering soil) were dried using blotting paper. Then five small segments (1 cm long) were randomly cut from roots of each treatment plants and were surface sterilized with calcium hypochlorite (1%) for 3 minutes. These root segments that were obtained from each plant were placed onto petri plates containing Potato Dextrose Agar (PDA) and antibiotics (Penicillin and Streptomycin). All plates were incubated at 30 ± 2^{o}C for one-week, emerging fungi from each root segment were identified and the % colonization was determined.

DATA ANALYSIS:

Data were analyzed using analysis of variance (ANOVA) and by the least significant (LSD) test at P=0.05, according to Gomez and Gomez (1984).

RESULTS

Prosopis juliflora leaves and stem extracts positively affect the cowpea and mungbean plant growth. We found a significant (P<0.001) increase in shoot and root length, leaf area and the number of nodules after 3 months till the yield of plants were observed (Fig.1) in both cowpea and mungbean plants when their seeds were pelleted with *P. juliflora* leaves or stem before planting. However, the maximum weight of both shoots and roots were observed when seeds were primed with *P. juliflora* leaves powder (Fig.1). We also found a higher yield in both cowpea and mungbean plants when their seeds were primed with *P. juliflora* leaves extracts than primed with *P. juliflora* stem extracts.

Complete colony suppression of *M. phaseolina* and *R. solani* was observed when cowpea or mungbean seeds were pelleted and primed with *P. juliflora* plant parts powder before planting over untreated seeds. However, the effects of plant powder were little lower but still showed a significant reduction (P<0.001) on percent colonization of *Fusarium* spp. when plant seeds were pelleted with *P. juliflora* leaves powder (Fig. 3).

DISCUSSION

Seed pelleting is a seed coating with any plant parts improves the water absorption and disease resistance capacity of seed. Seed pelleting with *P. juliflora* leaves powder increases the growth parameters as well as germination percentage of both cowpea and mung beans plants. In their 2002 study, Maraddi noted a high germination rate in cowpea plants after seeds were treated with neem leaves powder (5 /kg) before planting. Similar results were obtained by Khatun *et al*., (2011) in lentil seeds. In their experiment lentil seeds were treated with neem leaves powder and stored at room temperature which improved the seed quality and improved seeds germination capacity, and also increased their shoot and root lengths. Pal and Basu (1995) reported that wheat seeds after treatment with neem leaves powder at 2 g/ kg resulted maximum germination and seedling vigour after 7 months of storage. Srimathi *et al*., (2013) observed a positive effect of seed pelleting techniques. According to Srimanthi and collegues Jatropha seeds pelleted with *Azadirachta indica* leaves powder yielded 92% higher germination than

control after 9 months of storage. Ogunwolu and Odunlani (1996) showed reduced orchid infestation after cowpea seeds treated with neem leaves powder (3 g/kg), stored for five months before plantation.

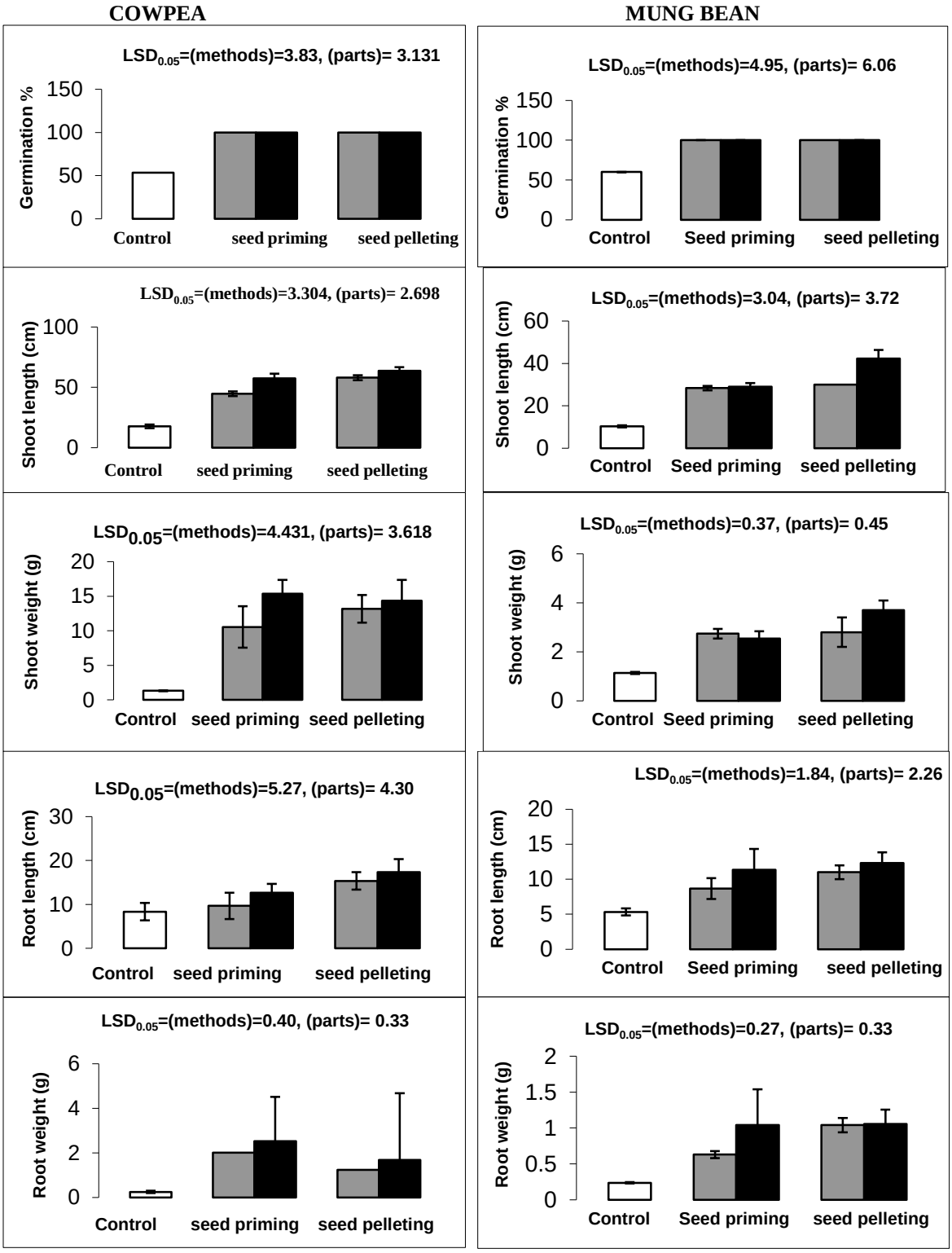

Fig.1. Effect of seed priming and seed pelleting with *P. juliflora* on the growth parameters of cowpea and mung bean. Control, ☐ *P. juliflora* stem, ▒ *P. juliflora* leaves. ■

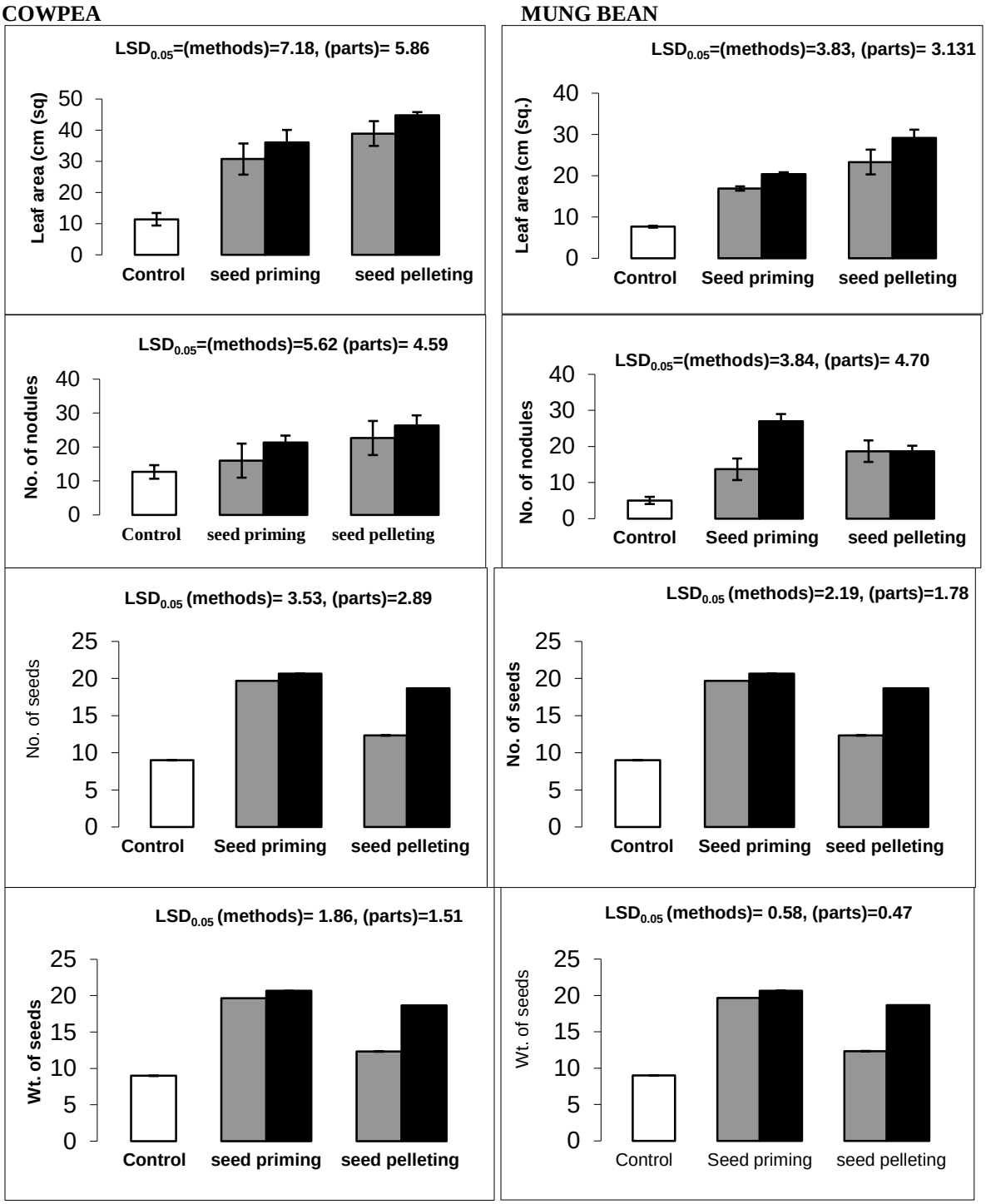

Fig. 2. Effect of seed priming and seed pelleting with *P. juliflora* on the growth parameters of cowpea and mung bean. Control, ☐ *P. juliflora* stem, ▒ *P. juliflora* leaves. ■

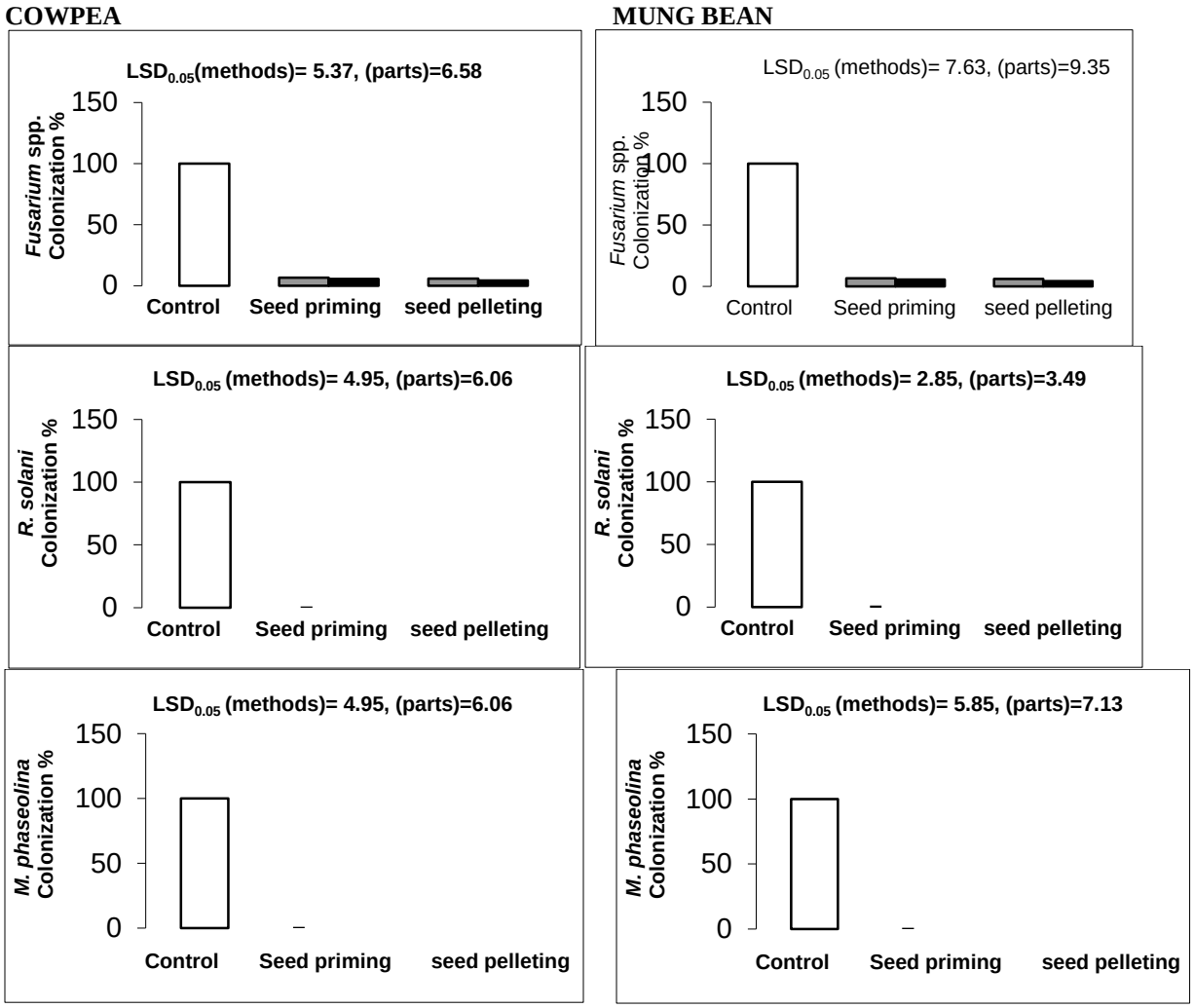

Fig. 3. Effect of seed priming and seed pelleting with *P. juliflora* parts in the control of root rot fungi of cowpea and mung bean. Control □ *P. juliflora* stem, ▒ *P. juliflora* leaves ■

We observed better yields in both mung beans and cowpea plants after their seeds were primed with aqueous extracts of *P. juliflora* leaves before their plantation. In our previous study, we have shown that a significant suppression of root rot fungi colonization and an increase in plant growth parameters when soil was drenched with *P. juliflora* leaves extract @50% (Ikram and Dawar, 2014). Just recently, Hanif and Dawar (2015) noted that *Arnica montana* and Thuja *occidentalis* (75 and 50% v/v) drenched in soil reduced the colonization percentage of root rot fungi in leguminous and non-leguminous plants. In field condition ginger and garlic extracts protected pea plants from powdery mildew pathogen (Singh *et al.*, 1990). Chandrashekhara *et al*. (2010) found that seed priming with *Viscum album* extracts was significant under both greenhouse and field conditions, *V. album* was more effective in enhancing the seed quality parameters and also in inducing resistance against downy mildew disease in *Pennisetum glaucum*.

REFERENCES

Ahmad, V.U., A. Basha and W. Haque (1978). New alkaloids from *Prosopis juliflora*.*Natur forsch*., 33: 347–348.

Aqeel, A., A.K. Khursheed, A. Viquaruddin and Q. Sabiha (1989). Antibacterial activity of julifloricine isolated from *Prosopis juliflora*. *Arzneim Frosch /Drug Res*., 39(6): 652-655.

Babu, J., D.A. Muzafar and K. Vinod (2008). Bioefficacy of plant extracts to control *Fusarium solani* F. Sp. *Melongenae* of Brinjal wilt. *Global J. of Biotech. and Biochem*., 3(2): 56-59.

Booth, C. (1971). *The genus Fusarium*. Kew, Surrey, England: Commonwealth Mycological Institute 237 pp.

Chandrashekhara, S. Niranjan Raj , G. Manjunath , S. Deepak and H. S. Shetty (2010). Seed treatment with aqueous extract of *Viscum album* induces resistance to pearl millet downy mildew pathogen. *J. of Plant Interaction*, 5(4): 283-291

Deepa, N., S. Nayaka, K. Girish and M.P. Raghavendra (2013). Synergistic effect of Prosopis juliflora extract and chemical fungicides against seed borne toxigenic fungi. *Inter. J. of Advanced Life Sci*., 6 (4): 312-316.

Garett, S. G. (1970). *Pathogenic root infecting fungi*, Cambridge University press. 48: 23-46.

Gomez, K. A. and A. A. Gomez (1984). *Statistical procedures for Agricultural Research*. An international rice research institute book. John Wiley & Sons.

Govinden, J. and M. Levantard (2008). Comparative studies of seed priming and pelleting on percentage and meantime to germination of seeds of tomato (*Lycopersicon esculentum* Mill.). *African Journal of Agricultural Research*, 3 (10): 725-731.

Hanif A. and S. Dawar (2015). Fungicidal effects of homeopathic drugs in the control of root rot fungi and growth of leguminous and non-leguminous crops. *Int. J. Biol. Biotech*., 12 (1): 97-105.

Ikram, N. and S. Dawar (2014). Application of *Prosopis juliflora* (Sw.) DC. extracts in the management of root infecting fungi of cowpea and mungbean. *Int. J. Biol. Biotech.*, 11(4): 581-587.

Javaraska, T. (1978). Effect of combined herbicides on the occurrence of morphoses in spikes of spring barley. *Agrochemica*, 18: 37-42.

Khatun, A., G. Kabir, M.A.H. Bhuiyan and D. Khanam (2011). Effect of preserved seeds using different botanicals on seed quality of lentil. *Bangladesh J. Agric. Res*., 36(3): 381-387.

Maraddi, B. (2002). *Influence of growth regulators on seed yield and quality and seed treatments on storabilityof cowpea cv. C-252*. M.Sc. (Agri.) Thesis. University of Agricultural Sciences. Dharwad.

Nelson, P.E., Toussoun and T.A., Marasas (1983). *Fusarium species: An illustrated manual for identification*. Pennsylvania State University Press, Pennsylvania, USA.

Ogunwolu, EO and A.T. Odunlani (1996). Suppression of seed bruchid (*Callosobruchus aculates*) development and damage on cowpea (*Vigna ungiculata*) with *Zantoxylemz antoxyloider* L. (Rutaceae) root bark powder when compared to neem seed powder and primiphos methyl. *Crop Protect*., 15: 603-607.

Pal, P. and R.N. Basu (1995). Effect of powdered chilli, turmeric and neem leaf on pre and post storage germinability of wheat seed. *Indian Agric*., 57(4): 267-271.

Peterhalmer , (2003). Enhancing seed performance for better yield and quality. *Asian Seed Planting Mater*. 10(2): 4-6.

Sackston, W.E. (1981). The sunflower crop and disease progress problems and prospects. *Plant Disease*, 65: 643-648.

Singh, U.P., V.N. Pandey, K.G. Wagner, and K.P. Singh (1990). Antifungal activity of ajone, a constituent of garlic (*Allium sativum*). *Can J Bot.*, 68: 1354–1356.

Srimathi, N. Mariappan, L. Sundaramoorthy and M. Paramathma (2013). Effect of organic seed pelleting on seed storability and quality seedling production in biofuel tree species *Journal of Horticulture and Forestry*, 5(5): 68-73.

Suma, N. (2005). Studies *of seed quality enhancement techniques in sesamum (Sesamum indicum*. L) cv. Co 1 in sesamum. M.Sc. Thesis. Tamil Nadu Agricultural University, Coimbatore.

Toteja, G.S., A. Mukherjee, S. Diwarkar, P. Singh and B.N. Saxena (2003). Residues of DDT and HCH pesticides in rice samples from different geographical regions of India; a multi centre study. *Food Additives and Contaminants*, 20: 933-939.

(*Accepted for publication March 2017*)