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COMPARATIVE METHODS OF APPLICATION OF WILD PLANT PARTS ON GROWTH AND IN THE CONTROL OF ROOT ROT FUNGI OF LEGUMINOUS CROPS

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Abstract

Present research work was carried out for the management of root rot fungi with wild plant part capsules and pellets formulation in soil. When application of pellets and capsules was carried out with *Prosopis juliflora* stem, leaves and flowers showed significant reduction in disease incidence and enhancement in growth and physiological parameters. Colonization of *Fusarium* spp., *Macrophomina phaseolina* and *Rhizoctonia solani* was completely suppressed when *P. juliflora* leaves pellets incorporated in soil. Physiological parameters such as chlorophyll a and b and protein were significantly increased when leaves pellets incorporated in soil @ 1% w/w so *P. juliflora* leaves pellets were most effective in the control of root rot fungi and enhanced the growth of crop plants.

Key words: Methods of application, Leguminous crops, Root rot fungi, Plant powder.

Introduction

Prosopis juliflora (Sw.) DC., large shrub or small tree inhabitant to Mexico, South America and the Caribbean. *Prosopis* (Sw.) DC., usually established in xerophytic conditions of America, Africa and Asia as a wild and stromg tree with amazing variation capacity (Nadkarni & Nadkarni, 1976). Leaves are rich in plant nutrients especially nitrogen 5.6, Phosphorus 0.9, Potassium 3.11 and calcium 1.0%. Ectoposide phosphate, teniposide, taxanes (paclitaxel & docetaxel) and the camptothecin derivatives (irinotecan & topotecan) are also present in leaves so they used as green fertilizer (Conforti *et al*., 2008; Dholwani *et al*., 2008; Bhuvan *et al*., 2009). Recently, julifloravizole a new alkaloid reported from leaves of *P. juliflora* Raghavendra (2007). Pharmacological properties *In vitro* conditions shows that it has antibacterial (Shankarmurthy & Siddiqui, 1948; Aqeel *et al*., 1989), antifungal, hemolytic (Ahmad *et al*., 1989; Kanthasamy *et al*., 1989a,b) and anti-inflammatory actions (Daetwyler *et al*., 1981; Batatinha, 1997).

Several crop plants are infected by soil borne fungal pathogens such as *Fusarium* spp., *Rhizoctonia solani*, and *Sclerotium rolfsii* which cause serious diseases like root rot, wilt and finally reduced crop yield (Saad, 2006; Abdel-Monaim, 2010). Charcoal rot caused by *Macrophomina phaseolina* (Tassi) Goid and *Fusarium* wilt caused by *Fusarium* spp. are the most important diseases of crop plants which adversely affect the agriculture economy of country. Root rot caused by *Fusarium* spp. is one of the most destructive soil borne disease of economically important crop plants throughout the world (Seifert *et al.*, 2004). Dawar *et al*. (2014) reported 16 genera of fungi from soil of Karachi University campus among which root rot fungi such as *Macrophomina phaseolina*, *Fusarium oxysporum* and *F.solani* were detected.

Rafi & Dawar (2015) observed that capsules and pellets of *Acacia nilotica* and *Sapindus mukorossi* leaves showed enhancement in growth parameters and suppressed the infection of root rot fungi in leguminous and non leguminous plants. Pyrophyllite is ingredient of pellets and most frequently used in formation of pellets because of it amorphous nature. Pyrophyllite composed of aluminum silicate hydroxide $Al_2Si_4O_{10}(OH)_2$. It give extreme softness and greasiness to substance so it can be used as lubricant (Vitra, 2000). It is a hydrous aluminum silicate composed of three infinite layers formed by the sharing of oxygen ions at three corners of the silica tetrahedra (Hu *et al.*, 2003). It is widely used in tablets, pills and capsules because of it physiological inert and inexpensive nature (Jadhav *et al.*, 2011). In industries when it combined with other compounds used as insecticide and as a pressure transmitting medium (Fang *et al*., 2007). Present work was carried out to investigate the fungicidal activity of *P. juliflora* parts in the form of capsules and pellets in pots on the growth and in the control of root rot fungi.

Materials and Methods

Collection of wild plant: *Prosopis juliflora* (Swartz) DC. parts such as stem, leaves and flower were collected from University of Karachi campus. All parts washed with distilled water to remove dust particles and dried under shade. The plant parts materials were ground by using an electric grinder and stored at room temperature in a sealed bottle for further studies.

Preparation of capsules and pellets of wild plant parts: Stem, leaves and flower pellets of *P. juliflora* powder were prepared by using the pyrophyllite. Equal amount of *P. juliflora* parts powder were mixed with pyrophyllite in a ratio of 50:50. Sterilized distilled water used in pellets preparation. Pellets were prepared with the help of multiple pellets sampler. Equal size and weight (0.5 g) of *P. juliflora* each part powder pellets were prepared. All pellets were air dried in laminar air flow hood (Tariq & Dawar, 2011).

Empty capsule shells were filled with stem, leaves and flowers powder of *P. juliflora* @ 500 mg powder/ capsule separately and kept in room temperature till further use (Tariq & Dawar, 2013).

Experimental setup: Sandy loam soil (sand, silt, clay, 75, 14 and 11%) was obtained from experimental plot of Department of Botany, University of Karachi. The soil containing 50% moisture holding capacity with 7.5-9.2 pH (Keen & Raczkowski, 1922), total nitrogen 0.071-0.094% (Mackenzie & Wallace,1954). 2000 cfu g-1 *Fusarium* spp., as assessed by soil dilution technique (Nash & Synder, 1962), 6-19% of *R. solani* assessed by baiting technique (Wilhelm, 1955), with the help of wet sieving technique 3-7 sclerotia of *M. phaseolina* g-1 was isolated (Sheikh & Ghaffar, 1975). Capsules were added in soil @ 6 capsules per pot (1% w/w). Pellets of plants parts powder were mixed in soil @ 6 pellets per pot (1% w/w) and left them to decompose in soil. Five seeds were sown in each pot. After 30 days of seeds germination growth parameters were observed and colonization percentage of root rot fungi was detected.

Chlorophyll and protein estimation: Fresh leaf sample (0.3 g) was crushed in 80% cold acetone (5ml) and centrifuged at 4000 rpm for 10 minutes. Optical density was recorded at 645 and 663 nm for chlorophyll (Maclachlan & Zalik, 1963). Bradford assay was used to determine the soluble protein contents (Bradford, 1976).

Statistical analysis: Data were subjected to analysis of variance (ANOVA) followed by the least significant difference (LSD) test at P = 0.05 and Duncan's multiple range test to compare treatment means, using statistica software according to Sokal & Rohlf (1995).

Results

There was improvement ($p<0.001$) in germination percentage of cowpea plants when *P. juliflora* capsules and pellets were added in soil. Shoot and roots length as well as fresh weight, leaf area and number of nodules were significantly ($p<0.001$) enhanced when *P. juliflora* leaves pellets were mixed in soil. Root weight of plants were significantly ($p<0.001$) increased when capsules of *P. juliflora* leaves mixed in pots containing soil. Physiological parameters such as protein and chlorophylls of plants were enhanced ($p<0.001$) when pellets of *P. juliflora* leaves were added in pots containing soil (Fig. 2). Colonization percentage of *Fusarium* spp. *Rhizoctonia solani* and *Macrophomina phaseolina* were totally controlled when *P. juliflora* leaves pellets and capsules were mixed in soil (Fig. 3).

Mung bean plants showed 100% germination when plant parts capsules and pellets were added in soil. *P. juliflora* leaves pellets showed enhancement ($p<0.001$) in length of plants where as shoot and root weight and number of nodules were significantly ($p<0.001$) increased when *P. juliflora* leaves pellets mixed in soil (Fig. 1). There was enhancement ($p<0.001$) in leaf area of plants when *P. juliflora* leaves capsules were added in soil. Chlorophyll a and b of plants were significantly ($p<0.001$) increased when capsules of *P. juliflora* leaves mixed in pots. *P. juliflora* leaves pellets showed enhancement in protein of plants ($p<0.001$) (Fig. 2). Colonization percentage of *Fusarium* spp., *R. solani* and *M. phaseolina* were totally controlled when capsules and pellets of *P. juliflora* stem and leaves were mixed in soil (Fig. 3).

Discussion

In our studies leaves pellets of *P. juliflora* showed significant reduction in the control of root rot fungi and enhanced growth parameters such as length of shoot and root, fresh weight of root and shoot, leaf area and number of nodules. Similar results were reported by Tariq & Dawar (2011) that mangrove (*Avicennia marina*) parts pellets inoculation in soil enhanced *Vigna unguiculata* and *Solanum melongena* growth parameters and significantly suppressed *R. solani*, *M. phaseolina* and *F. oxysporum* infection on roots. Ibrahim *et al*. (2013) reported that Juliprosine and Isojuliprosine isolated from *P. juliflora* leaves has antifungal property. Aqueous extract of *P. juliflora* leaves showed significant results in the control of root rot fungi and improvement in growth parameters of crop plants (Ikram & Dawar 2014).

Noticeable improvement in growth parameters was observed when leaves pellets inoculated in soil as compared to pnematophore and stem (Tariq & Dawar 2011). Rafi *et al*. (2015) reported that *Acacia nilotica* and *Sapindus mukorossi* extracts used as seed priming significantly increase the growth parameters and reduced the root rot fungi of leguminous and non leguminous crops. In mung bean and chickpea colonization percentage of root rot fungi was suppressed when sodium alginate pellets were used (Ghaffar 1995).Walker & Connik (1983) were first to use alginate pellets for production and formulation of mycoherbicides. Kandula *et al*. (2006) reported that *Trichoderma* pellets and powder formulation in soil reduced the incidence of apple replant disease.

Pellets and powder filled capsules play major role in controlling root infecting fungi which was major target. It was reported that *P. juliflora* plant contain variety of chemicals which are released in soil. Alkaloid rich fractions of *P. juliflora* are antifungal and antibacterial (Aqeel *et al.*, 1989). Ikram & Dawar (2013) observed that *P. juliflora* leaves powder @ 1% significantly enhanced the growth parameters of crop plants. Abusuwar & Eldin (2013) observed that seed pelleting with farmyard manure resulted in higher plant density, higher numbers of leaves and higher productivity compared to seed pelleted with clay. Pelleted seeds were found to improve biological control capacity (Choong *et al*., 2006) and increase the percentage and speed of germination (Podlaski & Wyszkowska, 2003). Many different compounds have been used as binders, including various starches, sugars, gum Arabic, clay, cellulose, vinyl polymers (Skerman & Gentry, 1988) and even water (Burgesser, 1949).

Present results suggested that leaves pellets of *P. juliflora* were found better in the improvement of growth of cowpea and mung bean while root infecting fungi was significantly reduced by the use of leaves pellets and capsule.

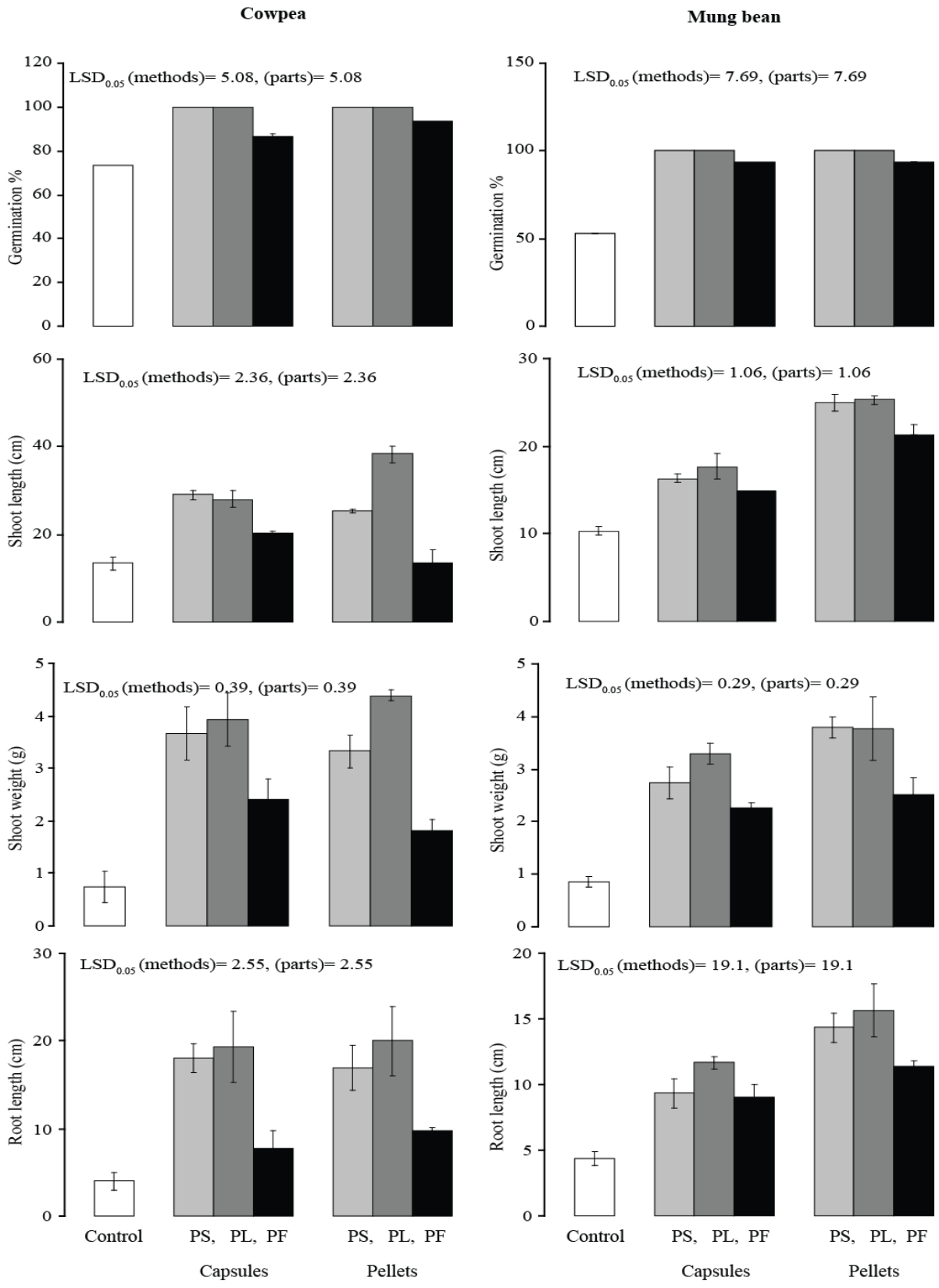
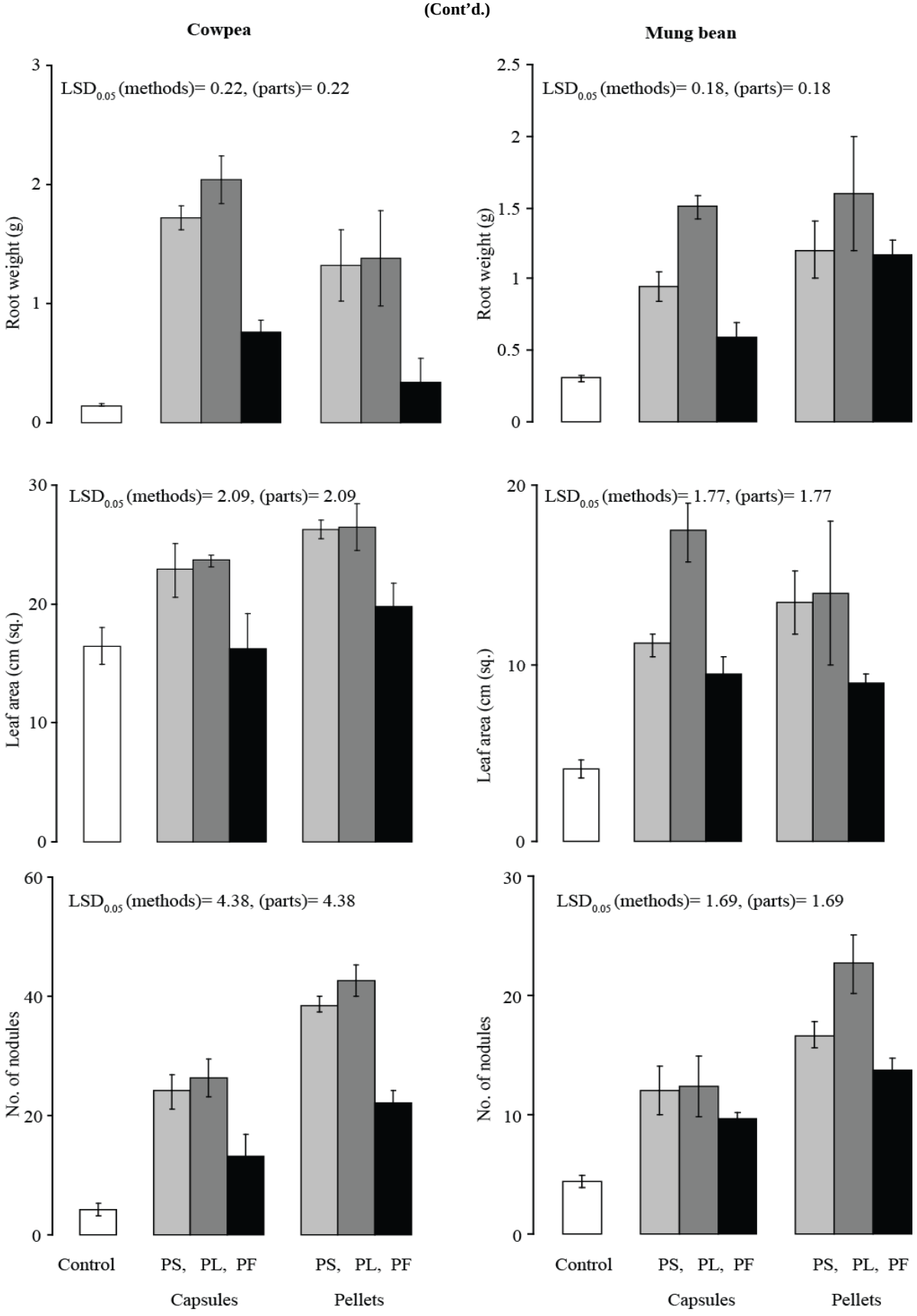


Fig. 1. Effect of *P. juliflora* capsules and pellets on growth parameters of cowpea and mung bean plants.
PS= *P. juliflora* stem, PL= *P. juliflora* leaves, PF= *P. juliflora* flower.

Fig. 1.
(Cont'd.)


Cowpea
Mung bean
Root weight (g)
LSD0.05 (methods)= 0.22, (parts)= 0.22
LSD0.05 (methods)= 0.18, (parts)= 0.18
Leaf area (cm (sq.)
LSD0.05 (methods)= 2.09, (parts)= 2.09
LSD0.05 (methods)= 1.77, (parts)= 1.77
No. of nodules
LSD0.05 (methods)= 4.38, (parts)= 4.38
LSD0.05 (methods)= 1.69, (parts)= 1.69
Control
PS, PL, PF
PS, PL, PF
Capsules
Pellets

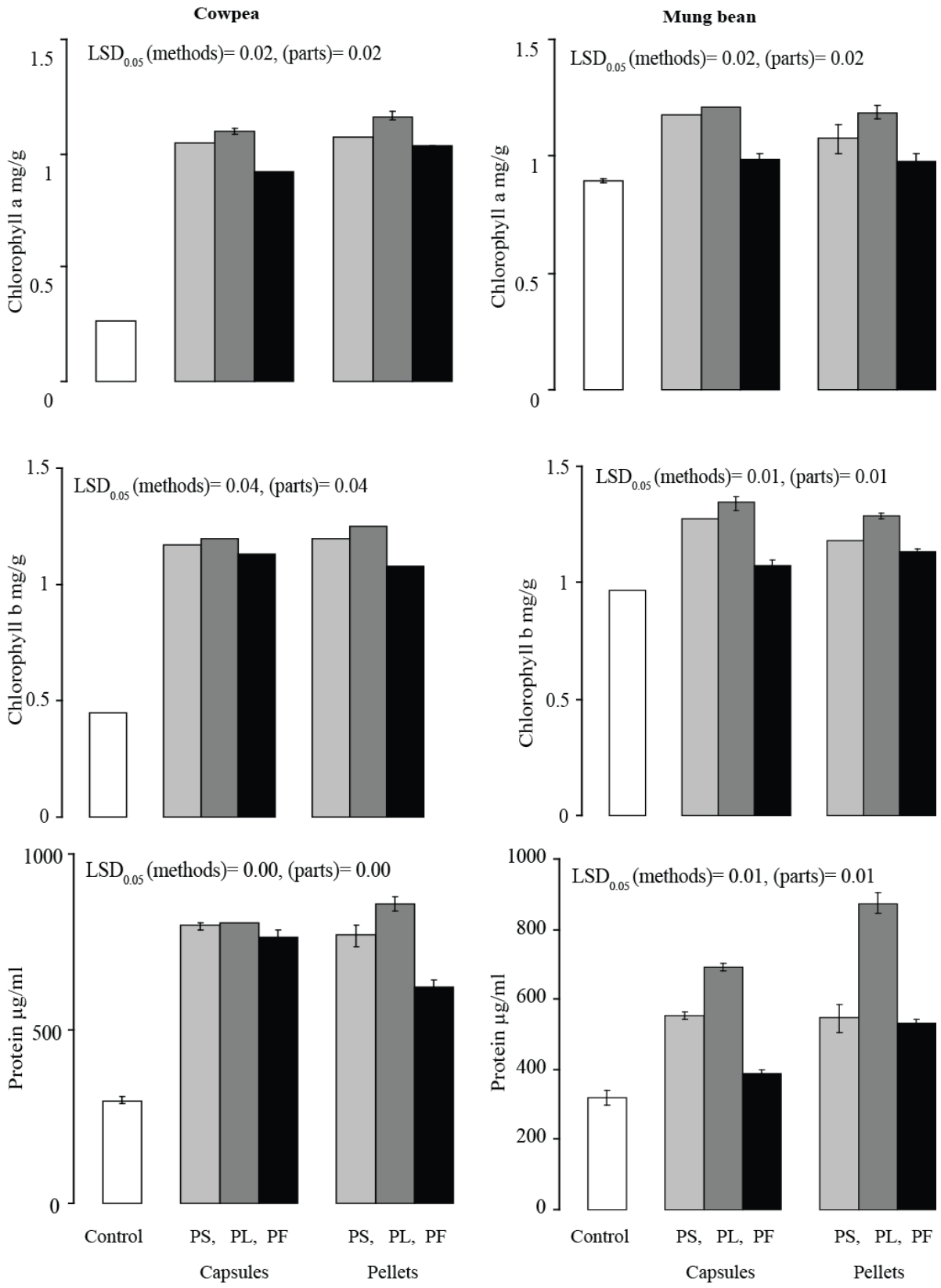


Fig. 2. Effect of *P. juliflora* capsules and pellets on physiological parameters of cowpea and mung bean plants.

PS= *P. juliflora* stem, PL= *P. juliflora* leaves, PF= *P. juliflora* flower.

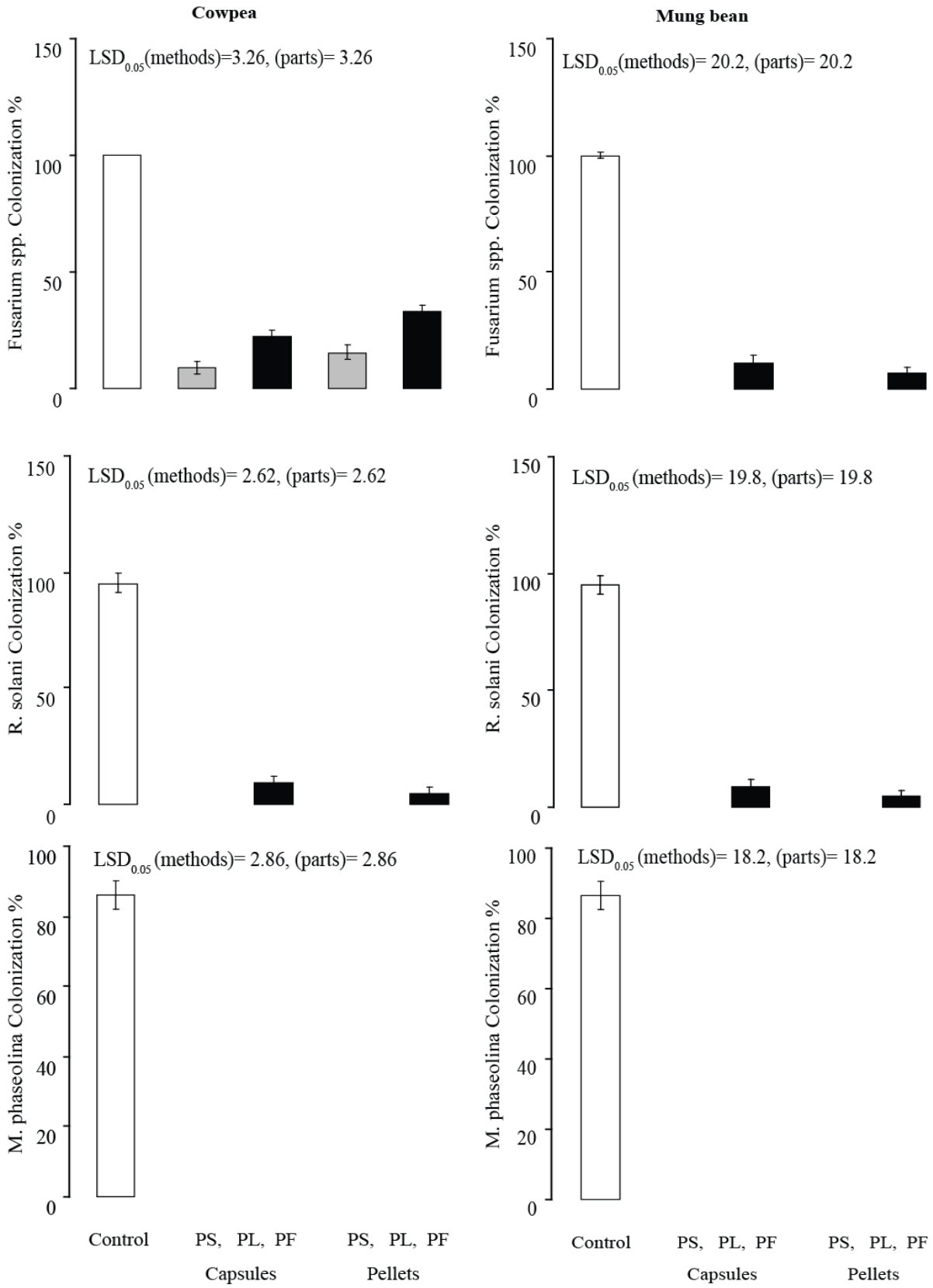


Fig. 3. Effect of *P. juliflora* capsules and pellets in the control of root rot fungi of cowpea and mung bean plants.
PS= *P. juliflora* stem, PL= *P. juliflora* leaves, PF= *P. juliflora* flower.

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