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USE OF HOMEOPATHIC DRUGS IN COMBINATION WITH FERTILIZERS FOR THE CONTROL OF ROOT ROT FUNGI

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Abstract

This study was conducted to evaluate the fungicidal effectiveness of homeopathic drugs in combination with fertilizers on the growth production and controlling of root rot fungi. Seeds treated with homeopathic drugs in addition of phosphorous and nitrogen fertilizers as soil amendment showed significant inhibitory effect on fungal growth as well as improved the plant growth. Remarkable control of root infecting fungi was shown by the seeds treated with *Thuja occidentalis* and *Arnica montana* @ 75% v/v concentration and soil amended with urea @ 0.1% w/w but greater increased in plant growth was observed by urea @ 0.01% in the tested plants viz., mung bean, mash bean, sunflower and okra. Whereas, when *A. montana* and *T. occidentalis* @ 75% v/v concentration along with the addition of DAP @ 0.01 and 0.1% w/w respectively showed maximum suppression of *Fusarium* spp, *R. solani* and *M. phaseolina* and enhanced the plant height and weight followed by *A. montana* and *T. occidentalis* @ 50% v/v concentration respectively showed a maximum control of root rot fungi and also strengthened the crop plant for better growth.

Key words: *Arnica montana, Thuja occidentalis*, Fertilizers, Root rot fungi.

Introduction

Crop damage due to insects, bacteria, fungi and viruses leads to enormous economic losses (Kotan *et al*., 2008; Kordali *et al*., 2008). *Fusarium* spp. are considered as an important plant pathogen known to produce toxins causes wilting by affecting cell membrane permeability and disturbing cell metabolism of several economically important plants (Garces de Granada *et al*., 2001; Pawar & Thaker, 2007). *Rhizoctonia solani* reduces the growth of plant by rotting the roots causing water and minerals uptake deficiency (Wallwork, 1996). *Macrophomina phaseolina,* the soil and root inhabiting fungus causes charcoal rot on vegetables, cereals, legumes, fibers, fruit and also other economic crops (Meyer *et al.,* 1973; Smith & Carvil, 1997). Basically it survives in soil debris in form of sclerotia, the principle stage of fungal survival (Watanabe *et al*., 1970; McCain & Smith, 1972; Cook *et al.,* 1973). In the recent years, there has been a worldwide swing to the use of biodegradable methods for protecting the crops from pest and disease (Rao *et al.,* 1998). To control plant diseases, plant products are gaining importance as compare to fungicides and bactericides (Hiremath *et al*., 1993, Rafi *et al*., 2015, Tariq & Dawar, 2015). Antifungal compounds obtained from higher plants are valuable over synthetic fungicides due to their simply eco-friendly nature (Srivastava & Lal, 1996).

Homeopathic drugs in plants have been studied recently as they amplify disease control and metabolic process in plants (Espinoza, 2001). These drugs including *Arnica montana* (Asteraceae) and *Thuja occidentalis* (Cupressacae) are used intensively in Pakistan, particularly in homeopathic system of medicine (Hulten & Fries, 1986; Alam, 2009). As the fertilizers mostly used to increase the nutritional quality of crop yield and improve the value of crops (Huber & Watson, 1970), they are known to have direct effect on the physiological growth of plants and enhance the soil micro flora as well as affecting the microbial activity of the pathogens (Curl & Rodriguezkabana, 1973). Chemical and bio-fertilizers significantly increased the growth components (Salahuddin *et al*., 2009). Essential nutrient supply of plant includes nitrogen which promotes the growth and distribution of plant (Grigon & Rorison, 1972; Havil *et al*., 1974). Under natural conditions, plants take up nitrogen in form of NO_3 and NH_4 but also take up nitrogen in form of Urea (Hayness & Goh, 1978). Fertilizer improved the growth and yield due to the neutralizing effect on sandy loam with the ensuing release of additional nutrients particularly phosphorus (Djokoto & Stephen, 1961).

The purpose of this research was to study the inter relationship of homeopathic medicine with fertilizer in the controlling of root rot fungi.

Materials and Methods

Dr. Willmar Schwabe homeopathic drugs like *Arnica montana* and *Thuja occidentalis* (30C) were purchased from medical store while nitrogen fertilizer such as Urea [$CO(NH_2)_2$] containing 45– 46% N and phosphorous fertilizer such as Diammonium phosphate [$(NH_4)_2HPO_4$] with 18–21% N, 46–53% P_2O_5 and 0–2% S were purchased from the local market of Karachi. Pot experiment was conducted at the green house bench of Department of Botany (Karachi University) in natural sunlight in a randomized design. Soil used for experiment was sandy loam soil with pH 7.9 and moisture holding capacity of 26% (Keen & Rackowski, 1922). The total nitrogen was 0.09% (Mackenzie & Wallace, 1954). The soil was sieved through 2 mm sieve to discard particles, then amended with Urea and DAP @ 0.01 and 0.1% w/w separately and transferred in plastic pots containing 300 g (8cm diameter). Seeds of mung bean (*Vigna radiata* (L.) R. Wilczek. cv. NM-2006), mash bean (*Vigna mungo* (L.) Hepper cv. NM-97), okra (*Abelmoschus esculentus* (L.) Moench cv. Arka anamika) and sunflower (*Helianthus annuus* L. cv. Hysun-38) were treated with *A. montana* and *T. occidentalis* @ 75 and 50% v/v concentrations (prepared from 30C) respectively and dried aseptically. Treated seeds with homeopathic drugs were sown in soil amended with the fertilizer. Treatments were replicated thrice and the pots without fertilizer and untreated seeds were served as control and randomized on a green house bench for one month of growth and watered daily. After one month, the plants were uprooted and the growth parameters were recorded. Roots were then washed and sterilized in 1% Ca $(ClO)_2$ for 5 mins., then cut into 5 pieces and placed on Petri plates containing Potato Dextrose Agar medium (PDA) supplemented with antibiotics (penicillin @ 10,000 unit/L and streptomycin @ 100 mg/L) to inhibit the growth of bacteria and incubated for one week at the room temperature (28-33˚C). Colonization percentage for root rot fungi was calculated. Data were analyzed to one way analysis (ANOVA) as per experimental design, separately followed by the least significant difference (LSD) test at P=0.05 as given by Gomez & Gomez (1984).

Results

Seeds treated with *A. montana* and *T. occidentalis* @ 75% v/v along with the soil amendment with urea and DAP @ 0.1, 0.01% w/w showed significant ($p<0.001$) increase in shoot length, weight and root length, weight of sunflower plant. When *A. montana* @ 75% v/v was combined with urea and DAP @ 0.01, 0.1% w/w *R. solani* colonization was suppressed. Complete reduction of root infecting fungi was observed by *T. occidentalis* @ 75% v/v in addition with urea @ 0.1% w/w. Whereas, *T. occidentalis* @ 75 and 50% v/v along with DAP @ 0.1% w/w inhibit *Fusarium* spp and *R. solani* infection (Table 1). In okra plant, greater plant height and weight was observed by *T. occidentalis* @ 75% v/v along with DAP @ 0.01% w/w and completely suppressed *R. solani* and *M. phaseolina* colonization. However, highest root weight was observed by *A. montana* @ 75% v/v combined with DAP @ 0.01% w/w. *A. montana* and *T. occidentalis* @ 75% v/v combining with urea and DAP @ 0.1% w/w as soil amendment significantly ($p<0.001$) suppressed root infecting fungi (Table 2). In case of mash bean, treated seeds with *A. montana* and *T. occidentalis* @ 75% v/v along with the addition of urea and DAP @ 0.01, 0.1% w/w in soil showed greater growth parameters but minimum plant height, weight and number of nodules were recorded by 50% v/w concentration. Complete inhibition of *Fusarium* spp, *R. solani* and *M. phaseolina* infection was observed by *A.montana* and *T. occidentalis* @ 75% v/v and soil mixed with urea @ 0.1% w/w. Soil amendment with DAP @ 0.1% w/w and seeds treatment with both drugs @ 50% v/v significantly ($P<0.001$) increased plant growth and reduced the colonization percentage of *R. solani* and *M. phaseolina* (Table 3). In mung bean plants, seeds treated with *T. occidentalis* and *A. montana* @ 75% v/v along with the addition of urea @ 0.01% w/w enhanced plant growth and complete suppression of root infecting fungi was observed by 0.1% w/w but when soil was amended with DAP @ 0.1% w/w completely controlled the *R. solani* and *M. phaseolina* infection (Table 4).

Discussion

Seed treatment with homeopathic drugs and soil amendment with fertilizers showed improvement in plant growth and also suppressed root infection on test crop plants. Recently, *Arnica montana* proposed in the agronomic use with the potencies of 3, 6 and 12 CH which advances plants growth (Bonfim *et al.*, 2008). When seeds were treated with microorganisms, they promote plant growth by increasing the supply of essential nutrients and enhancement of nutrient uptake (Lugtenberg *et al*., 2002). Seed dressing enhanced yield and reduce losses caused by fungal pathogen and pesticides. Dressing of seeds suppressed the infection of pathogenic fungi either superficially or penetrated inside the seed (Chang & kommedahl, 1968; Martha *et al*., 2003). Seed treatment and soil drenching methods showed complete suppression of *Rhizoctonia solani, Fusarium* spp and *Macrophomina phaseolina* and also promoted plant growth when treated with *Arnica montana* and *Thuja occidentalis* @ 100% v/v concentration (30C). Whereas, maximum inhibition of root rot fungi observed @ 75 and 50% v/v concentrations (prepared from 30C) on leguminous and non leguminous crops (Hanif & Dawar, 2015). Deficiency of nitrogen in soil causes stunted growth, necrosis, chlorosis and disorder in physiological and biochemical functions in plants (Epstein & Bloom, 2004; Taiz & Zeiger, 2010). Marschner (1995) suggested that use of nitrogen fertilizer along with other nutrients improve the crop productivity. Ashraf & Rehman (1999) reported that increasing supply of nitrogen enhanced the growth of corn. Khalid *et al.* (2003) examined that plant growth was improved when urea (N), phosphorus (P) and potassium (K) fertilizers were used in rice crop. By the addition of urea and potash, it reduced root rot diseases caused by *Fusarium* spp., *M. phaseolina* and *R. solani* in mung bean (Siddiqui *et al*., 1999). Similarly, Dawar & Ghaffar (2003) reported that infection of *Fusarium* spp. reduced significantly in mung bean when soil was mixed with urea or NPK and *Paecilomyces lilacinus* alone at 0 day but in 10 days, infection of *Fusarium* was completely controlled when soil was amended with *P. lilacinus* and DAP. Whereas, *M. phaseolina* and *R. solani* were suppressed completely when soil was treated with urea, DAP or NPK alone and mixed with *P. lilacinus* at 40 days. Tariq *et al*. (2008) examined that urea, DAP and frutan @ 0.01 and 0.1 % w/w as a separate dosage or combined with *Avicennia marina* plant parts including: leaves, stem and pneumatophore powder showed significant suppression of root infecting fungi and enhanced the growth of mung bean and okra plants. Mung bean and cow pea seeds treated with *Aerva javanica* leaves extract and soil amended with fertilizers such as Urea and Diammonium phosphate (DAP) @ 0.001, 0.01 and 0.1% w/w respectively showed significant suppression in the control of root rot fungi and maximum enhancement in plant growth parameters (Ikram & Dawar, 2015). Use of nitrogen + phosphorus, phosphorus + potassium or nitrogen + phosphorus + potassium in pea field was found to be effective in reducing the disease severity of root rot caused by *R. solani* and *F. oxysporum* (Srihuttagum & Sivasithamparam, 1991).

Table 1. Effect of seed treatment with homeopathic drugs along with soil amendment with fertilizer on growth parameters and in the control of root rot fungi of Sunflower.

Treatments	Shoot length (cm) ± SD	Shoot weight (g) ± SD	Root length (cm) ± SD	Root weight (g) ± SD	*Fusarium* spp. colonization (%) ± SD	*Rhizoctonia solani* colonization (%) ± SD	*Macrophomina phaseolina* colonization (%) ± SD
Control	12.87 ± 0.55	0.47 ± 0.061	5.2 ± 0.87	0.12 ± 0.025	86.66 ± 6.65	28.88 ± 3.83	93.31 ± 6.70
Arnica montana @75% v/v	15.77 ± 0.55	0.75 ± 0.031	7.9 ± 0.30	0.23 ± 0.04	20.0 ± 6.67	0.0 ± 0.0	17.78 ± 3.85
Arnica montana @50% v/v	15.13 ± 0.30	0.71 ± 0.031	7.7 ± 0.21	0.19 ± 0.031	26.66 ± 6.65	6.67 ± 6.66	22.22 ± 7.70
Thuja occidentalis@ 75% v/v	16.17 ± 0.35	0.81 ± 0.026	8.3 ± 0.4	0.22 ± 0.040	13.33 ± 6.66	0.0 ± 0.0	15.55 ± 3.85
Thuja occidentalis @50% v/v	15.6 ± 0.21	0.79 ± 0.015	7.4 ± 0.38	0.20 ± 0.02	22.22 ± 7.70	2.22 ± 3.85	15.56 ± 10.18
Urea@ 0.01% w/w	15.93 ± 0.61	0.63 ± 0.044	8.17 ± 1.25	0.18 ± 0.01	46.7 ± 6.66	28.89 ± 3.84	55.56 ± 10.18
Urea@0.1% w/w	16.53 ± 0.25	0.72 ± 0.03	8.9 ± 0.78	0.20 ± 0.021	31.11 ± 3.84	20.0 ± 6.67	35.56 ± 10.18
DAP@0.01% w/w	15.47 ± 0.31	0.71 ± 0.026	7.6 ± 0.25	0.19 ± 0.015	37.78 ± 10.18	26.67 ± 6.66	37.78 ± 13.88
DAP@0.1% w/w	16.83 ± 0.45	0.81 ± 0.050	8.6 ± 1.06	0.23 ± 0.01	28.89 ± 3.84	22.22 ± 7.70	35.56 ± 10.18
A. montana@75% + Urea@0.01% v/w	19.13 ± 0.21	1.36 ± 0.38	12.27 ± 0.76	0.28 ± 0.015	8.89 ± 3.84	0.0 ± 0.0	13.33 ± 6.66
A. montana@ 75% + Urea @0.1% v/w	18.4 ± 0.53	1.31 ± 0.42	14.3 ± 0.50	0.39 ± 0.015	4.45 ± 3.85	0.0 ± 0.0	11.11 ± 3.85
A. montana @*50%* + Urea @0.01% v/w	16.63 ± 0.38	0.90 ± 0.074	12.6 ± 1.18	0.31 ± 0.026	20.0 ± 6.67	2.22 ± 3.85	15.55 ± 3.85
A. montana @50% + Urea @0.1% v/w	17.3 ± 0.46	0.96 ± 0.021	13.83 ± 0.59	0.38 ± 0.025	11.11 ± 3.84	0.0 ± 0.0	13.33 ± 6.66
A. montana @75% + DAP @0.01% v/w	18.73 ± 0.76	0.95 ± 0.026	14.5 ± 0.65	0.39 ± 0.031	17.78 ± 3.85	0.0 ± 0.0	22.22 ± 7.70
A. montana @75% + DAP @0.1% v/w	16.87 ± 0.47	0.79 ± 0.031	10.5 ± 2.69	0.38 ± 0.060	4.45 ± 3.85	0.0 ± 0.0	6.67 ± 6.66
A. montana @50% + DAP @0.01% v/w	17.2 ± 0.4	0.88 ± 0.06	11.57 ± 1.00	0.27 ± 0.05	20.0 ± 6.67	11.11 ± 3.84	22.22 ± 3.85
A. montana @50% + DAP @0.1% v/w	16.13 ± 0.67	0.77 ± 0.050	9.43 ± 1.96	0.18 ± 0.015	13.33 ± 0.0	0.0 ± 0.0	11.11 ± 3.84
T. occidentalis @ 75% + Urea @0.01% v/w	18.87 ± 0.30	0.89 ± 0.026	15.13 ± 0.80	0.37 ± 0.05	0.0 ± 0.0	0.0 ± 0.0	6.67 ± 6.65
T. occidentalis @75% + Urea @0.1% v/w	17.67 ± 1.59	0.86 ± 0.025	14.33 ± 0.47	0.29 ± 0.021	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @50% + Urea @0.01% v/w	17.7 ± 1.13	0.81 ± 0.026	12.97 ± 0.74	0.28 ± 0.015	11.11 ± 3.84	0.0 ± 0.0	15.55 ± 3.85
T. occidentalis @50% + Urea @0.1% v/w	18.73 ± 0.49	0.96 ± 0.036	14.07 ± 0.71	0.31 ± 0.026	8.89 ± 3.84	0.0 ± 0.0	17.78 ± 3.85
T. occidentalis @75% + DAP @0.01% v/w	21.8 ± 1.40	1.79 ± 0.48	18.2 ± 1.25	0.44 ± 0.032	0.0 ± 0.0	0.0 ± 0.0	13.33 ± 6.66
T. occidentalis @75% + DAP @0.1% v/w	21.0 ± 1.31	1.04 ± 0.02	15.57 ± 0.71	0.41 ± 0.031	0.0 ± 0.0	0.0 ± 0.0	2.22 ± 3.85
T. occidentalis @50% + DAP @0.01% v/w	17.37 ± 0.66	0.96 ± 0.015	15.13 ± 0.70	0.35 ± 0.015	8.89 ± 3.84	0.0 ± 0.0	22.22 ± 3.85
T. occidentalis @50% + DAP @0.1% v/w	18.8 ± 0.40	0.96 ± 0.02	15.3 ± 0.44	0.32 ± 0.015	0.0 ± 0.0	0.0 ± 0.0	15.55 ± 3.85
$LSD_{0.05}$=	1.140	0.252	1.617	0.048	8.178	5. 55	11.151
Probability level (p<) =	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Where: ± SD = Standard deviation

Table 2. Effect of seed treatment with homeopathic drugs along with soil amendment with fertilizer on growth parameters and in the control of root rot fungi of Okra.

Treatments	Shoot length (cm) ± SD	Shoot weight (g) ± SD	Root length (cm) ± SD	Root weight (g) ± SD	*Fusarium* spp. colonization (%) ± SD	*Rhizoctonia solani* colonization (%) ± SD	*Macrophomina phaseolina* colonization (%) ± SD
Control	11.27 ± 1.47	0.58 ± 0.13	9.17 ± 1.18	0.15 ± 0.03	95.53 ± 3.87	31.11 ± 3.83	33.34 ± 11.55
Arnica montana @75% v/v	17.07 ± 0.64	0.92 ± 0.055	12.3 ± 0.78	0.26 ± 0.02	15.55 ± 3.85	0.0 ± 0.0	0.0 ± 0.0
Arnica montana @50% v/v	16.22 ± 0.45	0.86 ± 0.025	11.07 ± 0.61	0.20 ± 0.015	22.22 ± 7.70	4.45 ± 3.85	31.11 ± 3.84
Thuja occidentalis@ 75% v/v	17.67 ± 0.2	0.99 ± 0.030	13.0 ± 0.72	0.28 ± 0.01	6.67 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Thuja occidentalis @50% v/v	16.63 ± 0.21	0.84 ± 0.02	11.33 ± 0.50	0.21 ± 0.02	20.0 ± 6.67	0.0 ± 0.0	11.11 ± 3.84
Urea@ 0.01% w/w	16.6 ± 0.26	0.82 ± 0.087	11.27 ± 0.42	0.27 ± 0.01	48.89 ± 3.85	28.89 ± 3.84	51.11 ± 3.84
Urea@0.1% w/w	15.8 ± 0.4	0.82 ± 0.025	11.37 ± 0.45	0.22 ± 0.025	35.55 ± 3.85	26.67 ± 6.66	37.78 ± 7.70
DAP@0.01% w/w	16.77 ± 0.40	0.82 ± 0.076	8.77 ± 0.15	0.25 ± 0.026	55.56 ± 10.18	40.0 ± 6.67	28.89 ± 3.84
DAP@0.1% w/w	15.23 ± 0.15	0.71 ± 0.031	9.13 ± 0.50	0.21 ± 0.015	42.22 ± 7.70	31.11 ± 3.84	42.22 ± 13.88
A. montana@75% + Urea@0.01% v/w	19.67 ± 0.15	1.43 ± 0.21	13.07 ± 0.64	0.46 ± 0.061	15.55 ± 3.85	0.0 ± 0.0	0.0 ± 0.0
A. montana@ 75% + Urea @0.1% v/w	19.17 ± 0.71	1.38 ± 0.02	12.3 ± 0.5	0.54 ± 0.02	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
A. montana @*50%* + Urea @0.01% v/w	18.57 ± 0.35	1.14 ± 0.10	10.67 ± 0.81	0.35 ± 0.031	35.56 ± 10.18	11.11 ± 3.84	8.89 ± 3.84
A. montana @50% + Urea @0.1% v/w	17.13 ± 0.31	0.99 ± 0.030	9.73 ± 0.42	0.26 ± 0.025	11.11 ± 3.85	4.45 ± 3.85	0.0 ± 0.0
A. montana @75% + DAP @0.01% v/w	20.83 ± 0.60	1.8 ± 0.19	15.8 ± 0.40	0.69 ± 0.042	17.78 ± 7.70	0.0 ± 0.0	6.67 ± 0.0
A. montana @75% + DAP @0.1% v/w	19.27 ± 0.50	1.33 ± 0.044	16.43 ± 0.96	0.51 ± 0.046	2.22 ± 3.85	0.0 ± 0.0	4.44 ± 7.69
A. montana @50% + DAP @0.01% v/w	18.93 ± 0.76	1.15 ± 0.12	12.73 ± 0.61	0.29 ± 0.038	22.22 ± 3.85	11.11 ± 3.84	17.78 ± 7.70
A. montana @50% + DAP @0.1% v/w	18.2 ± 0.3	1.09 ± 0.031	10.2 ± 1.06	0.23 ± 0.026	13.33 ± 0.0	0.0 ± 0.0	15.55 ± 3.85
T. occidentalis @ 75% + Urea @0.01% v/w	19.6 ± 0.2	1.28 ± 0.055	12.93 ± 0.42	0.42 ± 0.032	8.89 ± 3.84	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @75% + Urea @0.1% v/w	19.13 ± 0.30	1.22 ± 0.04	12.27 ± 0.76	0.34 ± 0.021	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @50% + Urea @0.01% v/w	17.07 ± 0.46	1.08 ± 0.049	11.0 ± 0.72	0.28 ± 0.02	24.45 ± 3.85	0.0 ± 0.0	24.44 ± 10.18
T. occidentalis @50% + Urea @0.1% v/w	17.27 ± 0.50	0.98 ± 0.1	11.47 ± 1.81	0.25 ± 0.030	20.0 ± 6.67	0.0 ± 0.0	11.11 ± 7.69
T. occidentalis @75% + DAP @0.01% v/w	21.87 ± 0.30	1.22 ± 0.035	14.07 ± 0.42	0.35 ± 0.030	6.67 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @75% + DAP @0.1% v/w	19.6 ± 1.11	0.99 ± 0.056	11.1 ± 1.57	0.25 ± 0.030	0.0 ± 0.0	0.0 ± 0.0	0.0± 0 .0
T. occidentalis @50% + DAP @0.01% v/w	16.07 ± 0.64	0.86 ± 0.035	13.1 ± 1.08	0.21 ± 0.030	21.11 ± 3.84	11.11±3.84	22.22 ± 7.70
T. occidentalis @50% + DAP @0.1% v/w	15.17 ± 0.78	0.78 ± 0.04	9.93 ± 0.42	0.19 ± 0.032	15.55 ± 3.85	0.0±0.0	8.89 ± 3.84
$LSD_{0.05}$=	0.943	0.136	1.329	0.049	8.377	4.721	9.447
Probability Level (p<) =	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Where: ± SD = Standard deviation

Table 3. Effect of seed treatment with homeopathic drugs along with soil amendment with fertilizer on growth parameters and in the control of root rot fungi of Mash bean.

Treatments	Shoot length (cm) ± SD	Shoot weight (g) ± SD	Root length (cm) ± SD	Root weight (g) ± SD	Number of nodules ± SD	*Fusarium* spp. colonization (%) ± SD	*Rhizoctonia solani* colonization (%) ± SD	*Macrophomina phaseolina* colonization (%) ± SD
Control	13.27 ± 0.42	0.32 ± 0.055	13.93 ± 1.33	0.15 ± 0.031	12.33 ± 1.53	95.53 ± 3.87	42.22 ± 7.12	64.44 ± 10.18
Arnica montana @75% v/v	16.83 ± 0.55	0.49 ± 0.061	17.7 ± 0.46	0.26 ± 0.032	24 ± 2.0	28.89 ± 3.85	15.55 ± 3.85	22.22 ± 7.70
Arnica montana @50% v/v	16.13 ± 0.31	0.53 ± 0.135	17.53 ± 1.45	0.24 ± 0.02	21.33 ± 3.06	37.78 ± 7.70	28.89 ± 3.84	26.67 ± 6.66
Thuja occidentalis@ 75% v/v	17.33 ± 0.64	0.71 ± 0.030	19.2 ± 0.72	0.29 ± 0.032	27.3 ± 1.15	17.78 ± 7.70	11.11 ± 3.84	20.0 ± 6.67
Thuja occidentalis @50% v/v	15.67 ± 0.50	0.81 ± 0.030	18.23 ± 1.00	0.23 ± 0.026	22 ± 2.0	22.22 ± 7.70	15.55 ± 3.85	24.44 ± 10.18
Urea@ 0.01% w/w	17.67 ± 0.50	0.69 ± 0.030	20.27 ± 1.94	0.26 ± 0.02	26.3 ± 2.08	53.33 ± 6.66	40.0 ± 6.67	57.78 ± 7.70
Urea@0.1% w/w	18.8 ± 0.40	0.75 ± 0.030	20.27 ± 0.99	0.29 ± 0.030	21.3 ± 3.06	35.56 ± 10.18	28.89 ± 3.84	37.78 ± 7.70
DAP@0.01% w/w	17.93 ± 0.61	0.72 ± 0.035	16.3 ± 1.42	0.18 ± 0.04	16.3 ± 2.08	64.44 ± 10.18	42.22 ± 7.70	60.0 ± 6.67
DAP@0.1% w/w	16.23 ± 0.60	0.55 ± 0.070	18.8 ± 0.53	0.16 ± 0.02	16.67 ± 2.08	48.89 ± 3.84	28.89 ± 3.84	44.44 ± 10.18
A. montana@75% + Urea@0.01% v/w	20.53 ± 1.45	1.11 ± 0.030	23 ± 2.12	0.59 ± 0.083	31.33 ± 3.05	17.78 ± 7.70	13.33 ± 6.66	24.44 ± 7.69
A. montana@ 75% + Urea @0.1% v/w	22.7 ± 0.70	1.09 ± 0.030	22.27 ± 2.40	0.49 ± 0.02	34 ± 2.0	00 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
A. montana @50% + Urea @0.01% v/w	19.2 ± 0.6	0.96 ± 0.030	20.9 ± 1.66	0.41 ± 0.072	27.3 ± 3.21	24.44 ± 10.18	15.55 ± 3.85	17.78 ± 7.70
A. montana @50% + Urea @0.1% v/w	20.23 ± 0.31	1.11 ± 0.030	22.0 ± 1.21	0.45 ± 0.02	30 ± 2.0	20 ± 6.67	6.67 ± 0.0	13.33 ± 6.65
A. montana @75% + DAP @0.01% v/w	19.6 ± 0.83	1.05 ± 0.030	22.5 ± 0.83	0.35 ± 0.021	21.3 ± 2.08	26.67 ± 0.0	0.0 ± 0.0	17.78 ± 13.88
A. montana @75% + DAP @0.1% v/w	20 ± 1.33	0.98 ± 0.023	19.6 ± 0.61	0.39 ± 0.04	23.7 ± 1.53	15.56 ± 10.18	0.0 ± 0.0	8.89 ± 3.84
A. montana @50% + DAP @0.01% v/w	17.87 ± 0.82	0.89 ± 0.097	26.16 ± 2.01	0.36 ± 0.076	20 ± 2.0	28.89 ± 3.84	20.0 ± 6.67	11.11 ± 3.84
A. montana @50% + DAP @0.1% v/w	18.8 ± 0.6	0.99 ± 0.02	22.8 ± 1.64	0.34 ± 0.030	20.7 ± 1.15	17.78 ± 7.70	6.67 ± 0.0	24.45 ± 3.85
T. occidentalis @ 75% + Urea @0.01% v/w	24.87 ± 0.57	1.11 ± 0.030	22.8 ± 1.64	0.42 ± 0.030	34 ± 2.0	8.89 ± 3.84	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @75% + Urea @0.1% v/w	21.47 ± 0.2	1.05 ± 0.030	21.6 ± 1.56	0.39 ± 0.030	33.3 ± 3.05	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @50% + Urea @0.01% v/w	20.93 ± 0.53	1.03 ± 0.030	21.93 ± 2.93	0.32 ± 0.023	27.7 ± 1.53	19.99 ± 11.54	0.0 ± 0.0	20.0 ± 6.67
T. occidentalis @50% + Urea @0.1% v/w	19.93 ± 0.42	0.99 ± 0.030	19.6 ± 3.10	0.31 ± 0.030	28.7 ± 3.06	17.78 ± 3.85	0.0 ± 0.0	8.89 ± 3.84
T. occidentalis @75% + DAP @0.01% v/w	22.7 ± 1.80	1.11 ± 0.030	18.7 ± 1.80	0.27 ± 0.01	21.3 ± 3.06	6.67 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @75% + DAP @0.1% v/w	23.6 ± 1.74	1.15 ± 0.030	21.53 ± 0.70	0.26 ± 0.053	23.7 ± 3.21	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @50% + DAP @0.01% v/w	19.1 ± 0.82	0.95 ± 0.030	20.5 ± 2.20	0.24 ± 0.04	20.7 ± 1.53	20.0 ± 6.67	8.89 ± 3.84	15.55 ± 3.85
T. occidentalis @50% + DAP @0.1% v/w	17.93 ± 0.61	0.89 ± 0.030	21.73 ± 0.90	0.18 ± 0.04	16 ± 2.0	11.11 ± 3.84	0.0 ± 0.0	0.0 ± 0.0
$LSD_{0.05}$=	1.355	0.079	2.645	0.064	3.797	10.789	6.315	10.861
Probability level (p<) =	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Where: ± SD = Standard deviation

Table 4. Effect of seed treatment with homeopathic drugs along with soil amendment with fertilizer on growth parameters and in the control of root rot fungi of Mung bean.

Treatments	Shoot length (cm) ± SD	Shoot weight (g) ± SD	Root length (cm) ± SD	Root weight (g) ± SD	Number of nodules ± SD	*Fusarium* spp. colonization (%) ± SD	*Rhizoctonia solani* colonization (%) ± SD	*Macrophomina phaseolina* colonization (%) ± SD
Control	14.4 ± 0.70	0.37 ± 0.035	14.7 ± 0.93	0.16 ± 0.036	12.7 ± 1.53	93.33 ± 6.67	44.44 ± 10.18	66.7 ± 6.67
Arnica montana @75% v/v	16.9 ± 0.30	0.59 ± 0.036	19.5 ± 1.26	0.25 ± 0.030	21.3 ± 2.08	26.67 ± 6.67	13.33 ± 6.66	24.4 ± 10.18
Arnica montana @50% v/v	16.23 ± 0.47	0.58 ± 0.091	18 ± 0.79	0.24 ± 0.026	23 ± 2.65	28.88 ± 3.84	20 ± 6.67	24.4 ± 10.18
Thuja occidentalis@ 75% v/v	17.77 ± 1.06	0.67 ± 0.04	20.83 ± 0.59	0.27 ± 0.026	23.7 ± 1.53	15.55 ± 3.85	6.67 ± 0.0	11.11 ± 3.84
Thuja occidentalis @50% v/v	16.1 ± 0.89	0.65 ± 0.03	19.83 ± 0.45	0.22 ± 0.04	21 ± 2.65	24.44 ± 10.18	8.89 ± 3.85	24.45 ± 3.85
Urea@ 0.01% w/w	16.1 ± 0.26	0.82 ± 0.085	17.97 ± 1.72	0.26 ± 0.049	27 ± 1.0	46.67 ± 6.66	31.1 ± 3.85	35.56 ± 10.18
Urea@0.1% w/w	14.27 ± 0.76	0.49 ± 0.15	17.67 ± 1.20	0.23 ± 0.046	24.7 ± 2.52	24.42 ± 10.18	22.22 ± 10.18	17.76 ± 7.72
DAP@0.01% w/w	15.5 ± 0.30	0.64 ± 0.072	18.7 ± 0.46	0.33 ± 0.10	18.33 ± 1.53	55.52 ± 10.18	33.33 ± 6.66	51.07 ± 16.76
DAP@0.1% w/w	14.87 ± 0.83	0.51 ± 0.062	16.8 ± 0.60	0.23 ± 0.05	14.3 ± 2.08	44.45 ± 3.85	15.56 ± 10.18	28.88 ± 3.83
A. montana@75% + Urea@0.01% v/w	18.9 ± 0.30	1.02 ± 0.087	25.1 ± 2.23	0.73 ± 0.078	29.7 ± 2.08	11.11 ± 3.84	0.0 ± 0.0	15.55 ± 3.85
A. montana@ 75% + Urea @0.1% v/w	15.63 ± 0.59	0.61 ± 0.11	20.77 ± 2.38	0.87 ± 0.057	29 ± 3.0	4.45 ± 3.85	0.0 ± 0.0	0.0 ± 0.0
A. montana @50% + Urea @0.01% v/w	17.43 ± 0.78	0.79 ± 0.078	22.23 ± 2.74	0.59 ± 0.021	26.7 ± 2.52	22.22 ± 10.18	6.67 ± 6.66	15.55 ± 3.85
A. montana @50% + Urea @0.1% v/w	16.8 ± 0.46	0.82 ± 0.06	22.17 ± 1.31	0.61 ± 0.17	31 ± 2.65	15.56 ± 10.18	0.0 ± 0.0	11.11 ± 3.84
A. montana @75% + DAP @0.01% v/w	19.83 ± 0.45	1.06 ± 0.16	25.77 ± 2.63	0.50 ± 0.059	19.33 ± 2.08	15.55 ± 3.85	0.0 ± 0.0	4.45 ± 3.85
A. montana @75% + DAP @0.1% v/w	19.7 ± 1.35	0.92 ± 0.055	22.33 ± 3.04	0.64 ± 0.067	19.67 ± 2.08	15.56 ± 10.18	0.0 ± 0.0	0.0 ± 0.0
A. montana @50% + DAP @0.01% v/w	17.6 ± 0.92	0.66 ± 0.073	21.93 ± 2.35	0.43 ± 0.056	18 ± 1.0	24.45 ± 3.85	11.11 ± 3.85	13.33 ± .6.66
A. montana @50% + DAP @0.1% v/w	17.1 ± 0.75	0.82 ± 0.035	19.1 ± 0.70	0.33 ± 0.046	21.3 ± 2.52	17.78 ± 7.70	0.0 ± 0.0	8.89 ± 3.84
T. occidentalis @ 75% + Urea @0.01% v/w	23.53 ± 0.70	1.03 ± 0.05	26.53 ± 1.14	0.41 ± 0.021	31 ± 3.0	8.89 ± 3.84	0.0 ± 0.0	2.22 ± 3.85
T. occidentalis @75% + Urea @0.1% v/w	19.13 ± 0.38	0.85 ± 0.038	19.33 ± 1.9	0.36 ± 0.068	35 ± 1.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @50% + Urea @0.01% v/w	16.53 ± 0.70	0.83 ± 0.042	19.17 ± 0.78	0.34 ± 0.045	30.7 ± 1.53	22.22 ± 7.70	2.22 ± 3.85	11.11 ± 3.84
T. occidentalis @50% + Urea @0.1% v/w	19.07 ± 0.42	0.87 ± 0.085	18.9 ± 0.82	0.41 ± 0.07	27.33 ± 0.58	28.89 ± 3.84	8.89 ± 3.84	6.67 ± 6.66
T. occidentalis @75% + DAP @0.01% v/w	17.5 ± 0.66	0.91 ± 0.015	18.3 ± 0.95	0.36 ± 0.072	29.7 ± 2.08	17.78 ± 3.85	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @75% + DAP @0.1% v/w	18.83 ± 0.25	0.92 ± 0.025	17.07 ± 1.03	0.29 ± 0.031	21.33 ± 2.52	2.22 ± 3.85	0.0 ± 0.0	0.0 ± 0.0
T. occidentalis @50% + DAP @0.01% v/w	16.3 ± 0.56	0.66 ± 0.047	18.9 ± 0.89	0.32 ± 0.04	20 ± 2.0	20.0 ± 6.67	4.45 ± 3.85	15.55 ± 3.85
T. occidentalis @50% + DAP @0.1% v/w	16.9 ± 0.66	0.57 ± 0.10	16.63 ± 0.38	0.24 ± 0.047	17.3 ± 1.53	11.11 ± 3.84	0.0 ± 0.0	0.0 ± 0.0
$LSD_{0.05}$=	1.105	0.124	2.533	0.101	3.429	10.860	7.883	10.098
Probability level (p<) =	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Where: ± SD = Standard deviation

Fertilizers viz., flourish, frutan, NPK, urea @ 0.001, 0.01 and 0.1% w/w and fishmeal @ 0.1, 0.3 and 0.5% v/w amended in the soil showed significant inhibition of root rot infection and maximum growth productivity in okra and mung bean plants (Irshad *et al*., 2006). The diseases caused by root infecting fungi were reduced by the effect of mineral fertilizers (Pal & Chaudhary, 1980). By the application of phosphorous the yield of mung bean was significantly increased (Khan *et al*., 2008). Use of inorganic phosphorous fertilizers namely, Diammonium phosphate (DAP) and single superphosphate (SSP) showed significant effect on the soil properties, soil pH and phosphorus uptake as well as significantly increased the plant height, number of branches/plant, number of fruits/ plant and fruit yield in chillies (Batool *et al*., 2015). Huber (1980) observed that control of root rot fungi by the use of mineral fertilizers amplified the tolerance of thicker cuticle and cell wall which caused difficulty for penetration of pathogen. Anis *et al*. (2013) reported that greater plant length and weight was observed when soil was amended with ammonium nitrate alone and potassium sulphate in combination with *Trichoderma viride* or *T. reesei* followed by Diammonium phosphate in combination with *Rhizobium meliloti*. By the addition of organic and inorganic fertilizers in soil it enhances the plant height, fresh weight and leaf area of okra plant (Attarde *et al*., 2012). Use of inorganic fertilizers improves soil pH, nutrient content and availability but also growth of okra plant (Akanbi *et al*., 2010). Application of organic amendments in soil had been reported which not only enhanced the activity of bio-control agents but also suppressed plant pathogens (Cook, 1977; Sitaramaiah, 1990). Mixture of organic amendments had effective results in controlling plant pathogenic fungi and consequently improved the productivity of economically important crop plants (Chandra *et al.,* 1981; Stone *et al*., 2003).

Investigation on present research showed that seed treatment with homeopathic drugs and soil amendment with fertilizers has resulted in better plant growth promotion and disease reduction of root rot fungi which ought to be implicated for improving crop yield in field.

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