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INTEGRATED DISEASE MANAGEMENT OF WILT IN CHICKPEA BY ORGANIC AMENDMENT

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ABSTRACT

Siddique SS, Khatun F, Khalequzzaman KM, Momotaz R, Uddin MR (2013) Integrated disease management of wilt in chickpea by organic amendment. *Int. J. Sustain. Crop Prod.* 8(1), 5-10.

The experiment was conducted against wilt of chickpea at RARS, Jessore during Rabi season of 2009-10 and 2010-11 to reduce the use of chemical fungicide to against wilt disease and increase yield of chickpea. Pre-sowing soil treatment with Poultry litter (5 t/ha) with proper seed treatment by Provax (2 gm/kg seed) reduced wilt incidence with 34.36% in 2009-10 and 56.81% in 2010-11. Neem oil cake (100 kg/ha) in combination with Provax also decreased wilt incidence over control. Germination was highest in Provax treated plot in both the year (97.18% in 2009-10 & 96.11% in 2010-11), where Poultry litter + Provax integrated treatment also performed good in case of germination (94.62% in 2009-10 and 95.20% in 2010-11). Yield increased over control was also highest in Poultry litter + Provax combined plot (65.09% in 2009-10 and 77.15% in 2010-11). Among the two biocontrol agents, the performance of *Trichoderma harzianum* was better than *Trichoderma viridi*.

Key words: *wilt, Fusarium oxysporum, poultry litter, provax, chickpea*

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important leguminous crop grown in diverse soils and agronomic conditions (Godhani *et al.* 2010). It is the world's third most important pulse crop, after dry beans (*Phaseolus vulgaris* L.) and dry peas (*Pisum sativum* L.) (Dhar and Gurha, 1988). It is consumed not only as pulse but also snack foods, sweets, condiments even as green vegetable in the world (Nikam *et al.* 2007). It occupies about 8300 hectare in 19 to 21 regions in Bangladesh. Its average grain yields stands at about 6500 MT per year. The top four growing regions are Jessore, Rajshahi, Faridpur and Potuakhali (Anon. 2012). The diseases are one of the main constrains for the low production of this crop (Godhani *et al.* 2010). *Fusarium* wilt caused by *Fusarium oxysporum* is one of the major soil and seed borne disease, this facultative saprophyte pathogen can survive in soil up to six years in the absence of susceptible host (Haware *et al.* 1986) and then it may acquire the ability to overcome different environmental stress and biological competition which indicates to the existence of physiological races. With regard to crop losses, no definite data are available. However estimates indicate that losses may over around 10-15% each year as a regular feature. In the years of severe epidemics, crop losses have gone as high as 60-70% (Chand and Khirbat, 2009). Nema and Khare (1973) observed damage upto 61% at seedling stage and 43% at flowering stage. Similarly, early wilting reduced the seed number/plant and caused more yield losses than late wilting (Haware and Nene, 1980). The seeds harvested from wilted plants are lighter, wrinkled and duller than those from healthy plants. The yield losses vary between 10-100% depending on the agro climatic conditions (Grewal and Pal, 1970).

In this situation not only seed treatment but also soil treatment is a major concern to face this pathogen. Therefore integrated management strategies by using the organic materials and bioagent should be the only solution to maintain the plant and soil health as well as the environment by reducing the chemical use. Organic amendments and plant residues suppress disease caused by *Fusarium oxysporum* in soilless container mixes (Pharand *et al.* 2002). General suppression, specific antagonists, propagule lysis (Oritsejafar and Adeniji, 1990), induced resistance (Pharand *et al.* 2002), and non biotic factor (Kai *et al.* 1990) have been implicated in organic matter implicated suppressiveness of *Fusarium* wilt. Poultry manure which is a high N containing organic amendment have the potential to suppress soil-borne diseases through the toxic effects of ammonia, nitrous acid, or volatile fatty acids on plant pathogen growth and survival (Lazarovits 2001). This phenomenon has been reported in many plant pathogen including *Fusarium* spp. (Smiley *et al.* 1970). Considering above factors, the experiment was conducted to develop an integrated management practice to reduce disease by reducing the use of chemical fungicides and increase yield of chickpea.

MATERIALS AND METHODS

This experiment was conducted at RARS, Jessore during Rabi season in both the year 2009-10 and 2010-11. It was a RCB design with 3 replications. The plot size was 3.2 m x 2.0 m in 2009-10 and 3.2 m x 3.0 m for the year 2010-11 with row to row distance 40 cm and replication to replication distance 1 m. BARI Chickpea 1 was used as an experimental material. Ten treatments were used in this experiment *viz.* T_1 = *Trichoderma harzianum* (Th), T_2 = Provax (P), T_3 = Poultry Litter (PL), T_4 = Mustard Oil Cake (MOC), T_5 = Neem Oil Cake (NOC), T_6 = PL + P, T_7 = MOC + P, T_8 = NOC + P, T_9 = *Trichoderma viridi* (Tv) and T_{10} = Control. Provax (Carboxin + Thiram) @ 2 gm/kg seed was used as seed treating material. Three organic matter *viz*. Poultry litter @ 5 ton/ha, Mustard oil cake @ 1 ton/ha, Neem oil cake @ 300 kg/ha were mixed with the experimental plot 21 days before

sowing the seed as it could decompose properly. Two bio-control agents *viz. Trichoderma harzianum* and *T. viridi* were grown on petridishes on Potato Dextrose Agar media, and scrub finally mixed with the seed before sowing. Number of germinated seeds was counted 14 days after germination. The mortality symptoms were observed very closely and recorded at every alternate day from emergence of seedling to maturity stage. Data on yield was recorded after necessary sun drying of seeds. The recorded data were statistically analyzed by least significance difference (LSD) for comparisons among the treatments (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of treatments on germination of chickpea

Effect of treatments on germination of chickpea are presented in Fig. 1. Number of germinated seedling were counted in the field in both the year. It was observed that germination were highest in Provax treated plot in both the year (97.18% in 2009-10 and 96.11% in 2010-11) which was followed by T_6 (poultry litter + Provax) and T_7 (mustard oil cake + Provax). Control treatment showed the lowest incidence in both the year (87.95% in 2009-2010 and 85.25% in 2010-11). Germination (%) was better for all other treatments compared to control.

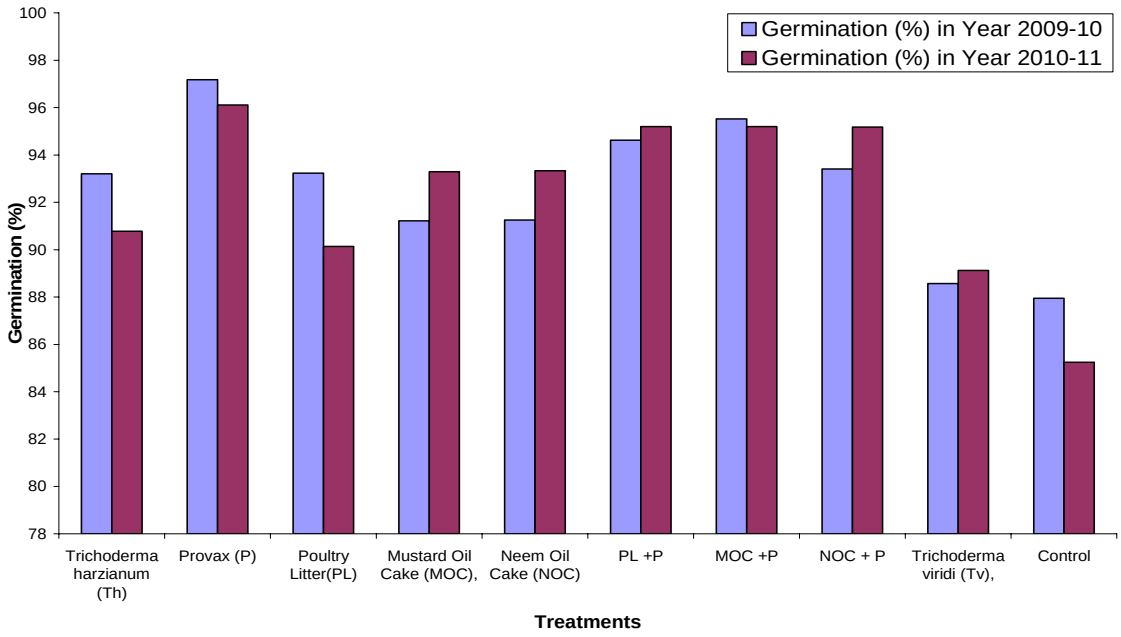

Fig. 1. Effect of treatments on germination (%) of chickpea

Effect of treatments on wilt disease of chickpea

With the objective of integrated management of wilt disease, two *Trichoderma* species, one chemical fungicide and three organic amendments were experimented in natural epiphytotic condition and the results are presented in Table 1. Results explain that T_6 where poultry litter (PL) applied at soil and Provax (P) used as seed treating material is found effective in controlling this disease (14%). The next best treatment was T_2 (15%) where P as seed treatment at 2009-10 followed by T_8 (15.67%) where Neem oil cake (NOC) as soil treatment and P as seed treatment and then T_7 (16.00%) where Mustard oil cake (MOC) at soil with P treated seed. In the year 2010-11 same phenomena occur, where the lowest wilt caused mortality was found in PL + P (T_6) treated plot (7.957%) followed by T_8 (NOC + P) treatment (10.71%) then T_2 (11.19%) where only seeds were treated with Provax. Similarly incase of disease reduction over control in 2009-10 was highest in T_6 plot (34.36%) followed by T_2 (29.67%) and T_8 (26.53%). In the year 2010-11, it was highest in T_6 (56.81%) followed by T_8 (41.82%) and T_2 (39.21%). Among the two bio agent, *T. harzianum* and *T. viridi*, first one performed better for controlling the wilt symptom over control (23.80 and 24.55% in 2009-10 and 2010-11, respectively) in case of seed treatment in both the year. Fungicidal seed treatment with Provax (Carboxin + Thiram) reduced both the symptom in compare to control. But the overall result indicate that soil treatment with high nitrogenous organic amendments i.e. PL with proper seed treatment by Provax effectively controlled the wilt symptom in case of natural epiphytotic condition. Besides other two organic soil amendments in combination with Provax proved to be effective in controlling wilt of chickpea in natural epiphytotic condition.

Table 1. Effect of treatments on wilt disease of chickpea

Treatment	2009-10			2010-11		
	Wilt (%)	% of healthy plant	% Disease reduction over control	Wilt (%)	% of healthy plant	% Disease reduction over control
T_1 = Th	16.33	83.67	23.80	13.89	86.11	24.55
T_2 = P	15.00	85.00	29.67	11.19	88.81	39.21
T_3 = PL	17.33	82.67	18.75	13.12	86.88	28.73
T_4 = MOC	17.00	83.00	20.30	15.89	84.11	18.68
T_5 = NOC	19.00	81.00	10.92	15.62	84.38	15.15
T_6 = PL + P	14.00	86.00	34.36	7.95	92.05	56.81
T_7 = MOC + P	16.00	84.00	24.98	13.98	86.02	24.06
T_8 = NOC + P	15.67	84.33	26.53	10.71	89.29	41.82
T_9 = Tv	20.33	79.67	4.68	17.03	82.97	7.49
T_{10} = Control	21.33	78.67	-	18.41	81.59	-
CV (%)	14.78			11.70		
LSD (P≥0.05)	4.361			2.767		

T_1 = *Trichoderma harzianum* (Th), T_2 = Provax (P), T_3 = Poultry Litter (PL), T_4 = Mustard Oil Cake (MOC), T_5 = Neem Oil Cake (NOC), T_6 = PL + P, T_7 = MOC + P, T_8 = NOC + P, T_9 = *Trichoderma viridi* (Tv) and T_{10} = Control

Effect of treatments on yield of chickpea

Results of treatments on yield of chickpea are presented in Table 2. T_6 treated plot (PL applied for soil treatment and P for seed treatment) performed highest yield in both the year 2009-10 and 2010-11 (1783 and 1673 kg/ha, respectively). Yield increase over control was 65.09% in 2009-10 and 77.15% in 2010-11 in T_6 treatment which was followed by T_2 (47.22% in 2009-10 and 71.58% in 2010-11). Yield increase over control in two bio-agent treated plots were not satisfactory comparing to the other treatment.

From the above study, It was observed that germination was highest in Provax (carboxin + thiram) treated plot which was followed by poultry litter applied in soil and Provax used as seed treatment, and mustard oil cake applied in soil and Provax used as seed treatment. Shahid *et al.* (2011) observed 97.66% germination in laboratory when seeds are treated with Vitavax (carboxin + thiram) at the rate of 2 gm/kg seed which was more conformity of the experiment. A synergistic effect of seed treatment with Vitavax and *T. harzianum* was observed by Khanal (2002) in both glass house and field where this treatment increased seedling emergence. Several authors observed that seed dressing with protectant or systemic fungicides used singly or as mixtures at recommended rates significantly increase emergence of chickpea seedlings in a naturally infested plot (Cother 1977; Dhingra *et al.* 1980; Shukla *et al*. 1981).

Table 2. Effect of treatments on yield of chickpea

Treatment	2009-10		2010-11	
	Yield (kg/ha)	Yield increased over control (%)	Yield (kg/ha)	Yield increased over control (%)
T_1 = Th	1240	14.81	1130	18.95
T_2 = P	1590	47.22	1630	71.58
T_3 = PL	1390	28.71	1530	61.05
T_4 = MOC	1083	0.28	980	3.16
T_5 = NOC	1420	31.48	1200	26.32
T_6 = PL + P	1783	65.09	1673	77.15
T_7 = MOC + P	1410	30.55	1470	54.74
T_8 = NOC + P	1567	45.09	1500	57.89
T_9 = Tv	1493	38.24	1300	36.84
T_{10} = Control	1080	-	950	-
CV (%)	14.11		11.03	
LSD (P≥0.05)	340.2		252.9	

T_1 = *Trichoderma harzianum* (Th), T_2 = Provax (P), T_3 = Poultry Litter (PL), T_4 = Mustard Oil Cake (MOC), T_5 = Neem Oil Cake (NOC), T_6 = PL + P, T_7 = MOC + P, T_8 = NOC + P, T_9 = *Trichoderma viridi* (Tv) and T_{10} = Control

It has been revealed that poultry litter applied in soil and Provax used as seed treatment showed the lowest wilt incidence of chickpea. Shakil Ahmed *et al.* (2012) reported that soil amendment with poultry litter decrease both root rot incidence (16%) and plant mortality (6%) caused by *Fusarium solani* in Groundnut. Poultry litter have the potentiality to suppress the soil borne diseases through the toxic effect of ammonia, nitrous acid or volatile fatty acids on plant pathogens growth and survival was reported by Lazarovits (2001). Baily and Lazarovits

(2003) reported that organic amendments, manures and composts with high nitrogen contents may suppress soil borne diseases by releasing allelochemicals during microbial decomposition. Haruna *et al*. (2012) observed successful control of *Fusarium oxysporum* f.sp. *lycopersici* in tomato by using poultry manure based compost extract. Continuous application of compost extract reduce disease incidence due to induced natural defense mechanism against *Fusarium oxysporum* in tomato was reported by Al-Dhamani *et al.* (2003) and Gangaih (2004). Significant reduction of *Fusarium solani* by neem amendment also reported by Lakashmi and Jeyarajan (1987). The suppressive ability of neem organic amendment in inhibiting growth of soil borne pathogens has been demonstrated to be through competition, antibiosis or due to increase of soil microbial populations (Zakaria and Lackword, 1980). Khalequzzaman (2008) found that dry seed treatment with Vitavax 200 (carboxin + thiram) @ 0.25% (w/w) or seeds dipped in 0.25% suspension of Vitavax 200 for 3 hours gave significant decrease of foot and root rot incidence and increase of plant stand of lentil and chickpea as compared to control. Chemical seed treatment with Thiram (0.15%) + Carbendazim (0.1%) were found most effective against *Fusarium oxysporum* f.sp. *ciceri* by Nikam *et al*. (2007). Cother (1977) effective control of gram wilt by seed treatment with Thiram, Benomyl and Captain. Kovacikova (1970) reported that seed treatment with @ 2 gm/kg seed gave the best protectant against the *Fusarium* wilt of chickpea caused by *Fusarium oxysporum* f.sp. *ciceri*. Kaur and Mukhopadhyay (1992) reported that seeds treated with Vitavax-200 and Ziram resulted in 29.9% disease control which was further increased to 63.3% when integrated with soil application of *Trichoderma harzianum* and carboxin for seed treatment was the best which enhanced the seed germination 42.6%-72.9% and reduced wilt incidence (44.1-60.3%) during experimentation. Carboxin, Thiram and Bavistin singly or in combination has great effect on reducing wilt, protection of seedlings and increasing yield under pots and field condition has been observed by different authors (Gupta *et al*. 1997; Singh and Jha, 2003). Subhani *et al*. (2013) reported that *T. harzianum* produced longer inhibition zone to reduce the growth of *Fusarium oxysporum* f.sp. *ciceri* in green house condition, this antagonist pathogen reduced the number of wilted plants with 67.93% reduction of disease incidence. Kolte *et al*. (1988) effectively controlled chickpea wilt with seed treatment by *T. viridi*, and *T. harzianum*. Prasad *et al.* (2002) observed two antagonistic fungi *viz. T. harzianum* (PDBCTH-10) and *T. viridi* (PDBCTV) against wilt (*Fusarium oxysporum* f.sp. *ciceri*) and wet root rot (*Rhizoctonia solani*) of chickpea in field. Seed treatment with *T. harzianum* enriched the canopy perimeters was observed by Godhani (2010). Subhani *et al.* (2013) reported that *T. harzianum* produced longer inhibition zone to reduce the growth of *Fusarium oxysporum* f.sp. *ciceri* and in green house condition this antagonist pathogen reduces the number of wilted plants with 67.93% reduction of disease incidence.

It was observed that Poultry litter applied for soil treatment and Provax (carboxin + thiram) for seed treatment performed highest yield in both the year 2009-10 and 2010-11, which was followed by Provax for seed treatment. The highest seed yield of 3.96 g/plant was obtained by inoculating chickpea plants with poultry litter in association with Rhizobium and arbuscular mycorrhiza was reported by Solaiman *et al*. (2005). Again Animisha *et al.* (2012) reported about the increased yield of chickpea by soil amendment with neem cake along with carbendazim which reduce 42.6-45.2 percent wilt incidence. Khalequzzaman (2008) found that dry seed treatment with Vitavax 200 (carboxin + thiram) @ 0.25% (w/w) or seeds dipped in 0.25% suspension of Vitavax 200 for 3 hours gave significant increase grain yield of lentil and chickpea as compared to control. Coating of chickpea seeds with biocontrol agent like *T. harzianum* integration with carboxin increased the seed yield by 25.4-42.6% (De *et al.* 1996). A synergistic effect of seed treatment with Vitavax and *T. harzianum* was observed by Khanal (2000) in both glass house and field where this treatment increased grain yield. Gupta (2006) found that Vitavax (carboxin + thiram) improved yield of chickpea.

CONCLUSION

It may be concluded that Poultry litter applied as soil amendment (21 days before seed sowing) and Provax (2 gm/kg seed) used as seed protectant (at the time of seed sowing) gave best result in case of reducing wilt disease and increasing yield of chickpea.

REFERENCES

Al-Dahmani JH, Abbasi PA, Miller SA, Hointik HAJ (2003) Suppression of bacterial spot of tomato with foliar sprays of compost extracts under screen house and field conditions. *Plant disease*, 87, 913-919.

Animisha S, Zacaharia KK, Pandey P (2012) Integrated management of chickpea wilt caused by *Fusarium oxysporum* f.sp. *ciceris. International Journal of Agricultural Research*, 7, 284-290.

Anonymous (2012) Bulletin of Tropical Legume. A monthly Publication of the Tropical Legumes II. Project, pp 1-4, http//www.icrisat.org/TropicallegumesII.

Bailey KL, Lazarovits G (2003) Suppressing soil borne diseases with residue management and organic amendments. Soil & Tillage Research 72, 169-180.

Chand Hari, Khirbat SK (2009) Chickpea wilt and its management- A review. Agric. Rev, 30(1), 1-12.

Cother EJ (1977) Identification and control of root rot fungi in gram. *Plant Dis. Reptr*. 61, 376.

De RK, Chaudhary RG, Naimuddin (1996) Comparative efficacy of biocontrol agent and Department of Plant Pathology, IAAS, Rampur, Chitwan, Nepal. pp 101.

Dhar V, Gurha SN (1988) Integrated management of Chickpea Diseases. Integrated pest and disease Management.

Dhingra OD, Muchovej JJ, Cruz Filho J (1980) Tratmento de sementes (Control de patogenos). Imprensa de Univ. Federal de Vicosa, Vicosa, Brazil. 121 pp.

Gangaih C (2004) Suppression of *Septoria* leaf spot (*Septoria lycopersici*) and early blight (*Alternaria solani*) of tomato using aerated compost tea. Unpublished M.Sc. Thesis. Kansas State University, Manhattan, Kansas.

Godhani PH, Patel RM, Jani JJ, Patel AJ, Korat DM (2010) Evaluation of two antagonists against wilt disease of chickpea. *Karnataka J. of Agric. Sci.* 23(5), 795-797.

Gomez KA, Gomez AA (1984) Statistical Procedures for Agricultural Research. 2nd ed. Intl. Rice Res. Inst., John Willy and Sons, New York, Chichester, Brisbane, Toronto, Singapore. pp. 187-240.

Grewal JS, Pal M (1970) *Proc. IV Annual workshop on pulse crops*. Punjab Agricultural University, Ludhiana, India. 168 pp.

Gupta A (2006) Efficacy of bio-agents vs. fungicides on disease incidence in chickpea. Ann. Plant Protec. Sci., 14(2), 496-497.

Gupta SK, Upadhyay JP, Ojha KH (1997) Effect of fungicidal seed treatment on the incidence of chickpea wilt complex. Ann. Pl. Prot .Sci. 5, 184-187.

Haruna SG, Adebitan SA, Gurama AU (2012) Field evaluation of compost extracts for suppression of *Fusarium* wilt of tomato by *Fusarium oxysporum* f.sp. *lycopersici. Int. J. Agr. & Agri.* R. 8-17.

Haware MP, Nene YL (1980) *Crop Grain Legume Bull*., 19, 38.

Haware MP, Nene YL, Natarajan M (1986) Survival of *Fusarium oxysporum* f.sp. *ciceri* in soil in absence of chickpea.1986 Paper presented in the National Seiminar on Management of soil borne diseases of crop plants. Proc. Natn. Sem. 8-10 Jan. 1986, Tamilnadu Agricultural University, Coimbatore, Tamilnadu India.

Kai H, Ueda T, Sakaguchi M (1990) Antimicrobial activity of bark compost extracts. *Soil Biol. Biochem.,* 22, 983-986.

Kaur NP, Mukhopadhyay AN (1992) Integrated control of 'chickpea wilt complex' by *Trichoderma* and chemical methods in India. Tropical Pest Management, 38(4), 372-375.

Khalequzzaman KM (2008) Effect of seed treating fungicides and biofertilizers in the incidence of foot and root rot disease of lentil and chickpea. Annals of Bangladesh Agriculture, 12 (2), 39-44.

Khanal NP (2002) Integrated management of lentil and chick pea wilt complex. M. Sc. Thesis.

Kolte SO, Thakre KG, Gupta M, Lokhande VV (1988) Biocontrol of *Fusarium* wilt of chickpea (*Cicer arietinum*) under wilt sick field condition. Paper submitted, ISOPP at National Symposium on management of soil and soil-borne diseases. 9-10th Feb., 1988. p.22.

Kovacikova E (1970) Seed treatment of lentil and chickpea against some fungal diseases. Ochr. Rost. 6, 117-126.

Lakashmi R, Jeyarajan R (1987) Biological control of Crossandra wilt by organic amendment. In. Biological control of plant disease. A workshop Department of Plant pathology. Tamilnadu Agricultural University, Coimbatone. p. 35.

Lazarovits G (2001) Managements of soil-borne plant pathogens with organic soil amendments: A disease control strategy salvaged from the past. *Can. J. Plant Pathol*., 23, 1-7.

Nema KB, Khare MN (1973) Symposium on wilt problem and breeding for wilt resistance in Bengal gram, IARI, New Delhi, pp 4.

Nikam PS, Jagtap GP, Sontakke PL (2007) Management of chickpea wilt caused by *Fusarium oxysporum* f.sp. *ciceri. African J. Agric. Res*., 2(2), 692-697.

Oritsejafor JJ, Adeniji MO (1990) Influence of host and non host rhizospheres and organic amendments on survival of *Fusarium oxysporum* f.sp. *elaeidis*. *Mycol. Res*., 94, 57-63.

Pharand B, Carisse O, Benhamou N (2002) Cytological aspects of compost mediated induced resistance against in *Fusarium* crown and root rot in tomato. *Phytopathology*, 92, 424-438.

Prasad RD, Rangeshwaran R, Anuroop CP, Rashni HJ (2002) Biological control of wilt and root rot of chickpea under field conditions. Ann. Pl. Prot. Sci., 10(1), 72-75.

Shahid M, Singh A, Srivastava M, Sachan CP, Biswas (2011) Effect of seed treatment on germination and vigour chickpea. Trends in Biosciences, 49(2), 205-207.

Shakil Ahmed, Noor Zaman, Khan SN (2012) Evaluation of manuring practices on root rot diseases and agronomic characters of *Arachis hypogeae* L. *African J. of Biotech*., 11(5), 1119-1122.

Shukla P, Sing RR, Misra AN (1981) Search for best seed dressing fungicides to control chickpea wilt (*Fusarium oxysporum*). Pesticides, 15, 15-16.

Singh DK, Jha MM (2003) Effect of fungicidal treatment against chickpea wilt caused by *F. oxysporum* f.sp. *ciceris*. *J. of Applied Biology*, 13(1/2), 41-45.

Smiley RW, Cook RJ, Papendick RI (1970) Anhydrous ammonia as a soil fungicide against *Fusarium* and fungicidal activity in the ammonia retention zone. *Phytopathology.* 60, 1227-1232.

Solaiman ARM, Rabbani MG, Molla MN (2005) Effects of inculation of Rhizobium and arbuscular mycorrhiza, poultry litter, nitrogen and phosphorus on growth and yield of chickpea. *Korean Journal of Crop Science*, 50(4), 256-261.

Subhani MN, Sahi ST, Ali L, Hussain S, Ikbal J, Hussain N (2013) Management of chickpea wilt caused by *Fusarium oxysporum* f.sp. *ciceris* through antagonistic microorganisms. *Canadian Journal of Plant Protection*, 1(1), 1-6.

Zakaria MA, Lockwood JT (1980) Reduction of *Fusarium* population in soil by oil seed meal amendments. *Phytopathology*, 70, 240-243.