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Management of chick pea wilt caused by *Fusarium oxysporum* f.sp. *ciceri*

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Abstract
Chickpea (*Cicer arietinum* L), wilt caused by *Fusarium oxysporum* f. sp. *ciceri* is the most destructive disease in India and also first reported from India in 1918. It is seed-borne as well as soil-borne pathogen. The results concluded that Soil inoculation with *Fusarium oxysporum* f. sp. *ciceri* @ 100g/ plot of soil. Seed dressed with bio-control agents @ 4g/ Kg of seed and fungi-toxicants viz. neem leaf and neem bark powder @ 4g/ Kg of seed, bavistin and Thiram @ 3 g/Kg of seed. Observation of wilt incidence was recorded at 30, 60 and 90 DAS. Root length, Shoot length, Root weight and Shoot weight were also recorded at 30, 60 and 90 DAS. The wilt incidence was recorded minimum with Bavistin, Thiram and *Trichoderma viride*. The Shoot weight, Root weight, Shoot length and Root length was maximum when treated with *Pseudomonas fluorescence* (T_3), *Trichoderma viride* (T_2).

Keywords: Fungi-toxicants, *Pseudomom fluorescence*, *Trichoderma viride*, Bavistin, *Fusarium oxysporum* f. sp. *ciceri*

Introduction
Pathogen is soil borne, it is essential to use bioagents and fungicides for the effective management of chickpea wilt disease caused by *F. oxysporum* f.sp. *ciceri*. Among the many factors responsible for lower productivity, lack of pest and disease management is one of the major factors. The species of *Trichoderma* have been evaluated against the wilt pathogen and have exhibited greater potential in managing the chickpea wilt under field condition (Podder *et al*., 2004) [14]. The disease can appear at any stage of plant growth, symptoms in a highly susceptible cultivar can develop any time between 25 days after sowing till as late as podding stage (Nene 1985) [13]. Annual yield losses in chickpea were estimated to be 4.8 million tones worldwide due to biotic stresses, including infectious plant diseases Ryan *et al*., 1997 [16]. Leeman *et al*. 1995 [10] reported satisfactory control of *Fusarium* wilt of radish by treating the seed with *P. fluorescence.* In addition *P. fluorescence* produces auxins, gibberellins etc. (Glick, 1995) [7] and solubilises phosphorus in the soil Dube and Yeole, 1997 [6], which helps plant growth among mycoparasites, The genus *Trichoderma* includes the most widely used bio-control agent of soil-borne, seed-borne and other diseases Chet *et al.*, 1979; Chet and Baker, 1981 [2]. *Trichoderma harzianum* is active rhizosphere colonisers Tronsmo and Harman, 1992 [8] that produce antibiotics such asgliotoxin, viridin, and some cell wall degrading enzymes (Larito *et al.*, 1976; Bello *et al*., 1997) [11, 1] and also certain biologically active heat-stable metabolites such as ethyl acetate Claydown *et al.*, 1987 [4]. These substances may be involved in disease suppression or plant growth promotion. *Trichoderma viride* is one efficient biocontrol agent that is successfully used to suppress *Fusarium* wilt Khan *et al*., 2004; Dubey *et al*., 2007 [9, 5]. Similarly, amending soil with plant extracts significantly reduces *Fusarium* wilt in the field Chand and Singh, 2005 [3].

Materials and Methods
Roots of diseased chickpea plants showing characteristic symptoms of wilt disease were collected from chickpea infected field of Plant Pathology section, Sam Higginbottom University of Agriculture Technology & Sciences, Allahabad for the isolation of *F. oxysporum* f.sp. *ciceris*. Roots of chickpea plants were cut into 8 to 10 mm long segments, washed with tap water and surface sterilized by dipping in 0.1% mercuric chloride solution for 60 s. These pieces were washed three times in sterilized distilled water and were placed on sterilized filter paper sheets for drying. These dried segments were then plated on chickpea seed meal agar

(CSMA) in Petri plate and were incubated at 25 °C for more than one week for recovery of pathogen. The Petri dishes and pipettes will be wrapped in clean paper and sterilized in hot air oven at temperature of 150 ^{0}C for two hours. Already sterilized melted PDA will transferred into Petri-dishes and then small pieces of chick pea infected roots will keep on semi-solidify media inside Petri plates. This whole process will be done inside the laminar flow under highly aseptic condition. These Petri-plates will be incubated under room temperature. Colonies of *F. oxysporum* along with some other colonies, that is, air borne fungi were recorded. *F. oxysporum* was purified by single spore method.

Viability and population assessment test of the product: Commercial formulations of *Trichoderma viride* and *Pseudomonas fluorescence* will tested for the viability and population assessment test before using in the experiment by the following procedure.1g of product will weight and make upto10 ml with sterilized distilled water and was shaken well (1:10).1ml of this suspension will take and transferred to 9 ml of sterilized water in a test tube (1:100) serial dilution will made similarly transferring 1ml of the suspension to the subsequent tubes to get 1:1000000 dilution 1ml.of the 1000000 suspension will transferred to sterile pertiplate. 15 ml of the melt and cool PDA will poured in Petri plates for assessment *Trichoderma viride* and *Pseudomonas fluorescence.* The plates will incubated at room temperature. After 48 hrs average no of colonies per plate was calculated.

$$\text{Colony Forming Unit (cfu) in/g product } \frac{\text{No of colonies}}{\text{Amount place}} \text{ x dilution factor}$$

Incorporation of bacterial antagonists *Pseudomonas fluorescence* into medium: Effect of *P. fluorescence on growth of test fungus Fusarium oxysporum* f.sp.*ciceri*. was studied using different concentration of bacterial suspension prepared from 48 h old culture of bacterial isolate grown on kings'B medium. Bacterial suspension will used at (0.1ml) and (0.3ml) concentrations. Transfer different concentrations bacterial suspension in replicated Petri plates and poured the medium into sterilized Petri plate as the rate of 15 ml of medium per dish and allow solidifying. Control will maintain with the mycelia disc of the *Fusarium oxysporum* f.sp.*ciceri*. on PDA medium containing bacterial suspension.

Inoculation of fungus in PD broth: All the treatments will be keep according as in radial growth method. The only difference between the two experiments will be here the same fungus was inoculated in PD broth carried in conical flasks. After the inoculation of the fungus in all the conical flasks will inoculated under room temp. all the treatments replicate 5 time

Disease intensity (%) was calculated by using the following formula

$$\text{Disease intensity (\%)} = \frac{\text{Sum of all disease rating}}{\text{Total no.rating x Max.disease grade}} \text{ x } 100$$

(IRRI, 1996)

Results & discussion

In-vitro evaluation of different fungicides against *Fusarium oxysporum* f.sp. *cicerei* was done by followed poisoned food technique. The fungicides were tasted at 10 & 100 ppm concentration each and the observations on percent inhibition of colony growth, over control. The data are presented in table 2. During both the years of experimentation *Trichoderma viride* in 2:1 ratio resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by *Trichoderma vidide* in 1:1 ratio. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. During both the years of experiment *Pseudomonas fluorescence* in the 0.3 ml resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by *Pseudomonas fluorescence* 0.1 ml. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. During both the years of experimentation, neem leaf extract 6% resulted insignificantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Neem leaf extract 3%. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated fest fungus treatments. The order of the treatments $T_2 < T_1 < T_0$ During both the year of experimentation Neem bark extract 6% resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Neem bark extract 3%. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments.

Interaction effect: During 2015-16, 2016-2017 treatment T_2 significantly reduced the redial growth of *Fusarium oxysporum* f. Sp. *ciceri* as compared with control at all the successive stages of the radial growth expert T_2D_1 and ToD_1 were ate per with each other. Similar observation was also recorded in case of T_1 during both the years of experimentation. During 2015-2016, and 2016-2017 treatment T_2 significantly inhibited the radial growth of *Fusarium oxysporum* f. Sp. *ciceri* as compared with control at all the successive stages of the radial growth. Similar results were observed in T_1 also. During 2015-2016 and 2016-2017 Neem leaf extract 6% T_2 significantly inhibited the radial growth of *Fusarium oxysporum* f. Sp. *ciceri* as compared with control at all the stages of the radial growth. Neem leaf extract 3% (T_1) also significantly reduced the radial growth of *Fusarium oxysporum* f. Sp. *Ciceri* at all the stages of radial growth as compared with control during both the years of experimentation. Neem leaf extract (6%) also reduced the radial growth of *Fusarium oxysporum* f.sp. *ciceri* significantly as compared with neem leaf extract (3%) at D_5, D_6, D_7 and D_8 stages during 2015-2016 and at D_3, D_4, D_5, D_6, D_7 and D_8 during 2016-17. During 2015-2016 and 2016-2017 treatment T_2 significantly inhibited the radial growth of *Fusarium oxysporum* f. Sp. *ciceri* as compared with control at all the successive stages of the radial growth. Similar results were observed in T_1 also.

Table 1: Effect of *Trichoderma viride*, *Pseudomonas fluorescence*, Neem leaf extract, Neem bark extract on growth of *Fusarium oxysporum* f. Sp. *Ciceri*. at different intervals

Effect of *Pseudomonas fluoresence*, Neem leaf extract, Neem bark extract, Bavistin & Thiram on growth of *Fusarium oxysporum* f.sp *ciceri* at 12 DAI by Mycelial weight Method

Replications/ Treatments	*Pseudomonas fluorescence*	Neem leaf extract	Neem bark extract	Bavistin	Thiram
Fusarium oxysproum f. sp. *ciceri*	2.120	1.27	1.26	2.06	1.335
Pseudomonas fluoresence (1ml) + *Fusarium oxysporum* f. sp. *ciceri* (1disc)	0.580	0.38	0.38	0.575	0.375
Pseudomonas fluoresence (3ml) + *Fusarium oxysporum* f. sp. *ciceri* (1 disc)	0.170	0.255	0.2575	0.175	0.31

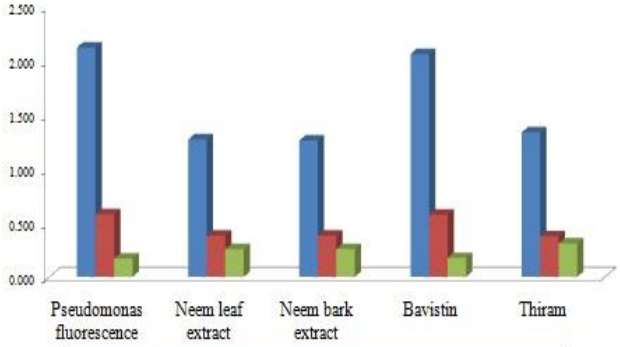

Fig: Effect of *Pseudomonas fluoresence*, Neem leaf extract, Neem bark extract, Bavistin & Thiram on growth of *Fusarium oxysporum* f.sp *ciceri* at 12 DAI by Mycelial weight Method

Effect of *Trichoderma viride* , *Pseudomonas fluroscence*, Neem Leaf Extract, Neem Bark Extract , Bavistin and Thiram on growth of *Fusarium oxysporum* f.sp. *ciceri* by radial growth at different intervals

Radial Growth						
Replications/ Treatments	*Trichoderma viride*	*Pseudomonas fluorescence*	Neem leaf extract	Neem bark extract	Bavistin	Thiram
Fusarium oxysproum f. sp. *ciceri* (1 disc)	48.61	45.44	43.78	43.27	43.31	43.29
Trichoderma viride (1 disc) + *Fusarium oxysporum* f. sp. *ciceri* (1 disc)	8.27	8.62	11.49	11.54	11.62	11.58
Trichoderma viride (2 disc) + *Fusarium oxysporum* f. sp. *ciceri* (1 disc)	6.54	6.76	7.17	7.41	7.65	7.53
Mean	21.14	20.27	20.81	20.74	20.86	20.80

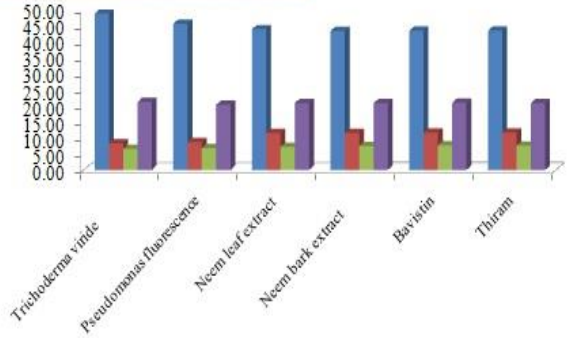

Fig: Effect of *Trichoderma viride* , *Pseudomonas fluroscence*, Neem Leaf Extract, Neem Bark Extract , Bavistin and Thiram on growth of *Fusarium oxysporum f. sp. ciceri* by radial growth at different intervals

Table 2: Effect of bio control agents and fungi-toxicants on wilt incidence of Chickpea at different stages of growth

Effect of bio-control agent and fungitoxicants on the wilt incidence (Number of plant infected)

Treatments	30DAS		60DAS				90DAS			
	2015-16	2016-17	2015-16		2016-17		2015-16		2016-2017	
	Wilt incidence	Percent reduction in wilt incidence over inoculated control.	wilt incidence	Percent reduction in wilt incidence over inoculated control.	Wilt incidence	percent reduction in wilt incidence over inoculated control	Wilt incidence	Percents reduction in wilt incidence over inoculated control.	Wilt incidence	Percent reduction in wilt incidence over inoculated control.
T1 *Fusarium oxysporum* (inoculated)	20.30	21.00	30.30	0.00	30.60	0.00	44.60	0.00	45.00	0.00
T2 *Fusarium oxysporum* + *Trichoderma viride*	3.30	4.00	6.00	80.20	5.60	81.70	6.30	89.90	6.30	86.00
T3 *Fusarium oxysporum*+ *Pseudomonas fluorescence*	8.60	11.30	11.00	63.70	11.60	62.09	14.60	67.30	14.30	68.20
T4 *Fusarium oxysporum*+ Neem leaf extract	12.00	13.00	15.00	50.49	14.60	52.29	21.00	52.90	21.30	52.70
T5 *Fusarium oxysporum* +Neem bark extract	13.30	13.60	14.00	53.80	15.30	50.00	21.30	52.24	21.00	53.30
T6 *Fusarium oxysporum* + Bavistin	2.60	3.00	3.30	89.11	3.60	83.66	5.30	88.12	4.60	86.70
T7 *Fusarium oxysporum*+ Thiram	3.00	4.00	6.00	80.20	5.00	88.24	6.00	86.55	6.00	89.80
T8 Control (Uninoculated)	11.30	12.60	15.00	50.49	16.30	46.73	23.00	48.43	23.30	48.20

Table : Effect of bio-control agents and fungitoxicants on the wilt incidence.(No of plants infected).

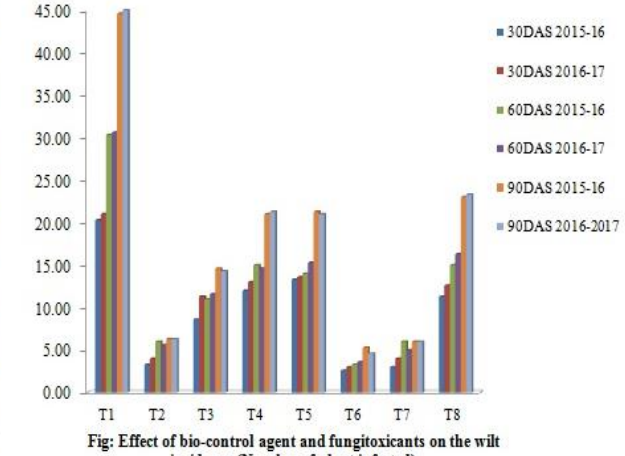

Fig: Effect of bio-control agent and fungitoxicants on the wilt incidence (Number of plant infected)

Table 3: Effect of Bio pesticides and fungitoxicants on the shoot length, root length (cm). shoot weight (g), root weight (g) at 30, 60 and 90 DAS.

Effect of bio-control agents and fungitoxicants on Shoot length, Root length, Shoot weight and Root weight

Treatments	Soot length (cm)			Root length			Shoot weight			Root weight		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Fusarium oxysporum (inoculated)	5.05	13.19	15.44	4.44	5.27	5.45	3.42	6.85	7.95	2.05	4.65	6.64
Fusarium oxysporum+ *Trichoderma viride*	14.90	35.90	47.79	6.57	12.78	16.32	18.80	33.05	47.28	15.25	21.55	32.77
Fusarium oxysporum+ *Pseudomonas fluorescence*	17.64	39.65	52.15	7.33	15.10	17.68	21.55	39.45	49.75	20.95	23.12	35.14
Fusarium oxysporum+ Neem leaf extract	12.30	25.15	40.10	5.95	8.53	12.28	10.55	20.96	35.80	8.93	13.42	20.40
Fusarium oxysporum +Neem bark extract	11.89	24.57	37.15	5.83	8.37	12.20	9.80	21.40	35.95	8.55	13.65	20.56
Fusarium oxysporum + Bavistin	9.60	21.90	21.95	5.62	8.17	12.06	9.27	20.45	35.60	8.45	13.46	21.47
Fusarium oxysporum+ Thiram	10.15	22.40	22.10	5.68	8.23	12.02	9.95	21.16	35.55	8.75	13.30	20.17
Control (Uninoculated)	7.85	16.00	18.68	5.00	6.95	10.73	6.09	18.87	22.20	5.20	9.60	11.46

Table Effect of bio-control agents and fungi-toxicants on the Shoot length (cm), Root length, Shoot Weight and Root Weight during 2015-16 and 2016-17

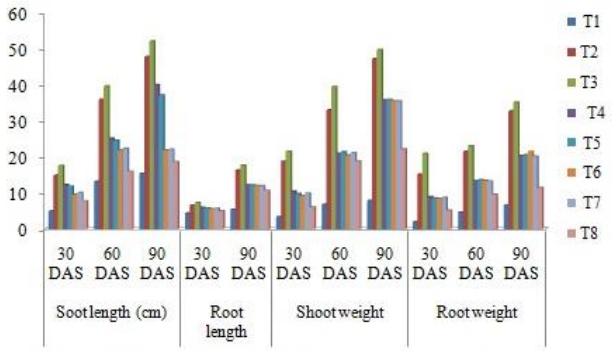

Fig: Effect of bio-control agents and fungitoxicants on Shoot length, Root length, Shoot weight and Root weight

Effect of Bavistin, Thiram on growth of *Fusarium oxysporum* f. Sp. *ciceri*: Bavistin 100 ppm resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Bavistin 10 ppm. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. The order of the treatments $T_2<T_1<T_0$. During both the years of experimentation Thiram 100 ppm resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Thiram 10 ppm. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. The order of the treatments $T_2<T_1<T_0$**.** Interaction effect of Bavistin 100 ppm (T_2) significantly inhibited the growth of *Fusarium oxysporum* f. Sp. *ciceri* as compared with control at all the stages of the radial growth. Bavistin 10 ppm (T_1) also reduced significantly the radial of *Fusarium oxysporum* f. Sp. *ciceri* at all the stages of radial growth as compared with control during both the years of experimentation. Bavistin 100 ppm also reduced the radial growth of *Fusarium oxysporum* f. Sp. *ciceri* significantly as compared with Bavistin 10 ppm at all the stages of radial growth during the years of experimentation. During 2015-2016, and 2016-2017. Thiram 100 ppm (T_2) significantly inhibited the growth of *Fusarium oxysporum* f. Sp. *ciceri* as compare with control at all the stages of the radial growth. Thiram 10 ppm (T_1) also reduced significantly the radial growth of *Fusarium oxysporum* f. Sp. *ciceri* at all the stages of radial growth as compared with control during both the years of experimentation. Thiram 100 ppm also reduced the radial growth of *Fusarium oxysporum* f. sp. *ciceri* significantly as compared with Thiram 10 ppm at all the stages of radial growth during both the year of experimentation.

Comparing the growth of *Fusarium oxysporum* f. Sp. *ciceri* with *Trichoderma viride* in PD broth: During both the years of experimentation data showed that after 12 days of inoculation of fungus in PD broth, the mycelium of *Fusarium oxysporum* f. Sp. *ciceri* was completely overgrown by *Trichoderma viride* in both treatments T_1 (*Fusarium oxysporum* f. Sp. *ciceri* + *Trichoderma viride* ration of 1:1) and T_2 (*Fusarium oxysporum* f. Sp. *ciceri* + *Trichoderma viride* ration of 2:1), where as in T_0 *Fusarium oxysporum* f. Sp. *ciceri* showed its normal growth The present ïn vitro" study indicated that the growth of *Fusarium oxysporum f. Sp. ciceri* ws completely inhibited by *Trichoderma viride* in liquid medium.

Effect of Pseudomonas fluorescence, Neem leaf extract, Neem bark extract, Bavistin, Thiram on growth of *Fusarium oxysporum f. Sp. ciceri* at 12 DAI: 12 days of inoculation of fungus in PD broth, *Pseudomonas fluorescence* 0.3ml resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by *Pseudomonas fluorescence* 0.1 m. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. The order of treatments was $T_2<T_1<T_0$**.** During both the years of experimentation, data showed that after 12 days of inoculation of fungus in PD broth, Neem leaf extract 6% resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Neem leaf extract 3%. The growth of *Fusarium oxysporum* f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. The order of treatment was $T_2<T_1<T_0$. During both the years of experimentation, data showed that after 12 days of inoculation of fungus in PD broth, Neem bark extract 6% resulted in significantly reduced the growth of *Fusarium oxysporum f. Sp. ciceri* followed by Neem bark extract 3%. The growth of *Fusarium oxysporum f. Sp. ciceri* was the highest in the inoculated test fungus treatments. The order of treatments was $T_2<T_1<T_0$. During both the years of experimentation data showed that after 12 days of inoculation of fungus in PD broth, Bavistin 100 ppm resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Bavistin 10 ppm. The growth of *Fusarium* oxysporum f. Sp. *ciceri* was the highest in the inoculated test fungus treatments. The order of treatments was $T_2<T_1<T_0$. During with the years of experimentation, data observed showed that after 12 days of inoculation of fungus in PD broth Thriam 100 ppm resulted in significantly reduced the growth of *Fusarium oxysporum* f. Sp. *ciceri* followed by Thiram 10 pp,. The growth of *Fusarium oxysporum f. Sp. ciceri* was the highest in the inoculated test fungus treatments. The order of treatment was $T_2<T_1<T_0$

Effect of bio control agents and fungi-toxicants on wilt incidence of Chickpea at different stages of growth: At 30 DAS the maximum wilt incidence was recorded in the T_1 (inoculated plots) and the minimum wilt incidence was recorded inthe T_6 (Bavistin + *Fusarium oxysporum* f. Sp. *ciceri*) with 87.19 and 85.71 percent reduction in wilt incidence of chickpea during 2015-2016, and 2016-2017 respectively over inoculated control and it was followed by T_7 (Thiram + *Fusarium oxysporum* f. Sp. *ciceri*) with 85.22 and 80.95 percent reduction in wilt incidence of chickpea over inoculated control during 2015-2016, and 2016-2017 respectively. At 60 DAS the maximum wilt incident was recorded in the T_1 (inoculated plots) and the minimum wilt incidence was recorded in the T_6 (Bavistin + *Fusarium oxysporum* f. Sp. *ciceri*) with 89.11 and 88.66 percent reduction in wilt incident of chickpea During 2015-2016, and 2016-2017 respectively over inoculated control and was followed by T_7 (Thiram + *Fusarium oxysporum* f. Sp. *ciceri*) resulting in 80.20 and 88.66 percent reduction in wilt incident of chickpea over inoculated control during 2015-2016, and 2016-2017 respectively T_2 (*Trichoderma viride* and *Fusarium oxysporum* f. Sp. *ciceri* resulted in 80.2 and 81.7 percent reduction in wilt incident of chickpea over inoculated control during 2015-2016, and 2016-2017 respectively**.** At 90 DAS the maximum wilt incident was recorded in the T_1 (inoculated plots) and the minimum wilt incidence was recorded in the T_6 (Bavistin + *Fusarium oxysporum* f. Sp. *ciceri*) with 88.12 and 89.80 percent reduction in wilt incident of chickpea during 2015-2016, and 2016-2017 respectively over inoculated control and it was followed by T_7 (Thiram + *Fusarium oxysporum* f. Sp. *ciceri*) resulting in 86.55 and 86.70 percent reduction in wilt incident of chickpea over inoculated control during 2015-2016, and 2016-2017 respectively T_2 *(Trichoderma viride + Fusarium oxysporum* f. Sp. *ciceri)* resulted in 85.90 and 86.00 percent reduction in wilt incident of chickpea over inoculated control during 2004-05 and 2005-06 respectively

Effect of Bio pesticides and fungitoxicants on the shoot length, root length (cm). shoot weight (g), root weight (g) at 30, 60 and 90 DAS.

There were significant different in the shoot length (cm) of chickpea due to different treatments at 30, 60 and 90 DAS during both the years of experimentation. At 30 DAS the maximum shoot length was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas flurescence* with 19.78 cm and 15.50 cm of chickpea during 2015-2016, and 2016-2017 and it was followed by T_2 *Fusarium oxysporum* f. Sp. *ciceri + Trichoderma viride* with 17.30 cm and 12.50 cm of chickpea during 2015-2016, and 2016-2017 and the minimum shoot length was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) with 5.00 cm and 5.10 cm of chickpea during 2015-2016, and 2016-2017 respectively. At 60 DAS the maximum shoot length was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescence*) 41.20 cm and 38.10 cm of chickpea during 2015-2016, and 2016-2017 and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri +Trichoderma viride*) 36.8 cm and 35.00 cm of chickpea during 2015-2016, and 2016-2017 respectively and the minimum shoot length was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) 13.50 cm 13.33 cm of chickpea during 2015-2016, and 2016-2017 respectively. The order of Treatments during both the year was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$ at 90 DAS the maximum shoot length was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescene*) 52.30 cm and 52.00 cm of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri +Trichoderma viride*) 47.87 cm and 47.70 cm of chickpea during 2015-16 and 2016-17 respectively and the minimum shoot length was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) 15.50 cm and 15.38 cm of chickpea during 2015-2016, and 2016-2017 respectively. The order of Treatment during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$ at 30 DAS, the maximum root length was recorded in the treatment T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescence* having 7.35 cm and 7.30 cm of chickpea 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri +Trichoderma viride*) having 6.80 and 6.33 cm of chickpea during 2015-2016, and 2016-2017 respectively and the minimum root length was recorded in the T_1 *Fusarium oxysporum* f. Sp. *ciceri* inoculated) having 4.60 cm and 4.27 cm of chickpea during 2015-2016, and 2016-2017 respectively. The order of treatment during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$**.** At 60 DAS the maximum root length was recorded in the treatment T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescence* having 15.06 cm and 15.13 cm of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri + Trichoderma viride*) having 12.73 cm and 12.83 cm of chickpea during 2015-2016, and 2016-2017 respectively and the minimum root length was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri* inoculated) having 5.27 cm and 5.27 cm of chickpea 2015-2016, and 2016-2017 respectively. The order of treatment during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$ at 90 DAS the maximum root length was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescence* having 17.53 cm and 17.83 cm of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri + Trichoderma viride*) having 16.17 cm and 16.47 cm of chickpea during 2015-2016, and 2016-2017 respectively and the minimum root length was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri* inoculated) having 5.43 cm and 5.47 cm of chickpea during 2015-2016, and 2016-2017 respectively. The order of treatment during 2015-16 was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. The order of treatment during 2016-17 $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. There were significant differences in the shoot weight (g) of chickpea due to different treatment at 30, 60 and 90 DAS during both the years of experimentation. At 30 DAS, the maximum shoot weight in (g) was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescence*) having 21.40 g and 21.70 g of chickpea during 2015-2016, and 2016-2017 respectively and it followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri + Trichoderma viride*) having 18.60 g and 19.00 g of chickpea during 2015-2016, and 2016-2017 respectively and the minimum shoot weight was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) havng 3.20 g and 3.63 g of chickpea during 2015-2016, and 2016-2017 respectively. At 60 DAS the maximum shoot weight was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas fluorescence*) having 39.60 g and 39.30 g of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri + Trichoderma viride*) having 33.5 g and 32.6 g of chickpea during 2015-2016, and 2016-2017 respectively and the minimum shoot

weight was recorded in the T_1 *Fusarium oxysporum* f. Sp. *ciceri*) having 6.60 g and 7.10 g of chickpea during 2015-2016, and 2016-2017 respectively The order of treatment during 2015-16 was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. The order of treatment during 2016-17 was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. At 90 DAS the maximum shoot weight was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri* + *Pseudomonas fluorescence*) having 49.70 g and 49.80 g of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri* + *Trichoderma viride*) having 47.06 g and 47.50 g of chickpea during 2015-2016, and 2016-2017 respectively and the minimum shoot weight was recorded in the T_1 (*Fusarium* oxysporum f. Sp. *ciceri*) having 7.60 g and 8.30 g of chickpea during 2015-2016, and 2016-2017 respectively. The order of Treatment during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. At 30 DAS the maximum root weight was recorded in the T_3 *Fusarium oxysporum* f. Sp. *ciceri* + *Pseudomonas fluorescence*) having 20.60 g and D_2 1.30 g of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri* + *Trichoderma viride)* having 15.30 g and 15.40 g of chickpea during 2015-2016, and 2016-2017 respectively and the minimum root weight was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) having 1.90 g and 2.20 g of chickpea during 2015-2016, and 2016-2017 respectively. The order of treatments during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. At 60 DAS the maximum root weight was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri + Pseudomonas flurescence*) having 23.30 g and 23.2 g of chickpea during 2015-2016 and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri* + *Trichoderma viride*) having 21.40 g and 21.70 g of chickpea during 2015-2016, and 2016-2017 respectively and the minimum root weight was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) having 4.8 g and 4.5 g of chickpea during 2015-2016 and 2016-2017 respectively. The order of treatments during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$. At 90 DAS the maximum root weight was recorded in the T_3 (*Fusarium oxysporum* f. Sp. *ciceri* + *Pseudomonas fluorescence*) having 35.10 g and 35.17 g of chickpea during 2015-2016, and 2016-2017 respectively and it was followed by T_2 (*Fusarium oxysporum* f. Sp. *ciceri + Trichoderma viride*) having 32.37 g and 33.17 g of chickpea during 2015-2016, and 2016-2017 respectively and the minimum root weight was recorded in the T_1 (*Fusarium oxysporum* f. Sp. *ciceri*) having 6.60 g and 6.67 g of chickpea during 2015-2016, and 2016-2017 respectively. The order of Treatments during both the years was $T_3>T_2>T_4>T_5>T_7>T_6>T_8>T_1$

Conclusion

The two bio control agents used are viz. *Trichoderma viride and Pseudomonas flurescence*, fungi-toxicants viz. Neem leaf extract, Neem bark extract, Bavistin and Thiram. These tasted in both solid and broth medium. The test fungus isolated was inoculated on PDA and PD- broth. The commercial formulation of *Trichoderma viride* and *Pseudomonas fluorescence* were tested for their viability and population assessment before using in the experiment by Serial dilution techniques Pure culture of *Trichoderma viride* and *Pseudomonas flurescence* was maintained by periodic sub culturing in PDA and PD- broth, King's B medium and King's B broth by zigzag streaking after every 15 day respectively.Soil inoculation with *Fusarium oxysporum* f. sp. *ciceri* @ 100g/ plot of soil. Seed dressed with bio-control agents @ 4g/ Kg of seed and fungitoxicants viz. Neem leaf and Neem bark powder @ 4g/ Kg of seed, Bavistin and Thiram @3 g/Kg of seed. Observation of wilt incidence was recorded at 30, 60 and 90 DAS. Root length, Shoot length, Root weight and Shoot weight were also recorded at 30, 60 and 90 DAS. The wilt incidence was recorded minimum with Bavistin, Thiram and *Trichoderma viride*. The Shoot weight, Root weight, Shoot length and Root length was maximum when treated with *Pseudomonas fluorescence* (T_3), *Trichoderma viride* (T_2). Bavistin, Thiram, *Trochoderma viride* and *Pseudomonas fluorescence* inhibit the growth of *Fusarium oxysporum* f. sp. *ciceri*. But the chemicals provide good short term protection, and the biological fungus provides long term root protection As a consequence, yields frequently are increased over use of the chemical alone chemicals are very toxic for controlling soil- borne disease like *Fusarium oxysporum f. sp. ciceri*. For avoiding these factors, bio-control agents should be use which have eco-friendly non- poisonous behaviour and do not adversely effect the crop. But it still needs more investigation to be conducted in this regards for proper recommendation

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