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Integrated Management of Wilt Disease in Chickpea

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A B S T R A C T

Wilt disease of chickpea caused by *Fusarium oxysporum* f. sp. *ciceri* is serious biotic constraints for Chickpea (*Cicer arietinum* L.) production. These are most important and widespread soil and seed-borne diseases of chickpea grown where the climate is relatively dry and warm. To find out the effective management of the diseases through chemicals and soil application of biocontrol agents, the field studies were conducted during *Rabi* season of 2012-13, 2013-14 and 2014-15. Seed treatment checked the incidence of wilt and increased the yield of chickpea. However, combined applications of seed treatment with *Trichoderma* sp. as well as soil application significantly checked the disease incidence (3.80 %) and increased the grain yield (1352 kg/ha). The pooled result of three years revealed Minimum wilt incidence of 3.78 per cent recorded in carboxin + Thiram @ 2 g/kg seed + soil application of *T. harzianum* @ 4 kg/ha (T_7) at the time of sowing and maximum grain yield 1352 kg/ha was recorded in *T. harzianum* @ 4 g/ha of seed as a seed treatment + soil application of *T. harzianum* @ 4 kg/ha (T_6) at the time of sowing.

Introduction

Gram or chickpea (*Cicer arietinum* L.) is one of the most important *Rabi* pulse crops. Chickpea attacked by numerous root pathogens, of which the most destructive is *Fusarium oxysporum* f. sp. *ciceri* causing vascular wilt. India is a major chickpea growing country producing around 75% of the world's supply (Tomar *et al.*, 2010).

Chickpea wilt is soil and seed-borne; facultative saprophyte and survive in soil for two to three years (Haware *et al.*, 1978). Wilt is the common and frequently occurring diseases of chickpea and causes considerable yield loss (Haware *et al.*, 1996; Kaur and Mukhopadhyay, 1992). *Fusarium oxysporum* f. sp. *ciceri* (Padwick) Synd. and Hans. is considered to be the primary cause of wilt disease in chickpea (Chattopadhyay and Sen Gupta, 1967). These cause complete losses in grain yield, if the diseases occur in the vegetative and reproductive stages of the crop (Haware and Nene, 1980). Researchers have shown that commonly grown cultivars of chickpea in India may suffer from 9-41% seed yield loss due to wilt, depending on the cultivar and disease severity (Khan *et al.*, 2004). Biological control is one of the best low-cost and ecologically sustainable methods for managing plant diseases caused by soil-borne pathogens like *Fusarium*, *Macrophomina*, *Rhizoctonia*, etc. Research

shows that seed and soil applications of different strains of *T. harzianum* successfully control wilt disease caused by *F*. oxysporum f. sp. *ciceri* under pot conditions (Rudresh *et al.,* 2005; Kumar *et al.,* 2008) and field conditions (Prasad *et al.,* 2002; Dubey *et al.,* 2012). The present study was undertaken to examine the performance of *Trichoderma harzianum* through seed treatment and soil application. The fungicidal seed treatment will not severe the complete control of the disease, hence experiment was conducted to manage the disease through bio agent, too.

Materials and Methods

The study was conducted at Pulses Research station, Junagadh Agricultural University, Junagadh during three consecutive years in the *Rabi*: 2012-13, 2013-14 and 2014-15 in Randomized Block Design with ten treatments along with four replications using cultivar Gujarat Junagadh Gram-3. The crop was sown with 45×10 cm spacing having a gross plot size of 3.0 x 2.70 m and net plot size of 4.8 x 2.4 m. The seed rate was used at 60 kg/ha. The experiment was performed in fusarium wilt infected sick soil. The bioagent used in the present investigations was *T. harzianum* and different fungicides viz. vitavex powder, carbendazim and thiram. Per cent disease incidence in each treatment was calculated using the following formula.

$$\text{Wilt incidence (\%)} = \frac{\text{No. of Plant wilted}}{\text{Total Plant stand}} \times 100$$

The benefit cost ratio was calculated on the basis of prevailing market prices of chickpea and other inputs. Benefit cost ratio was calculated as follows:

$$\text{BCR} = \frac{\text{Gross return}}{\text{Total Cost}} \times 100$$

The field experiments comprised of 7 treatments and control (untreated check) given as below

Results and Discussion

Three years pooled analysis for management of chickpea wilt presented in Table 1. It revealed that all the treatments were found significantly effective over the control. Minimum wilt incidence of 3.78 per cent was recorded in carboxin + Thiram (Vitavax power) @ 2 g/kg seed + soil application of *T. harzianum* @ 4 kg/ha (T_7) at the time of sowing, but it was at par with T_6, T_1 and T_4 (3.80%, 4.36% and 4.41%, respectively). The maximum wilt incidence 8.74 per cent was recorded in control.

Results of grain yield showed in Table 2 indicated that maximum grain yield 1352 kg/ha was recorded in *T. harzianum* @ 4 g/ha of seed as a seed treatment + soil application of *T. harzianum* @ 4 kg/ha (T_6) at the time of sowing, but it was at par with T_7 and T_4 (1309 kg/ha and 1261 kg/ha). The minimum grain yield (927 kg/ha) was recorded in control. While considering the cost of treatments, maximum net return of Rs. 16253/ ha was recorded in the treatment of *T. harzianum* @ 4 g/ kg of seed as a seed treatment + soil application of *T. harzianum* @ 4 kg /ha at the time of sowing (T_6) followed by Rs. Rs. 14300/ ha in treatment of carboxin + Thiram @ 2 g/ kg seed + soil application of *T. harzinanum* @ 4 kg/ ha (T_7) at the time of sowing.

The differences in the wilt incidence and grain yield between treatments T_7 and T_6 were non-significant there was a large difference in net return and ICBR.

Therefore the best treatment was T_6 (T_1 + Soil application of *T. harzanium* @ 4 kg/ha at the time of sowing.

Table.1 Details of treatments

Sr. No.	Name of Treatment
T_1	***Trichoderma harzianum* (Pusa 5 SD) @ 4g / kg of seed**
T_2	**Carboxin + Thiram (Vitavax power) @ 2g / kg seed**
T_3	***Trichoderma harzianum* (Pusa 5 SD) @ 4g + Carboxin + Thiram (Vitavax power) @ 1g a.i. / kg seed**
T_4	**Carboxin @ 2g / kg seed**
T_5	**Carbendazim + Thiram (1:2 ratio) @ 3g / kg seed**
T_6	**T_1 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.**
T_7	**T_2 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.**
T_8	**Control**

Table.2 Effect of different treatments on wilt incidence in chickpea

Sr. No.	Treatment	Disease Incidence (%)			Pooled
		(2012-13)	(2013-14)	(2014-15)	
T1	*Trichoderma harzianum* (Pusa 5 SD) @ 4g / kg of seed	2.19 (4.82)	2.20 (4.85)	1.86 (3.48)	**2.10 (4.36)**
T2	Carboxin + Thiram (Vitavax power) @ 2g / kg seed	2.17 (4.70)	2.15 (4.61)	2.09 (4.39)	**2.14 (4.57)**
T3	*Trichoderma harzianum* (Pusa 5 SD) @ 4g + Carboxin + Thiram (Vitavax power) @ 1g a.i. / kg seed	**2.02** (4.09)	2.04 (4.17)	1.87 (3.52)	**1.98 (3.92)**
T4	Carboxin @ 2g / kg seed	2.05 (4.22)	2.37 (5.61)	1.88 (3.53)	**2.10 (4.41)**
T5	Carbendazim + Thiram (1:2 ratio) @ 3g / kg seed	2.06 (4.26)	2.30 (5.28)	1.94 (3.76)	**2.10 (4.41)**
T6	T1 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.	2.12 (4.51)	2.10 (4.41)	**1.63** (2.65)	**1.95 (3.80)**
T7	T2 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.	2.04 (4.15)	**2.03** (4.12)	1.76 (3.11)	**1.94 (3.78)**
T8	Control	3.10 (9.63)	2.96 (8.89)	2.80 (7.85)	**2.96 (8.74)**
	S.Em.±	0.082	0.1103	0.0826	**0.053**
	C.D. at 5 %	0.2412	0.3245	0.243	**0.151**
	C.V. %	7.38	9.73	8.29	**8.57**
	Y x T	**NS**			

Note: √x transform value Data in parenthesis are retransformed values.

Table.3 Effect of different treatments on grain yield in chickpea

Sr. No.	Treatment	Disease Incidence (%)			Pooled
		(2012-13)	(2013-14)	(2014-15)	
T1	*Trichoderma harzianum* (Pusa 5 SD) @ 4g / kg of seed	1127	1187	1059	**1124**
T2	Carboxin + Thiram (Vitavax power) @ 2g / kg seed	1118	1133	1244	**1165**
T3	*Trichoderma harzianum* (Pusa 5 SD) @ 4g + Carboxin + Thiram (Vitavax power) @ 1g a.i. / kg seed	1280	1211	1250	**1247**
T4	Carboxin @ 2g / kg seed	1248	1306	1231	**1261**
T5	Carbendazim + Thiram (1:2 ratio) @ 3g / kg seed	1110	1204	1286	**1200**
T6	T1 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.	1242	1340	1476	**1352**
T7	T2 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.	1217	1336	1372	**1309**
T8	Control	883	904	995	**927**
	S.Em.±	44.3	62.099	50.74	**30.55**
	C.D. at 5 %	130.4	182.716	149.25	**86.36**
	C.V. %	7.7	10.33	8.2	**8.83**
	Y x T	**N.S.**			

Table.4 Economics of different treatments for the control of wilt of chickpea

Sr. No.	Treatment	Yield Increased over control	Gross Income (RS.)	Expenditure Cost (Rs.)		Total Expenditure (Rs.)	Net Return (Rs.)	ICBR
				Material cost/ha	Labour			
T1	*Trichoderma harzianum* (Pusa 5 SD) @ 4g / kg of seed	197	7880	17	-	17	7863	1:462.53
T2	Carboxin + Thiram (Vitavax power) @ 2g / kg seed	238	9520	250	-	250	9270	1:37.08
T3	*Trichoderma harzianum* (Pusa 5 SD) @ 4g + Carboxin + Thiram (Vitavax power) @ 1g a.i. / kg seed	320	12800	267	-	267	12533	1:46.94
T4	Carboxin @ 2g / kg seed	334	13360	264		264	13096	1:49.60
T5	Carbendazim + Thiram (1:2 ratio) @ 3g / kg seed	273	10920	106		106	10814	1:102.02
T6	T1 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.	425	17000	297	450	747	**16253**	1:21.76
T7	T2 + Soil application of *T. harzianum* @ 4kg/ha at the time of Sowing.	382	15820	530	450	980	**14300**	1:14.59

Price of one kilogram (Rs): Chickpea seed-40/-, Carbendazim-960/-, Thiram-400/-, Carboxin -2200/-, *Trichoderma harzianum* -70/-, Carboxin + Thiram -2080-
Labourer cost: 150 Rs/day

Manjunatha *et al.,* (2013) reported minimum root rot incidence of chickpea (2.67%) with higher seed germination (97.60%) and seed yield (1274 kg/ha) achieved through seed treatment of *T. viride* + soil application of FYM at 4 kg/plot. Rudresh *et al.,* (2005) reported significant control of wet root rot and *Fusarium* wilt of chickpea by soil application of *T. harzianum* (PDBCTH) and *T. virens* (PDBCTV12), respectively. Soil application of *T. harzianum*, *T. viride*, and *T. virens* has been found to be effective in controlling root rot (Khan and Gupta, 1998; Ganesan *et al.,* 2007; Kumar *et al.,* 2008) and wilt diseases (Prasad *et al.,* 2002; Dubey *et al.,* 2012). In the present study, seed treatment and soil application of *T. harzianum* provided better disease control with greater crop yield enhancement. Pandey *et al.,* (2017) reported singnificantly loweset wilt incidance and root rot (8.59%) and highest seed germination (96.69 %), vigour index (2734) and grain yield (1535 kg/ha) in the treatment T5 i.e. seed biopriming for 10 hrs with suspension of talc based formulation ($2x10^8$ cfu/g) of *T. viride* @ 50 g in 250 ml of water/ kg of seed + soil application of *T. viride* enriched FYM (10 kg bioagent/ ton FYM) in furrow @ 1 ton/ ha Animisha *et al.,* (2012).

Lowest percentage of wilt (19.0%) was found with *T. viride* (T_2) followed by carbendazim (21 %), neem cake (42.6 %), carbendazim + neem cake (45.2 %), carbendazim + *T. viridae* (47.2 %), neem cake + *T. viridae* (48.2 %). Sharma *et al.,* (2005) reported that the combination of neem cake + carbendazim + *T. harzianum* provided the highest control of the disease *Fusarium* yellows caused by *Fusarium oxysporum* f. sp. *gladioli.* Nikam *et al.,* (2007) reported that combined soil application of *T. viride* and ground nut cake followed by neem cake had given good control against chickpea wilt caused by *Fusarium oxysporum* f. sp. *cicero* (Table 3 and 4).

Looking to the effectiveness of different treatments grain yield and economics, the best treatment was seed treatment of *T. harzanium* (Pusa 5 SD) @ 4 g/Kg seed along with soil application of *T. harzianum* @ 4 kg/ha at the time of sowing.

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