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Field evaluation of integrated approaches for managing *Fusarium* wilt of chickpea

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Abstract
To manage *Fusarium oxysporum* F. sp. *Ciceri* (*Foc*), a soil borne plant pathogen, biorationals and *Trichoderma* (T 19001) were tested individually and in integration under field conditions during *rabi* 2018-19 and 2019-2020. One potential T 19001 isolate was selected for field studies based on *in vitro* antagonistic potential, production of strong volatile metabolites, non-volatiles and its compatibility with Panchagavya. Seed treatment with tebuconazole was also tested to compare relative efficacy of biorationals and / or *Trichoderma* in managing *Foc* wilt. Observations were also taken on stem rot due to *Sclerotium rolfsii* and dry root rot due to *Macrophomina phaseolina* (wilt complex). Pooled analysis during *rabi* 2018-19 and 2019-20 to assess the biocontrol potential of T 19001 in integration with biorationals revealed that seed treatment with T 19001 + Panchagavya @ 10% resulted in maximum disease control (35.9%) of chickpea wilt complex, yield (1586.5 kg/ha) and B:C ratio (2.40) and was on par with Tebuconazole seed treatment (1672.0 kg/ha and 2.42 B:C ratio). Beejaraksha and beejamrutha were inferior to panchagavya either alone or in integration with T 19001.

Keywords: *Foc*, Panchagavya, *Trichoderma*, chickpea, seed treatment, wilt incidence

Introduction

Chickpea (*Cicer arietinum* L.) is among the earliest cultivated legumes, originating over 7,500 years ago in the Middle East, and ranks as the third most important *Rabi* pulse crop globally after dry beans and peas. It is predominantly grown under rainfed conditions in diverse soils and is widely cultivated in the dry regions of the Indian subcontinent, which contributes nearly 90% of global chickpea production (Juan *et al*., 2000) [5]. Chickpea is an important source of human food and animal feed due to its high lysine-rich protein content and is consumed in various forms such as dhal, vegetables, soups and snacks, while its by-products are used as livestock feed (Jukanti *et al*., 2012) [6]. India, Australia, and Pakistan are the major producers, contributing 67.32%, 6.19%, and 5.72% of global production, respectively (Jendoubi *et al*., 2017) [4].

Chickpea productivity is constrained by both biotic and abiotic stresses, particularly diseases caused by fungal pathogens. The crop is attacked by nearly 172 pathogens worldwide, with the highest diversity reported from India (Nene *et al*., 1996) [13]. Major fungal diseases include *Fusarium* wilt, collar rot, dry root rot, Ascochyta blight, and Botrytis gray mold. Among these, soil-borne pathogens such as *Fusarium oxysporum* F. sp. *ciceris*, *Sclerotium rolfsii*, and *Macrophomina phaseolina* are the most destructive, causing plant mortality ranging from 10 to 100%. *Fusarium* wilt caused by *Fusarium oxysporum* F. sp. *ciceris* (Foc) is the most prevalent disease in India (McKerral, 1923) [11] and a major constraint to chickpea productivity (Haware and Nene, 1982; Hossain *et al*., 2013) [2, 3]. Disease incidence ranges from 14 to 32% across Indian states, with yield losses of 10-15% and up to 100% under favorable conditions (Cortes *et al*., 2000; Warda *et al*., 2017) [5, 17].

Management is challenging due to the soil-borne nature of the pathogen and limitations of chemical control, necessitating integrated, sustainable and eco-friendly disease management approaches that combine organic matter, non-conventional chemicals and PGPR-based bioagents (Landa *et al*., 2004; Kumar *et al*., 2020) [10, 8].

Materials and Methods

A field experiment was conducted during *Rabi* 2018-19 and 2019-2020 at the College Farm, Agricultural College, Bapatla, Guntur district, Andhra Pradesh. The treatments were seed treatment of *Trichoderma* isolate T19001 (T_1), Panchagavya 10% (T_2), Beejamrutha 10% (T_3), Beejaraksha 6% (T_4), $T_1 + T_2$ (T_5), $T_1 + T_3$ (T_6), $T_1 + T_4$ (T_7), Tebuconazole (T_8) and Control (T_9). The seeds were soaked in biorational solution *i.e.,* 10% panchagavya or beejamrutha for 20 min and shade dried. Beejaraksha powder was added @ 6 g per kg of seed and mixed. For *Trichoderma* seed treatment, seeds were mixed with 0.1% carboxy methyl cellulose (CMC) then, the spore suspension of *Trichoderma* was sprinkled, mixed and shade dried. For combinations, the seeds were initially soaked in biorational and shade dried then, they were treated with 0.1% CMC and sprinkled the *Trichoderma* spore suspension and shade dried. The spore concentration of *Trichoderma* was adjusted to 10^8 cfu/ml using a haemocytometer (Whitehead, 1957) [18].

All the treatments were imposed on the same day of sowing and observations were recorded on germination per cent, plant stand, number of wilted plants and disease incidence (%). Observations on yield parameters like number of pods per plant, number of grains per plant, root length, shoot length, 100-seed weight and grain yield per plant were recorded.

Results and Discussion

During evaluation of field experiments conducted in *Rabi* 2018 and 2019-2020, the incidence of the three major soil borne diseases caused by *S. rolfsii*, *Foc* and *M. phaseolina* were observed on the basis of symptoms and *in vitro* isolations. Throughout the crop growing period, occurrences of all the soil borne pathogens were recorded at periodic intervals of 15 days and samples were collected from field for *in vitro* isolations. Among the treatments that were tested, seed treatment with tebuconazole was found to be effective.

During *Rabi* 2018-19, disease incidences of *S. rolfsii*, *Foc* and *M. phaseolina* were least in tebuconazole treated plants with 1.6%, 11.7% and 0.9% disease incidence respectively. Among biorationals, Panchagavya in combination with *Trichoderma* was found effective after fungicidal check with 4.0%, 20.8% and 2.6% disease incidences respectively against control (13.0%, 38.9% and 8.5%). During *Rabi* 2019-2020 also, tebuconazole seed treatment was found effective in controlling all three pathogens (1.7%, 32.9% and 3.8%) followed by *Trichoderma* + panchagavya treatment (2.1%, 37.0% and 5.1%) over control (10.3%, 53.3% and 15.0%). Among biorationals, panchagavya had a beneficial effect on *Trichoderma* followed by *Trichoderma* alone. Beejaraksha and beejamrutha had a negative influence on *Trichoderma* (Table 1). In pooled analysis, tebuconazole treated plants were found effective in controlling all the three diseases. Except chemical fungicide, the combination of *Trichoderma* with Panchagavya showed least disease incidence (35.9%) of all three diseases and panchagavya has increased the efficacy of *Trichoderma* in controlling the diseases. The disease incidence was found high in beejamrutha alone treated plants (60.7%) over control (69.5%), (Table 1).

Among all the treatments, germination was found to be non-significant during *Rabi* 2018-19 and 2019-2020. Plant stand at harvest was affected due to wilt complex and plant stand% was found to be higher in tebuconazole seed treatment (93.2% and 84.1%) over control (74.7% and 68.4%) during *Rabi* 2018-19 and 2019-2020 (Table 2). Mortality was highest in beejamrutha alone and beejaraksha alone with or without *Trichoderma*. Beejamrutha and beejaraksha were not effective and even found to decrease the efficacy of *Trichoderma* when used in combination with *Trichoderma* (Table 2).

It may be noted here that *in vitro* experiments revealed highly compatible nature of *Trichoderma* and beejamrutha in comparison with beejaraksha and panchagavya. Further, inhibition effect of panchagavya was more on *Foc* when compared to the same by beejamrutha and beejaraksha. Thus, it may be presumed that panchagavya acted better against *Foc*, while *Trichoderma* sustained better under natural soil due to dissipation of inhibitory effect of panchagavya which further helped in sustenance of *Trichoderma* over panchagavya as carbon source.

Table 1: Effect of *Trichoderma* and biorationals on incidence of chickpea wilt complex under field conditions

Tr. No.	Treatments	Disease incidence (2018-19)				Disease incidence (2019-2020)				Pooled data			
		Sclerotium rolfsii (%)	*Fusarium oxysporum cicerii* (%)	*Macrophomina phaseolina* (%)	Total	*Sclerotium rolfsii* (%)	*Fusarium oxysporum cicerii* (%)	*Macrophomina phaseolina* (%)	Total	*Sclerotium rolfsii* (%)	*Fusarium oxysporum cicerii* (%)	*Macrophomina phaseolina* (%)	Total
T_1	*Trichoderma* seed treatment	5.4^{c}	23.1^{c}	3.3^{b}	31.8	6.0^{b}	40.6^{bc}	7.1^{bc}	53.7	5.7^{c}	31.9^{c}	5.2^{c}	42.8
T_2	Panchagavya seed treatment	5.8^{c}	25.3^{c}	5.3^{c}	36.4	7.1^{bc}	42.7^{cd}	8.6^{cd}	58.4	6.4^{c}	34.0^{cd}	6.9^{d}	47.4
T_3	Beejamrutha seed treatment	9.7^{f}	33.3^{f}	7.7^{ef}	50.7	9.4^{de}	47.1^{d}	14.1^{e}	70.6	9.6^{f}	40.2^{f}	10.9^{f}	60.7
T_4	Beejaraksha seed treatment	7.3^{d}	26.6^{d}	5.8^{cd}	39.7	8.0^{cd}	43.9^{cd}	8.3^{cd}	60.2	7.7^{d}	35.3^{d}	7.1^{d}	50.0
T_5	T_1+T_2	4.0^{b}	20.8^{b}	2.6^{b}	27.4	2.1^{a}	37.0^{ab}	5.1^{ab}	44.2	3.1^{b}	28.9^{b}	3.9^{b}	35.9
T_6	T3+T_1	8.4^{e}	30.7^{e}	7.4^{e}	46.5	8.9^{de}	46.4^{d}	10.4^{d}	65.7	8.7^{e}	38.5^{ef}	8.9^{e}	56.1
T_7	T_1+T_4	8.1^{de}	29.9^{e}	6.3^{d}	44.3	8.4^{cd}	45.5^{cde}	9.6^{d}	63.5	8.3^{de}	37.7^{e}	7.9^{de}	53.9
T_8	Tebuconazole seed treatment	1.6^{a}	11.7^{a}	0.9^{a}	14.2	1.7^{a}	32.9^{a}	3.8^{a}	38.4	1.7^{a}	22.3^{a}	2.4^{a}	26.3
T_9	Absolute control	13.0^{g}	38.9^{g}	8.5^{f}	60.4	10.3^{e}	53.3^{e}	15.0^{e}	78.6	11.7^{g}	46.1^{g}	11.7^{f}	69.5
	Mean	7.1	26.7	5.3	39.1	6.9	43.3	9.1	59.3	7.0	35.0	7.2	49.2
	SEM ±	0.45	0.24	0.41		0.49	0.66	0.76		0.30	0.36	0.43	
	CV%	5.23	1.38	5.56		5.79	2.79	7.69		3.49	1.74	4.95	
	C.D. ($p \leq 0.05$)	1.35	0.73	1.24		1.48	1.99	2.29		0.90	1.09	1.3 0	

Values with similar alphabets do not differ significantly

Table 2: Effect of *Trichoderma* and biorationals on chickpea wilt management during *Rabi* 2018-2019 and 2019-2020.

		***Rabi* 2018-2019**						***Rabi* 2019-2020**					
Tr. No.	**Treatments**	**Actual germination**	**Germination* (%)**	**Plant stand at harvest**	**Plant stand* (%)**	**Plant mortality (%)**	**Disease control (%)**	**Actual germination**	**Germination* (%)**	**Plant stand at harvest**	**Plant stand* (%)**	**Plant mortality (%)**	**Disease control (%)**
T_1	*Trichoderma* seed treatment	279	92.9 (75.09)	264	87.9 (69.9)^{abc}	12.1	52.2	249	82.9 (65.62)	233.7	77.9 (61.96)^{b}	22.1	30.06
T_2	Panchagavya seed treatment	278	92.7 (74.72)	262	87.3 (69.3)^{abc}	12.7	49.8	248	82.6 (65.29)	230.0	76.7 (61.09)^{bc}	23.3	26.3
T_3	Beejamrutha seed treatment	263	87.8 (69.89)	238	79.2 (63.0)^{d}	20.8	17.8	236	78.8 (62.56)	214.0	71.3 (57.61)^{cd}	28.7	9.2
T_4	Beejaraksha seed treatment	269	89.7 (71.46)	249	83.1 (65.8)^{bcd}	16.9	33.3	241	80.2 (63.58)	221.3	73.8(59.17)^{bcd}	26.2	17.1
T_5	T_1+T_2	280	93.3 (75.49)	269	89.6 (71.4)^{ab}	10.4	58.8	254	84.7 (67.08)	248.7	82.9 (65.65)^{a}	17.1	45.8
T_6	T_1+T_3	265	88.4 (70.19)	243	81.0 (64.2)^{cd}	19.0	25.0	243	80.9 (64.09)	221.0	73.7 (59.11)^{bcd}	26.3	16.7
T_7	T_1+T_4	266	88.8 (70.49)	245	81.6 (64.6)^{cd}	18.4	27.2	242	80.7 (63.98)	221.7	73.9 (59.30)^{bcd}	26.1	17.4
T_8	Tebuconazole seed treatment	284	94.8 (76.85)	280	93.2 (75.0)^{a}	6.8	73.3	257	85.6 (67.66)	252.3	84.1 (66.51)^{a}	15.9	49.7
T_9	Absolute control	256	85.2 (67.41)	224	74.7 (59.8)^{d}	25.3		229	76.3 (60.92)	205.3	68.4 (55.82)^{d}	31.6	
	SEm ±		2.27		1.88				1.36		1.20		
	CV%		5.42		4.85				3.7		3.43		
	C.D. (0.05)		NS		5.62				NS		3.60		

Each plot was sown with 300 seeds, *Percentages were calculated based on 300 seeds/plot, Values in the parenthesis are arc sine transformed values, Values with similar alphabets do not differ significantly

During *Rabi* 2018-19, data on yield parameters were taken and no significant difference among the treatments were found with respect to yield parameters like number of pods per plant, number of seeds per plant, shoot and root length. Yield was found to be the highest in tebuconazole treated plants (1666.70 kg/ha) with B:C ratio of 2.41 on par with *Trichoderma* + panchagavya (1554.52 kg/ha) with 2.34 b:c ratio. Yield was found least in beejamrutha and beejaraksha seed treatments alone (1121.79 and 1100.43 kg/ha) with 1.70 and 1.64 B:C ratio over control (913.48 kg/ha and 1.47 B:C ratio) (Table 3). During *Rabi* 2019-2020, no significant difference was obtained with respect to data on yield parameters like number of pods per plant, number of seeds per plant, shoot and root length. Yield and B:C ratio was found to be highest in tebuconazole treated plants (1677.35 kg/ha and 2.39 B:C ratio) and in *Trichoderma* + panchagavya treatment (1623.93 kg/ha and 2.41 B:C ratio) which were on par with *Trichoderma* seed treatment (1581.20 kg/ha and 2.38 B:C ratio), (Table 3).

Similarly, in pooled analysis, insignificant differences in the yield parameters like number of pods per plant, number of seeds per plant, shoot and root length was obtained. Yield and B:C ratio was found to be highest in tebuconazole treated plants (1672.0 kg/ha and 2.42 B:C ratio) which was on par with *Trichoderma* + panchagavya (1586.5 kg/ha) with 2.40 b:c ratio. Yield was found least in beejaraksha seed treatments alone (1151.2 kg/ha) with 1.72 B:C ratio over control (953.5 kg/ha and 1.55 B:C ratio) (Table 4 and Figure 1).

Thus, it may be interpreted that in the present chickpea wilt complex system, neither biorationals nor *Trichoderma* when applied either alone or in integration were found effective as chickpea plant growth promoters, as there is no significant difference in yield parameters. Hence, increase in yield is totally attributed to the plant stand.

Table 3: Effect of *Trichoderma* and biorationals on chickpea yield and yield attributing characters during *Rabi* 2018-2019 and 2019-2020

		***Rabi*, 2018-2019**								***Rabi*, 2019-2020**							
Tr. No.	**Treatments**	**N. of pods/ plant**	**Shoot length (cm)**	**Root length (cm)**	**No of seeds/ plant**	**100-seed weight (g)**	**Yield / plot**	**Yield (Kg/ ha)**	**B:C ratio**	**No of pods/ plant**	**Shoot length (cm)**	**Root length (cm)**	**No of seeds/ plant**	**100-seed weight (g)**	**Yield / plot**	**Yield (Kg/ ha)**	**B :C ratio**
T_1	*Trichoderma* seed treatment	49.3	33.8	11.2	80.3	25.8^{a}	0.92^{b}	1469.02	2.25	51.4	33.1	13.3	79.7	26.9^{b}	0.99^{ab}	1581.20	2.38
T_2	Panchagavya seed treatment	42.7	32.9	11.1	73.3	23.7^{b}	0.87^{b}	1394.26	2.11	44.0	32.8	11.3	73.3	24.7^{c}	0.91^{b}	1463.68	2.17
T_3	Beejamrutha seed treatment	40.4	31.3	9.8	71.3	20.5^{cd}	0.70^{c}	1121.82	1.70	41.4	29.4	10.4	74.0	21.9^{d}	0.80^{c}	1282.05	1.91
T_4	Beeja raksha seed treatment	43.4	33.0	10.4	73.7	19.3^{d}	0.69^{c}	1105.79	1.64	43.3	26.6	10.6	72.7	19.7^{de}	0.75^{c}	1201.92	1.76
T_5	T_1+T_2	48.9	34.3	11.9	81.3	27.7^{a}	0.97^{ab}	1554.52	2.34	49.7	34.2	12.3	80.0	29.2^{a}	1.01^{a}	1623.93	2.41
T_6	T_1+T_3	41.1	32.6	10.6	72.7	21.5^{c}	0.72^{dc}	1153.87	1.69	42.3	31.7	11.4	72.0	21.5^{d}	0.76^{c}	1217.95	1.76
T_7	T_1+T_4	45.4	33.2	10.8	76.0	19.9^{cd}	0.70^{dc}	1121.82	1.63	46.2	29.9	10.1	74.7	20.7^{de}	0.73^{c}	1169.87	1.68
T_8	Tebuconazole seed treatment	43.5	34.4	11.3	82.0	27.8^{a}	1.04^{a}	1666.70	2.41	43.6	28.8	11.3	77.3	28.9^{ab}	1.05^{a}	1677.35	2.39
T_9	Absolute control	42.4	30.1	11.5	77.0	18.8^{cd}	0.57^{d}	913.48	1.47	42.0	29.6	11.2	74.0	19.2^{e}	0.62^{d}	998.93	1.59
	SEm ±	1.38	0.65	0.33	1.99	0.37	0.02	36.70		1.59	0.9	0.5	2.7	0.42	0.02	28.69	
	CV%	9.42	5.94	9.02	7.80	4.93	8.63	8.63		10.67	8.75	12.36	10.75	5.37	6.34	6.34	
	C.D. (0.05)	NS	NS	NS	NS	1.12	0.07			NS	NS	NS	NS	1.27	0.06	86.01	

Values with similar alphabets do not differ significantly, Net plot area= 6.24 sq.m, Yield/ha conversion factor= 1602.6

Table 4: Effect of *Trichoderma* and biorationals on chickpea yield and yield attributing characters (Pooled data)

Tr. No.	Treatments	No of pods/ plant	Shoot length (cm)	Root length (cm)	No of seeds/ plant	100-seed weight (g)	Yield / plot	Yield (Kg/ ha)	B:C Ratio
T_1	*Trichoderma* seed treatment	50.3	33.5	12.2	80.0	26.4^{b}	0.95^{bc}	1525.1	2.33
T_2	Panchagavya seed treatment	43.3	32.9	11.2	73.3	24.2^{c}	0.89^{c}	1431.6	2.16
T_3	Beejamrutha seed treatment	40.9	30.4	10.1	72.7	21.2^{d}	0.75d	1201.9	1.82
T_4	Beeja raksha seed treatment	43.4	29.8	10.5	73.2	19.5^{e}	0.72^{d}	1151.2	1.72
T_5	T_1+T_2	49.3	34.3	12.1	80.7	28.5^{a}	0.99^{ab}	1586.5	2.40
T_6	T_1+T_3	41.7	32.2	11.0	72.3	21.5^{d}	0.74^{d}	1185.9	1.74
T_7	T_1+T_4	45.8	31.5	10.5	75.3	20.3^{de}	0.71^{d}	1143.2	1.67
T_8	Tebuconazole seed treatment	43.5	31.6	11.3	79.7	28.4^{a}	1.04^{a}	1672.0	2.42
T_9	Absolute control	42.2	29.9	11.3	75.5	19.0^{e}	0.60^{e}	953.5	1.55
	SEm ±	1.29	0.62	0.3	1.67	0.31	0.02	25.25	
	CV%	8.67	5.85	8.21	6.6	3.99	5.75	5.75	
	C.D. (0.05)	NS	NS	NS	NS	0.93	0.05	75.70	

Values with similar alphabets do not differ significantly, Net plot area= 6.24 sq.m, Yield/ha conversion factor= 1602.6

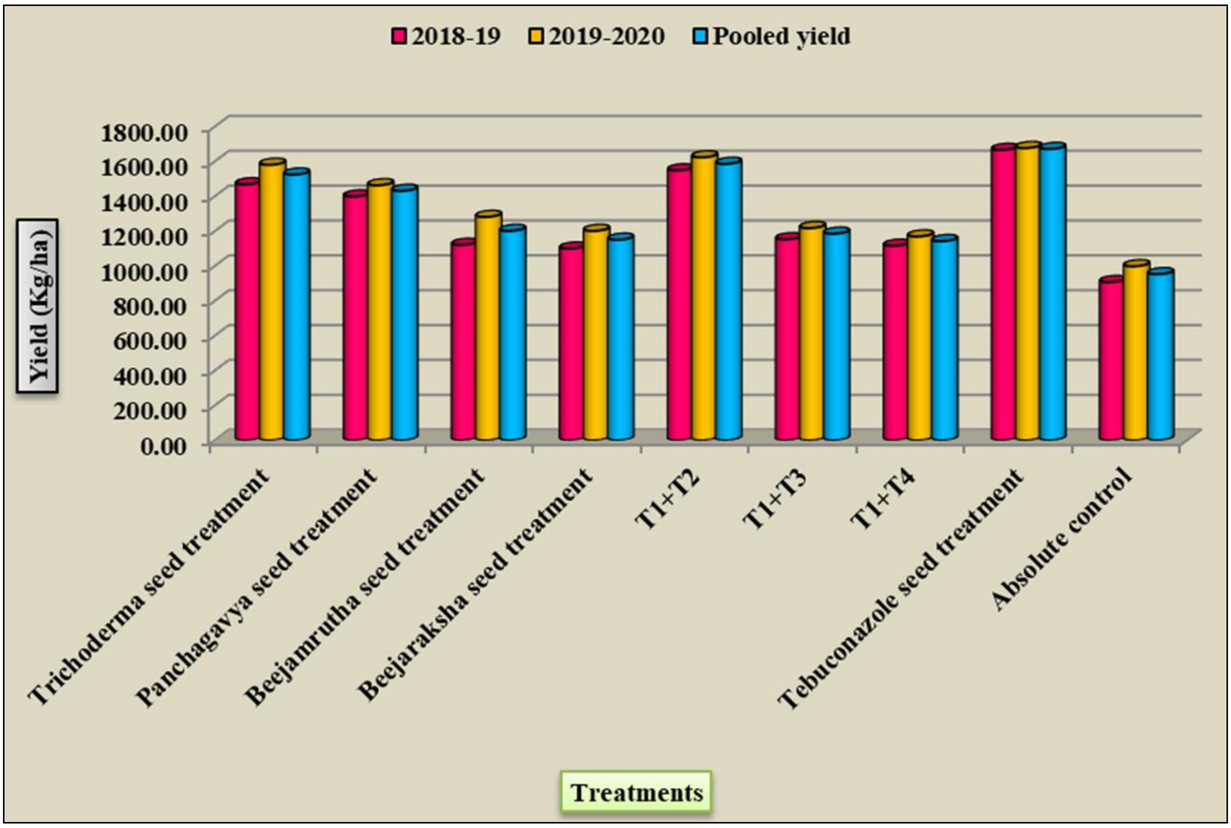

Fig 1: Effect of *Trichoderma* and biorationals on yield (kg/ha) during *Rabi* 2018-19, 2019-20 and pooled data

Several reports were published indicating the efficacy of biocontrol agents, organic amendments and biorationals in decreasing plant diseases specially caused by soil borne plant pathogenic fungi. Population of *F.O.* F. sp. *ciceri* (wilt of chickpea) in soil was reduced when bioagents (*Trichoderma* spp. + *P. fluorescens*) treated seeds were sown in soils amended with organic composts (FYM and vermicompost) by enhancing the disease control potentiality of antagonists (Kala *et al.*, 2016) [7]. Shubha (2014) [15] studied the effect of seed treatment, panchagavya application and organic farming systems on growth and yield of Maize. Maximum yield of 19.90 q/ha was recorded in seed treatment with Panchagavya (3%) followed by beejamrutha (17.99 q/ha) and minimum grain yield of 16.90 q/ha was recorded in control. Organic amendments are being recommended as biological means to reduce the incidence of several soil borne plant pathogens. Amendments of soil with organic materials have tremendous effect on enhancing the chickpea yield as it reduces the incidence of *Fusarium* wilt up to a considerable level (Patra *et al.*, 2017) [14]. Similar results of integrated management of *Fusarium* wilt were observed by Yang *et al.* (2011) [19], Hossain *et al.* (2013) [3], Kumar (2017) [9], Kumar *et al.* (2020) [8], Nandeesha and Huilgol, 2021 [12] and Vikas *et al.* (2024) [16].

Conclusion

Among different treatments tested under field conditions against chickpea wilt complex, with special reference to *Fusarium* wilt, T 19001+ Panchagavya (10%) seed treatment resulted in best control and was on par with fungicide (Tebuconazole seed treatment) with an yield (1100 kg/ha) and B:C ratio 1.66. Hence, the adoption of integrated disease management approaches is strongly recommended for effective and sustainable management of *Fusarium* wilt in chickpea.

References

1. Cortes NJA, Hau B, Diaz JRM. Yield loss in chickpeas in relation to development of *Fusarium* wilt epidemics. Phytopathol. 2000;90:1269-78.
2. Haware MP, Nene YL. Symptomless carriers of the chickpea wilt *Fusarium*. Plant Dis. 1982;66:250-251.

3. Hossain M, Hossain N, Sultana F, Islam SMN, Islam SM, Bhuiyan MKA. Integrated management of *Fusarium* wilt of chickpea (*Cicer arietinum* L.) caused by *Fusarium oxysporum* f. sp. *ciceris* with microbial antagonist, botanical extract. Biotechnol. 2013;12(29):4699-706.
4. Jendoubi W, Bouhadida M, Amal B, Mohamed MBK. *Fusarium* wilt affecting chickpea crop. Agric. 2017;7(23):1-16.
5. Juan A, Cortes NJA, Bernard H, Diaz JM. Yield loss in chickpeas in relation to development of *Fusarium* wilt epidemics. Phytopathol. 2000;90:1269-1278.
6. Jukanti AK, Gaur PM, Gowda CL, Chibbar RN. Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.): a review. Br J Nutr. 2012;108:11-26.
7. Kala C, Gangopadhyay S, Godara SL. Eco-friendly management of wilt caused by *Fusarium oxysporum* f.sp. *Ciceri* in chickpea. Legum Res. 2016;39(1):129-34.
8. Kumar S, Sahni S, Prasad BD. Integrated disease management of chickpea *Fusarium* wilt. Curr J App Sci Techno. 2020;39(7):20-25.
9. Kumar U. Integrated wilt disease management in chickpea. Int J Pure App Biosci. 2017;5(6):981-984.
10. Landa BB, Cortes NJA, Diaz JRM. Integrated management of *Fusarium* wilt of chickpea with sowing date, host resistance, and biological control. Phytopathol. 2004;94:946-960.
11. Mckerral A. A note on *Fusarium* wilt of gram in Burma and measures taken to combat it. Agri J Ind. 1923;28:608-613.
12. Nandeesha KL, Huilgol SN. Integrated management of *Fusarium* wilt of chickpea. Phar Innov J. 2021;10(7):174-177.
13. Nene YL, Sheila VK, Sharma SB. A world list of chickpea and pigeonpea pathogen. 5th Ed. Patancheru: ICRISAT; 1996, p. 27.
14. Patra S, Biswas MK, Mahato A. Prevalence of *Fusarium* wilt of chickpea in the agro-ecological condition of undulating red and lateritic zone of West Bengal, India. Int J Curr Microbiol Appl Sci. 2017;6(11):2456-62.
15. Shubha S. Effect of seed treatment, Panchagavya application, growth and yield of maize. In: Rahmann G, Aksoy U, editors. Building Organic Bridges. Braunschweig: Johann Heinrich von Thunen-Institute; 2014, p. 631-634.
16. Vikash K, Kartikay B, Ravi K, Aditya G, Ramkumar. Studies on biological management of chickpea wilt caused by *Fusarium oxysporum* F. sp. *ciceri*. Int J Adv Biochem Res. 2024;8(6):391-396.
17. Warda J, Mariem B, Amal B, Mohamed B, Mohamed K. A review on *Fusarium* wilt affecting chickpea crop. Agricul. 2017;7(23):1-16.
18. Whitehead MD. Sorghum grain, a medium suitable for the increase of inoculum for studies of soil-borne and certain other fungi. Phytopathol. 1957;47(7):450.
19. Yang X, Chen L, Yong X, Shen Q. Formulations can affect rhizosphere colonization and biocontrol efficiency of *Trichoderma harzianum* SQR-T037 against *Fusarium* wilt of cucumbers. Biol Fertil Soils. 2011;47(3):239-248.