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Antagonistic Activity of *Panchagavya* and *Trichoderma* spp. against Wilt Complex causing Pathogens of Chickpea (*Cicer arietinum* L.)

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ABSTRACT

Background: Chickpea wilt complex caused by several soil-borne pathogens is the major yield-reducing malady worldwide. Biological control is one of the best, low-cost and ecologically sustainable method for managing plant diseases caused by soil-borne pathogens.

Methods: In this present investigation *Panchagavya* and *Trichoderma* spp. were evaluated by following poisoned food technique and dual culture technique against wilt complex causing pathogens *i.e. Fusarium oxysporum* f. sp. *ciceri, Fusarium solani* and *Macrophomina phaseolina*.

Result: Among the different isolates of *Trichoderma* spp. evaluated, *Trichoderma viride* (AAU isolate) was highly antagonistic to *F. oxysporum* f. sp. *ciceri* (52.78%) and *F. solani* (65.37%) whereas, *Trichoderma asperellum* (AAU isolate) was highly antagonistic to *M. phaseolina* (65.93%). *Panchagavya* at the highest concentration (50%) showed significantly higher efficacy (80.74, 66.62 and 49.67%) in inhibiting the mycelial growth of all three pathogens and at the lowest concentration it was moderately effective.

Key words: Biological control, Chickpea wilt complex, *Fusarium oxysporum*, *Fusarium solani, Macrophomina phaseolina, Panchagavya*, *Trichoderma.*

INTRODUCTION

Chickpea (*Cicer arietinum* L.) occupies an important place in the pulse production and India is the largest producer of chickpea in the world. About 172 pathogens including 67 fungi, 3 bacteria, 22 viruses and 80 nematodes have been reported infecting chickpea world-wide (Nene *et al*., 1996), out of which 89 have been reported from India alone (Cother, 1977).

Among these, wilt complex caused by several soil-borne pathogens is one of the most destructive diseases of chickpea. Biological management has been proved to be an effective and safer alternative to hazardous agrochemicals against these soil-borne pathogens.

Panchagavya, an ancient preparation has been used to enhance the plant growth and resistance to diseases in traditional agricultural systems in India (Munshi, 1964). It increases the immunity of plants, thus the plants will be able to resist pests and diseases (Natarajan, 2002). While, among the various biocontrol agents *Trichoderma* spp. has been widely studied for their biocontrol ability (Sharma *et al*., 2014). Keeping this in view, the present investigation was carried to assess the efficiency of *Panchagavya* and *Trichoderma* spp. against wilt complex causing pathogens *i.e. F. oxysporum* f. sp. *ciceri, F. solani* and *M. phaseolina in vitro*.

MATERIALS AND METHODS

The experiment was carried out at the Department of Plant Pathology, B. A. College of Agriculture, AAU, Anand. The pathogens *viz., F. oxysporum* f. sp. *ciceri, F. solani* and *M. phaseolina* were isolated from infected chickpea plants on Potato Dextrose Agar (PDA) medium.

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Panchagavya

The effect of *panchagavya* was studied against all three pathogens separately at different concentrations *i.e.* 10, 20, 30, 40 and 50% using poisoned food technique given by Grover and Moore (1962). Three repetitions were kept for each concentration. The observation on the linear growth of the fungus was recorded until the entire plate in control was completely covered with mycelium. The per cent growth inhibition (PGI) over control was calculated by using the formula given by Vincent (1947).

$$PGI = \frac{DC - DT}{DC} \times 100$$

Where,

DC (Diameter of control) = Mean diameter of mycelial colony in control treatment (mm).

DT (Diameter of treatment) = Mean diameter of mycelial colony in treated set (mm).

Preparation of *panchagavya*

Panchagavya was prepared by the following method developed by the National Centre of Organic Farming (NCOF), Gaziabad (Anonymous, 2017).

- Fresh cow dung (500 g) and cow ghee (50 g) were mixed and poured in an earthen pot. This mixture was stored for three days and stirred two times a day during these three days, once in the morning and the other time in the evening.
- Then, cow urine (500 ml) and water (500 ml) were mixed into this mixture. The mixture was stored for three days and stirred two times a day.
- After that, cow milk (100 ml), curd (100 g), jaggery (150 g) and a ripened banana by making a paste were added in the mixture. The mixture was stirred daily for 15 days and closed tightly, the *panchagavya* was ready and used for the experiment (Fig 1).

Trichoderma spp.

The effects of different *Trichoderma* spp. *viz., T. viride, T. harzianum* and *T. asperellum* were studied by dual culture technique (Dennis and Webster, 1971) against wilt complex causing pathogens separately. *Trichoderma* spp. isolates were obtained from the Department of Plant Pathology, BACA, Anand Agricultural University, Anand, the Department of Plant Pathology, CoA, Junagadh Agricultural University, Junagadh and the Department of Plant Pathology, NMCA, Navsari Agricultural University, Navsari for the experiment. Three repetitions were maintained for each antagonist. In control, the pathogen alone was inoculated at center. Observation on the radial growth was recorded from 24 hr. of the incubation at 28±1°C till the complete growth of test pathogen in control plates. The per cent growth inhibition (PGI) over control was calculated by using the formula given by Vincent (1947).

Results and Discussion

Panchagavya

The antifungal effect of *panchagavya* on mycelial growth of fungal pathogens revealed that *panchagavya* exhibited significant inhibition of all the test organisms (Table 1 and Fig 2).

F. oxysporum f. sp. *ciceri*

Among the five different concentrations, *panchagavya*, 50% showed significantly maximum growth inhibition (80.74%) with lowest fungal colony diameter (17.33 mm) which was at par with *panchagavya*, 40% (78.63%) with the colony diameter of 19.23 mm. The next better antagonists in order of merit were as per the higher to lower concentration *viz.,* 30, 20% with 60.79 and 53.19 per cent growth inhibition, respectively. The least per cent growth inhibition was recorded with the lowest concentration of 10% (8.77%) with the colony diameter of 82.10 mm.

F. solani

A similar trend was observed in mycelial growth inhibition of *F. solani* as it was observed in *F. oxysporum* f. sp. *ciceri*. At the lowest concentration (10%), *panchagavya* was moderately effective as it inhibited the pathogen's growth by 7.87%, while at the highest concentration (50%) the growth inhibition was 66.62 per cent.

M. phaseolina

Panchagavya was moderately effective to inhibit the mycelial growth of *M. phaseolina.* At 50% concentration, *panchagavya* recorded maximum growth inhibition (49.67%) with lowest fungal colony diameter (45.30 mm) followed by *panchagavya*, 40% (32.20%) with the colony diameter of 60.56 mm, while at 10 and 20% concentration, it was not effective to inhibit the growth of *M. phaseolina*.

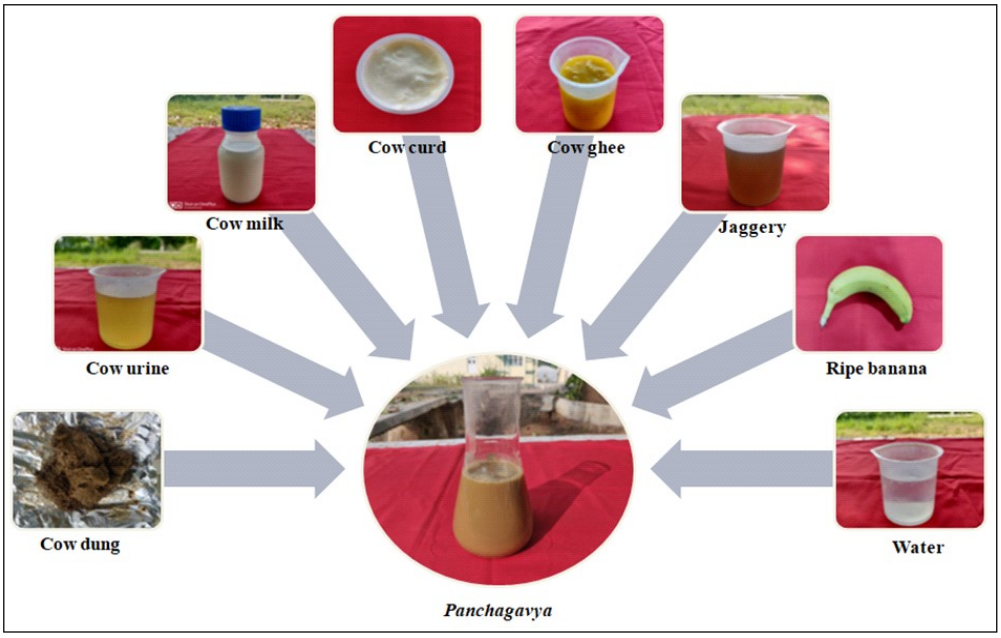


Fig 1: Ingredients used in the preparation of *panchagavya*.

Indigenous agricultural practices, which are based on natural and organic methods of farming offer several feasible and effective solutions to most of the problems being faced in the conventional farming system. "Cow" plays a key role in most of the organic farming systems prevailing in Asian countries and elsewhere. In the present investigation, it has been contemplated that '*Panchagavya'* contains growth-promoting hormones result in impressive yield and as immunity booster made the environment non-conducive for diseases.

Kumar *et al.* (2010) also found the effectiveness of *panchagavya* at the highest concentration (50%), while moderately effective at the lowest concentration (5%) against *Pythium aphanidermatum* causing damping-off in tomato. The above results were also in agreement with the findings of Jandaik and Sharma (2016), Kumar *et al.* (2018) and Rathore and Patil (2019) against *F. oxysporum, F. solani, R. bataticola, R. solani* and *S. rolfsii*.

***Trichoderma* spp.**

The antagonistic effect of *Trichoderma* spp. revealed that all the tested isolates significantly reduced the radial mycelial growth of all the test pathogens (Table 2 and Fig 3).

F. oxysporum* f. sp. *ciceri

Trichoderma spp. inhibited mycelial growth in the range of 42.85 to 52.78 per cent over the control. Out of seven antagonists, *T. viride* (AAU isolate) was found significantly superior in growth inhibition (52.78%) with lowest fungal colony diameter (42.50 mm) of *F. oxysporum* f. sp. *ciceri* followed by *T. viride* (JAU isolate) (49.63%) with the colony diameter of 45.33 mm and *T. viride* (NAU isolate) (48.89%) with the colony diameter of 46.00 mm. The least growth inhibition was recorded with *T. harzianum* (NAU isolate) (42.85%) with the colony diameter of 51.43 mm.

F. solani

All the antagonists tested have shown a significant reduction of the radial mycelial growth of *F. solani* to the extent of 55.56 to 65.37 per cent as compared to control. Out of seven antagonists, *T. viride* (AAU isolate) showed significantly maximum growth inhibition (65.37%) with lowest colony diameter (31.17 mm) of *F. solani* which was at par with *T. harzianum* (JAU isolate) (64.44%) with the colony diameter of 32.00 mm.

Table 1: *In vitro* evaluation of *panchagavya* against wilt complex causing pathogens.

Tr. no.	Treatments	*F. oxysporum* f. sp. *ciceri*		*F. solani*		*M. phaseolina*	
		Mycelial growth of pathogen (mm)	Growth inhibition (%)	Mycelial growth of pathogen (mm)	Growth inhibition (%)	Mycelial growth of pathogen (mm)	Growth inhibition (%)
T_1	*Panchagavya*, 10%	82.10	8.77	82.92	7.87	88.65	1.50
T_2	*Panchagavya*, 20%	42.13	53.19	46.12	48.75	85.40	5.11
T_3	*Panchagavya*, 30%	35.29	60.79	42.14	53.18	80.39	10.68
T_4	*Panchagavya*, 40%	19.23	78.63	33.81	62.43	60.56	32.20
T_5	*Panchagavya*, 50%	17.33	80.74	30.04	66.62	45.30	49.67
T_6	Control (Test pathogen only)	90.00	-	90.00	0.00	90.00	0.00
	S.Em±	-	0.98	-	1.12	-	0.43
	C.D. at 5%	-	3.03	-	3.46	-	1.33
	C.V. %	-	3.62	-	4.88	-	4.54

Table 2: *In vitro* evaluation of *Trichoderma* spp. against wilt complex causing pathogens.

Tr. no.	Antagonists	*F. oxysporum* f. sp. *ciceri*		*F. solani*		*M. phaseolina*	
		Mycelial growth of pathogen (mm)	Growth inhibition (%)	Mycelial growth of pathogen (mm)	Growth inhibition (%)	Mycelial growth of pathogen (mm)	Growth inhibition (%)
T_1	*T. viride* (AAU isolate)	42.50	52.78	31.17	65.37	38.00	57.78
T_2	*T. viride* (JAU isolate)	45.33	49.63	38.17	57.59	39.00	56.67
T_3	*T. viride* (NAU isolate)	46.00	48.89	40.00	55.56	42.33	52.96
T_4	*T. harzianum* (AAU isolate)	49.50	45.00	35.33	60.74	42.67	52.59
T_5	*T. harzianum* (JAU isolate)	49.67	44.82	32.00	64.44	44.00	51.11
T_6	*T. harzianum* (NAU isolate)	51.43	42.85	34.33	61.85	34.67	61.48
T_7	*T. asperellum* (AAU isolate)	50.00	44.44	37.00	58.89	30.67	65.93
T_8	Control (Test pathogen only)	90.00	-	90.00	-	90.00	-
	S.Em±	-	0.99	-	0.71	-	1.09
	C.D. at 5%	-	2.98	-	2.13	-	3.29
	C.V. %	-	4.20	-	2.32	-	3.81

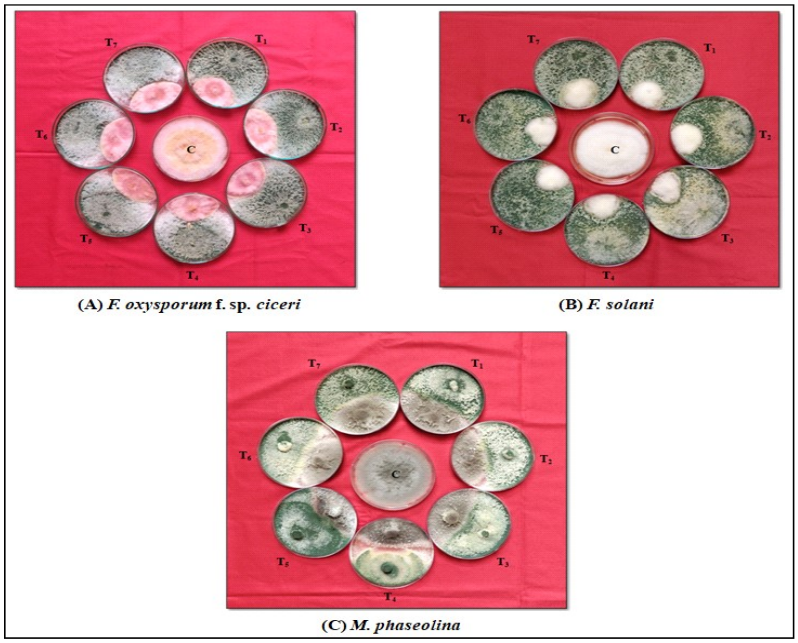


Fig 2: *In vitro* evaluation of *Trichoderma* spp. against wilt complex causing pathogens.

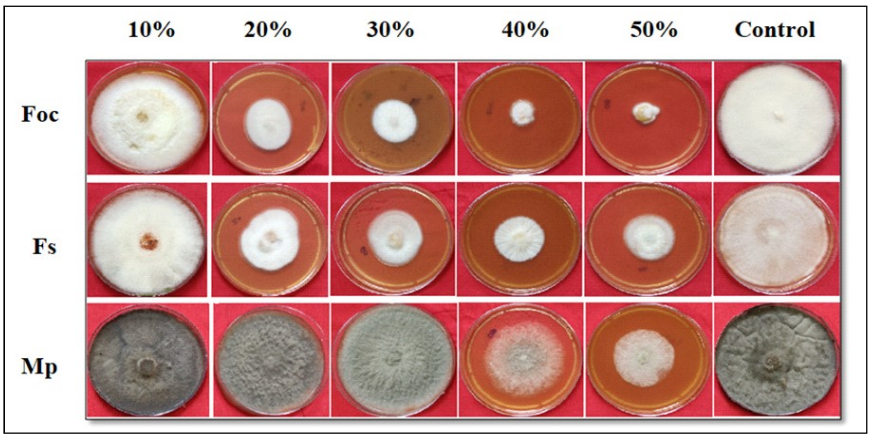


Fig 3: *In vitro* evaluation of *panchagavya* against wilt complex causing pathogens.

M. phaseolina

The maximum per cent growth inhibition (65.93%) of the pathogen was observed in *T. asperellum* with lowest colony diameter (30.67 mm), while the next better was *T. harzianum* (NAU isolate) (61.48%) with the colony diameter of 34.67 mm. The next better antagonists in order of merit were *T. viride* (AAU isolate), *T. viride* (JAU isolate), *T. viride* (NAU isolate), *T. harzianum* (AAU isolate) and *T. harzianum* (JAU isolate) with growth inhibition of 57.78, 56.67, 52.96, 52.59 and 51.11%, respectively.

Biocontrol agents are the balance wheel in nature, where there is life there is antagonism. Domestic isolates are the most virulent strains because of their persistent capability under the soil and local climatic conditions.

Similarly andrabi *et al.* (2011), Chanu *et al.* (2018), Lakhran and Ahir (2020) and Khanna *et al.* (2021) also evaluated *Trichoderma* spp. against chickpea soil-borne pathogens *viz., F. oxysporum* f. sp. *ciceri*, *F. solani*, *R. solani* and *S. rolfsii* and reported *T. viride* as most effective in inhibiting mycelial growth of the pathogens. The present findings are also in harmony with earlier workers *viz.,* Dhedhi *et al*. (1990), Devika Rani *et al.* (2009) and Nagamani *et al.* (2018).

Conclusion

In nutshell, with an increase in the concentration of the *panchagavya*, there was a corresponding increase in the inhibition of mycelial growth of the fungal pathogens. All the *Trichoderma* spp. were effective in reducing the mycelial growth of chickpea wilt complex pathogens. Further, *T. viride* isolates were superior in inhibiting the growth of *Fusarium* spp. and *T. asperellum* isolate was significant in inhibiting the growth of *M. phaseolina*.

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