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Comparative performance of fungicides and bio-control agents for management of collar rot in chickpea

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Abstract
Collar rot disease in chickpea, caused by *Sclerotium rolfsii*, is an important, fast-spreading soil-borne pathogen. The seed treatment is an important practice for disease control by preventing the pathogen from infecting seeds and young seedlings. A field experiment was conducted to evaluate the comparative performance of fungicides and bio-agents as a seed treatment for the management of collar rot during two consecutive years, 2019-21. A total of eight treatments were studied. Among those, seed treatment with Carboxin 37.5% + Thiram 37.5% DS @ 1.5 g/kg of seed + *Trichoderma* formulation (CPRT-10) @ 10 g/kg of seed showed 69.8% disease control which was on par with vitavax power @ 1.5 g/kg of seed+ *Trichoderma formulation* (CPRT-8) @ 10 g/kg of seed (65.7%). Similarly, the maximum seed yield (2231 kg/ha) was recorded in Carboxin 37.5% + Thiram 37.5% DS @ 1.5 g/kg of seed + *Trichoderma* formulation (CPRT-10) @ 10 g/kg of seed followed by vitavax power @ 1.5 g/kg of seed+ *Trichoderma formulation* (CPRT-8) @ 10 g/kg of seed (2165 kg/ha). Hence, it was concluded that using a combination of a bio-control agent (*Trichoderma*) with a fungicide for seed treatment was effective in the management of collar rot in chickpea.

Keywords: Collar rot, chickpea, seed treatment, *Trichoderma* and fungicides

Introduction
Chickpea (*Cicer arietinum* L.) is one of the world's most important pulse crops grown under rainfed conditions. The predominant soil-borne pathogen that affects the chickpea crop during the seedling stage (upto 6 weeks) was *Sclerotium rolfsii*, which causes 55-95% mortality of chickpea seedlings (Gurha & Dubey 1982) [4]. In Rayalaseema region of Andhra Pradesh, disease incidence of 6.31-12.2% was reported in chickpea during 2012-13 (Nagamani *et al.* 2015) [6]. Similarly, 3.6-18.0% incidence of collar rot was observed in Kurnool district of Andhra Pradesh during 2018-19 (Noor *et al.* 2020) [8]. Recently, the collar rot incidence ranged from 3.3 to 28.5% in Nandyal district during 2024-25 (Annual Report, 2024). *S. rolfsii* affects the collar region of chickpea plants, which can persist as mycelium in diseased tissues and plant debris, as well as in the form of sclerotial structures in the soil or in association with plant debris. Due to its extreme competitive saprophytic survival abilities, *S. rolfsii* has become more prevalent in agricultural areas with high temperatures and sudden rainfall, resulting in increased soil wetness for extended periods of time.

Seed treatment is an effective method, as it significantly reduces the damage/loss caused by collar rot. In the past, many fungicidal seed treatments have been suggested to reduce collar rot incidence in chickpea. However, judicious use of fungicides has led impose serious hazardous effects on rhizosphere microflora. Therefore, integration of biological agents with fungicides in the seed treatment of chickpea could be very effective against collar rot pathogen (Ahsan *et al.* 2020) [3]. The biocontrol agents have been used not only for the management of soil borne diseases but also for the improvement of plant growth. Keeping this in view, the present study was conducted to know the comparative performance of bio-agents, fungicides alone, and combination of bio control agents with fungicides for seed treatment against collar rot of Chickpea.

Materials and Methods

Treatments details

***Trichoderma* formulations:** Two potential strains of *Trichoderma* isolates were used in the present study namely CPRT-8 and CPRT-10 (Chickpea Rhizospheric *Trichoderma* spp.). The antagonistic effect of both *Trichoderma* isolates against *Sclerotium rolfsii* were proved in lab experiments as well as in pot culture studies (Noor, 2019) [7]. Talc based formulations of CPRT-8 & CPRT-10 were used for the seed treatment (10 g/ Kg of seed).

Fungicides: Three fungicides *i.e* Carboxin 37.5% + Thiram 37.5% DS (vitavax power) @ 1.5g/Kg of seed, Tebuconazole 2% DS @ 1.5g/Kg of seed and Carbendizim 12% + Mancozeb 63% WP @ 2g/Kg of seed were evaluated as a seed treatment chemicals against collar rot disease in Chickpea.

Integration of bio agent and Fungicide: The compatibility studies of *Trichoderma* isolates with fungicides were carried out. The compatibility of *Trichoderma* isolates (CPRT-8 and CPRT-10) was found with vitavax power fungicide at different concentrations. Hence, the fungicide vitavax power @ 1.5g/Kg of seed was used in combination with two *Trichoderma* formulation (CPRT-8 &CPRT-10) @10 g/Kg of seed.

Treatments

T_1-Seed treatment with CPRT-8 (10 g/Kg of seed)
T_2- Seed treatment with CPRT-8 (10 g/Kg of seed)
T_3- Seed treatment with Carboxin 37.5% + Thiram 37.5% DS (1.5g/Kg of seed)
T_4- Seed treatment with Tebuconazole 2% DS (1.5g/Kg of seed)
T_5- Seed treatment with Carbendizim 12% + Mancozeb 63% WP (2g/Kg of seed)
T_6- Seed treatment with CPRT-8 (10 g/Kg of seed) + Carboxin 37.5% + Thiram 37.5% DS @ 1.5g/Kg of seed
T_7- Seed treatment with CPRT-10 (10 g/Kg of seed) + Carboxin 37.5% + Thiram 37.5% DS @ 1.5g/Kg of seed)
T_8-Control

Statistical Analysis

The field experiment was planned in a randomized block design with a plot size of 3×3 mT_2 with three replications. Mean comparison of the treatments were done through Duncan Multiple Range Test (DMRT) and the significance of difference among the means was calculated by LSD (least Significant Difference) test.

Results and Discussion

The field experiment was carried out at Regional Agricultural Research Station, Nandyal, Kurnool district, Andhra Pradesh during Rabi season of 2019-20 and 2020-21. The chickpea variety NBeG-49 was used in this study. Total eight treatments were evaluated against collar rot of chickpea, consisting of three fungicide treatments (Vitavax power-Carboxin+ Thiram @ 1.5g/Kg of seed, Tebuconozole @ 1.5g/Kg of seed and Carbendizim + Mancozeb @ 2g/Kg of seed), two treatments with *Trichoderma* formulations (10 g/Kg of seed) alone and two treatments with in combination with Vitavax power @ 1.5g/Kg of seed. The chickpea seeds were first treated with chemical fungicide and thereafter treated with *Trichoderma* formulations (CPRT-8 & CPRT-10). Untreated chickpea seeds served as control. Observations on initial plant population, Percent disease incidence, seed yield per ha and B:C ratio were recorded.

Effect of different bio-agents/ fungicide treatments on Initial Plant Population (IPP), Disease Incidence (PDI), and Yield

The data mentioned in the Table 1 revealed that there is a significant difference among the various bio-agents/ fungicide seed treatments on initial plant population (IPP), per cent disease incidence (PDI), and yield, indicating the effectiveness of the treatments for reducing the collar rot disease incidence and thereby in increasing the crop productivity.

Table 1: The comparative evaluation of fungicides and bio-agents for the management of chickpea collar rot (pooled data of two years)

Treatments	Details of seed treatment	Initial plant population	Percent Disease Incidence	Yield (Kg/ha)
T_1	CPRT 8 @10 gm/Kg seed	198 ^{ab} (14.10)	8.09 ^{cd} (16.52)	1763 ^{a}
T_2	CPRT 10 @10 gm/Kg seed	220 ^{bcd} (14.86)	7.02 ^{bcd} (15.35)	1855^{ab}
T_3	Vitavax power @ 1.5gm/Kg seed	225 ^{cd} (15.03)	5.42 ^{b} (13.41)	2049 ^{bcd}
T_4	Tebeuconazole @ 1.5gm/Kg seed	229 ^{cd} (15.15)	6.79 ^{bc} (15.07)	2039 ^{bcd}
T_5	Carbendazim +Mancozeb @2 gm/Kg seed	216 ^{bc} (14.73)	8.77 ^{d} (17.20)	1987 ^{bc}
T_6	CPRT 8 @10 gm/Kg seed +Vitavax power @ 1.5gm/Kg seed	231 ^{cd} (15.25)	3.97 ^{a} (11.45)	2165 ^{cd}
T_7	CPRT 10 @10 gm/Kg seed +Vitavax power @ 1.5gm/Kg seed	247 ^{d} (15.75)	3.50 ^{a} (10.77)	2231 ^{d}
T_8	Control	180 ^{a} (13.44)	11.58 ^{e} (19.88)	1650 ^{a}
	S.Em (±)	0.28	0.66	71.83
	CD at 0.05%	0.843	1.83	201.06
	CV	3.26	7.59	6.32

Initial Plant Population (IPP)

Seed treatment significantly influenced the initial plant population (IPP). The maximum IPP (247) was recorded with the treatment T_7 (CPRT 10 @ 10 g/kg seed + Vitavax Power @ 1.5 g/kg seed), which was statistically superior to all other treatments, which was followed by T_6 (CPRT 8 @ 10 g/kg seed + Vitavax Power @ 1.5 g/kg seed) with 232 plants.

These two treatments showed a significant improvement in plant stand compared to untreated control (T_8, 180 plants). The increased plant stand was observed may be due to the synergistic action of chickpea rhizospheric *Trichoderma* and Vitavax Power, which effectively protected the seed and emerging seedlings from the soil-borne pathogens. Similar findings were reported by earlier workers who observed that seed treatment with a combination of fungicides and bio agents offers better germination.

Per cent Disease Incidence (PDI)

Per cent disease incidence (PDI) was significantly reduced in all the treatments except in the control. The lowest disease incidence was observed in T_7 (3.50%) and T_6 (3.97%), which were statistically at par and significantly superior to all other treatments. These results indicate that the combination of chickpea rhizospheric *Trichoderma* and Vitavax Power provided maximum disease control which might be possible because of their complementary modes of action Vitavax Power providing systemic control against seed- and soil-borne pathogens and Trichoderma isolate might colonize the root system and there by provides different ways of protection against collar rot pathogen in the chickpea.

Moderate level disease incidence was recorded in the chemical fungicidal treatments alone *i.e* in T_3 (Vitavax Power @ 1.5 g kg^{-1} seed) and T_4 (Tebuconazole @ 1.5 g kg^{-1} seed) with disease incidence of 5.42% and 6.79%, respectively, but, it was significantly lower than the untreated control (11.58%). The treatments T_1 (CPRT 8) and T_5 (Carbendazim + Mancozeb) were less effective, showing higher disease incidence of 8.09% and 8.77% respectively.

Yield

A significant difference in crop yield was observed among the eight treatments which follows a similar trend of IPP and PDI. The highest yield (2231 kg/ha) was recorded with T_7 (CPRT 10 + Vitavax Power), followed by T_6 (2165 kg/ha) and T_3 (2049 kg/ha). These three treatments were significantly superior compared to control (1650 kg/ha).

The higher yields obtained from combination treatments can be achieved with better seed germination, good plant stand and lower disease incidence which results in improved plant growth. Inversely, the lowest yield in the control was due to poor plant establishment and high disease pressure, which results in reduction of yield.

The positive correlation observed between IPP and yield, and the inverse relationship between PDI and yield, suggests that effective disease management through seed treatment.

The results of the present study coincide with the results reported by Ashan *et al*. (2020), who reported that combining Vitavax with either *T. harzianum* seed treatment or T. harzianum soil application significantly enhanced collar rot disease control as compared to the untreated control. The significant disease control was achieved when *T. harzianum* was applied as a soil application combined with Vitavax as seed treatment @ 10 g and 0.2% per kg seed respectively, followed by integration of Vitavax with *T. harzianum* for seed treatment. Similarly, Ravinder *et al.* (2008) [11] found that seed treated with *T. harzianum* (4 g/kg seed) + carboxin (0.5 g/kg seed) provided maximum protection to the crop against *S. rolfsii* in chickpea by giving maximum seedling emergence and grain yield (18.2 q/ha). Aravind *et al*., 2025 also reported cent percent germination and lowest incidence of disease was recorded in seed treatment with captan 70% + hexaconazole 5% WP and the soil was supplemented with vermicompost enriched *Trichoderma harzianum*. The similar findings were reported with collar rot disease affecting various crops like sugar beet, tobacco and Groundnut (Upadhyay and Mukhopadhyay, 1986; Tiwari and Mukhopadhyay, 2003) [13, 12]. However, the present study findings differ with Khalequzzaman (2016) [9], who reported less disease incidence of 21.67 per cent in the treatment of Carboxin 17.5 + Thiram 17.5 FF against *S. rolfsii* and it was 59.90% disease control with the integration of seed treatment using *T. harzianum* and Vitavax, which was at par with that obtained by seed treatment with Vitavax 0.2% alone.

Conclusion

Seed treatment with combined use of fungicides and bioagents proved to be significantly more effective than individual treatments in improving the initial plant population, minimizing disease incidence, and increasing yield. Among all treatments, T_7 (CPRT 10 + Vitavax Power) emerged as the most efficient, followed by T_6 (CPRT 8 + Vitavax Power). The untreated control recorded the poorest performance across all parameters. These findings demonstrate the significance of integrated seed treatment techniques for sustainable disease management and yield enhancement in the crop under study.

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