



Management of dry root rot disease in chickpea (*Cicer Arietinum* L.) caused by *Macrophomina Phaseolina*

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Abstract: A field experiment was carried out during *Rabi* and *Kharif* season at ZARS, UAS, GKVK, Bangalore under sick plot soil condition. Among the 15 treatments employed in management of dry root rot (DRR) during the *Rabi* season seed treatment with tebuconazole (2g kg⁻¹ of seed) recorded significantly lowest dry root rot incidence of 7.12 % with highest yield of 754.74 kg ha⁻¹, followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) recorded 14.87 % disease incidence with a yield of 721.05 kg ha⁻¹ compared to control which recorded 42.18 % diseases incidence with yield of 309.86 kg ha⁻¹. During *Kharif* season also seed treatment with tebuconazole (2g kg⁻¹ of seed) recorded lowest dry root rot incidence of 10.28 % with highest yield of 697.36 kg ha⁻¹, followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) recorded 16.44 % disease incidence with yield of 637.86 kg ha⁻¹ compared to control which recorded highest disease incidence of 45.64 % with yield of 259.55 kg ha⁻¹. Mean data of *Rabi* and *Kharif* seasons indicated that seed treatment with tebuconazole (2g kg⁻¹ of seed) recorded least disease incidence (8.70 %) with highest yield of 726.05 kg ha⁻¹ and C: B ratio (1:2.37), followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) recorded 15.66 % diseases incidence with yield of 679.45 kg ha⁻¹ and C: B ratio of 1:2.20 compared to control which recorded 43.91 % diseases incidence with yield of 284.70 kg ha⁻¹ and C: B ratio of 1:0.95.

Key words: Chickpea, *Macrophomina phaseolina*, Management, DRR

Introduction

Chickpea (*Cicer arietinum* L.), is the second most important pulse crop in the world. It is also known as Gram or Bengal Gram. In India, accounts around 60 and 75 per cent of the world's chickpea production. Chickpea seeds contain high quality easily digestible protein (25%) and carbohydrates (~20 %) making it an important source of protein for the vegetarians of the country and thus it is also called "Poor man's meat." In India it is grown in an area of about 9.51 m ha with production of 8.83 million tones and productivity of 929 kg ha⁻¹. In Karnataka it is grown in 0.8 m ha with production of 0.38 million tones and productivity of 473 kg ha⁻¹ (Singh, 2013).

Chickpea plays a significant role in improving soil fertility by fixing the atmospheric nitrogen. Chickpea meets 80 % of its nitrogen (N) requirement from symbiotic nitrogen fixation and can fix up to 140 kg N ha⁻¹ from air. It leaves substantial amount of residual nitrogen for subsequent crops and adds plenty of organic matter to maintain and improve soil health and fertility. Because of its deep tap root system, chickpea can withstand drought conditions by extracting water from deeper layers in the soil profile (Gaur *et al.*, 2010). The per hectare production is low in spite of high yielding varieties and new agronomic practices. The reasons of low yields are so many,

apart from other reasons the main cause of low yields of this crop is the incidence of diseases. The crop is vulnerable to a number of airborne and soil-borne diseases, some of which may be devastating. Chickpea suffers from about 172 pathogens consisting of fungi, bacteria, viruses and nematodes. Soil borne diseases such as wilt (*Fusarium oxysporum* f. sp. *ciceris*), dry root rot (*Macrophomina phaseolina*), black root rot (*Fusarium solani*), collar rot (*Sclerotium rolfsii*), and stem rot (*Sclerotinia sclerotiorum*) are important yield reducers. The foliar diseases, which may seriously damage chickpea under favourable conditions are blight caused by *Ascochyta rabiei* and grey mould caused by *Botrytis cinerea*. Dry root rot of chickpea caused by *M. phaseolina* is a major constraint in the chickpea production as it is emerging as a potential threat to chickpea cultivation in semi-arid regions because the host plant is predisposed to infection by moisture stress and high temperatures during the flowering to pod filling stage (Sharma *et al.* 2010). The annual yield loss due to this disease alone is 10-20 % (Vishwadhar and Chaudhary, 2001).

The dry root rot disease generally appears around flowering and podding stage. The disease may also appear at seedling stage, however, the susceptibility of the plant increases

with age. The disease generally appears when day temperature is more than 30°C and soil moisture content of 60 %. Drooping of petioles and leaflets is confined to those at the very top of the plant. Sometimes when the rest of the plant is dry, the top most leaves are chlorotic. The leaves and stems of affected plants are usually straw colored. The lower portion of the tap root usually remains in the soil when plants are uprooted. The tap root is dark, shows signs of rotting and is devoid of most of its lateral and finer roots. Dark, minute sclerotial bodies can be seen on the roots exposed or inside the wood (Nene *et al.*, 2012). *M. phaseolina* is primarily seed and soil-borne fungal pathogen. In chickpea, infected seeds and microsclerotia surviving in the soil are the major source of primary inoculum. The pathogen also has wide host range. The improved practices for disease management will pave a way to mitigate losses caused by dry root rot.

Materials and Methods

A field experiment was carried out during Rabi and Kharif season at ZARS, UAS, GKVK, Bangalore under sick plot soil condition during 2014-15. Three replications were maintained for each treatment with RCBD design. The % disease incidence and yield was recorded in individual treatments and the data was statistically analyzed. The treatment details are as follows.

- T1: Seed treatment with *Tricoderma viridae* @ 10g kg⁻¹ of seed
- T2: Application of *Tricoderma viridae* 5 kg in 50 kg of FYM ha⁻¹
- T3: Application of *Tricoderma viridae* 10 kg in 50 kg of FYM ha⁻¹
- T4: Seed treatment with carbendazim 2g + thiram 1 g kg⁻¹ of seed
- T5: Seed treatment with carbendazim 2g + captan 1 g kg⁻¹ of seed
- T6: Seed treatment with tebuconazole 2g kg⁻¹ of seed
- T7: Seed treatment with tebuconazole 2g + carbendazim 1g kg⁻¹ of seed
- T8: Seed treatment with vitavax power 2g kg⁻¹ of seed
- T9: Seed treatment with vitavax power 2g + *Tricoderma viridae* 5g kg⁻¹ of seed
- T10: Neem cake 250 kg ha⁻¹
- T11: Pongamia cake 250 kg ha⁻¹
- T12: Neem cake 250 kg ha⁻¹ + *Tricoderma viridae* 5 g kg⁻¹ of seed
- T13: Pongamia cake 250 kg ha⁻¹ + *Tricoderma viridae* 5 g kg⁻¹ of seed
- T14: Sorghum 1:3 ratio
- T15: Control

Results and Discussion

Among the treatments employed in management of DRR during the Rabi season of 2014-15, seed treatment with tebuconazole (2g kg⁻¹ of seed) recorded significantly lowest dry root rot incidence of 7.12 % with highest yield of 754.74 kg ha⁻¹, followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) recorded 14.87 % disease incidence with a yield of 721.05 kg ha⁻¹ compared to control which recorded 42.18 % diseases incidence with yield of 309.86 kg ha⁻¹ (Table-1). The disease reduction (%) was superior (83.12 %) and % yield increase over control was also superior (58.95 %) in seed treatment with tebuconazole (2g kg⁻¹ of seed), followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) which recorded 64.75 % disease reduction over control and 57.03 % yield increase over control.

During Kharif 2014-15, seed treatment with tebuconazole (2g kg⁻¹ of seed) recorded lowest dry root rot incidence (10.28 %

with highest yield of 697.36 kg ha⁻¹, followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) recorded 16.44 % disease incidence with yield of 637.86 kg ha⁻¹ compared to control which recorded highest disease incidence of 45.64 % with yield of 259.55 kg ha⁻¹ (Table-1). The disease reduction (%) was superior (77.48 %) and % yield increase over control was also superior (62.78 %) in seed treatment with tebuconazole (2g kg⁻¹ of seed), followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) which recorded 63.98 % disease reduction over control and 59.31 % yield increase over control.

Mean data of both Rabi and Kharif indicated that seed treatment with tebuconazole (2g kg⁻¹ of seed) recorded least disease incidence of 8.70 % with highest yield of 726.05 kg ha⁻¹ and C: B (cost benefit) ratio (1:2.37), followed by seed treatment with tebuconazole (2g kg⁻¹) + carbendazim (1g kg⁻¹) recorded diseases incidence of 15.66 % with yield of 679.45 kg ha⁻¹ and C:B ratio (1: 2.20) compared to control which recorded 43.91 % disease incidence with yield of 284.70 kg ha⁻¹ and C:B ratio of 1:0.95 (Table-2).

These findings are in confirmation with Vijay Mohan *et al.*, (2006) which showed that carbendazim (0.2 %) and Etaconazole (0.1 %) used as seed treatment, soil drenching and seed treatment plus soil drenching recorded lowest disease incidence of 15.6 % and 18.2 % highest grain yield of 19.2 and 18.9 q ha⁻¹ respectively, during rabi 2001-2002 and 2002-2003 crop seasons. The above treatment recorded 57.2 and 52.4 % higher yield over control with per rupee return of 12.78 and 11.80 respectively in fungicidal management of dry root rot of chickpea caused by *R. bataticola*. Manjunatha, (2014) reported that seed treatment with tebuconazole 2g kg⁻¹ recorded lowest % disease incidence of 26.61, with a highest yield of 722.81 kg ha⁻¹, that is on par with seed treatment with tebuconazole 2g + carbendazim 1g kg⁻¹ which recorded 38.59 % disease incidence with a yield of 596.74 kg ha⁻¹ followed by seed treatment with carbendazim 2g + captan 1g kg⁻¹ of seed recorded 46.27 % disease incidence with a mean yield of 519.92 kg ha⁻¹. They are significantly superior to control which recorded 95.77 % disease incidence with a lowest mean yield of 362.02 kg ha⁻¹.

It has been shown that tebuconazole was highly effective against *Fusarium graminearum* (Spolti *et al.*, 2012). Tebuconazole is a systemic fungicide of the triazole group, and the primary mode of action is the inhibition of ergosterol biosynthesis in fungi (Hewitt, 1998). Even though different triazole fungicides have a similar mechanism of action, they may show marked differences in their activity against different fungal pathogens (Buchenaer, 1987; Scheinpflug and Kuck, 1987). This broad-spectrum, relatively new triazole fungicide is being used for its effectiveness against soil-borne and foliar fungal diseases in nut, fruit, cereal and vegetable crops worldwide (Munoz-Leoz *et al.*, 2011). Results of the present study are in agreement with Brenneman *et al.* (1991) who reported the antifungal activity against *S. rolfsii* and *R. solani in-vitro*. Kanwal *et al.* (2012) evaluated the potential of tebuconazole against three problematic soil-borne fungal phytopathogens namely *M. phaseolina*, *F. oxysporum* f. sp. *lycopersici* and *S. rolfsii*. Different concentrations of this fungicide viz. 35, 70, 105 and 140 ppm were evaluated against the target fungal pathogen using food poisoning

Table-1: Management of dry root rot disease in chickpea during Rabi 2014-15

Treat-ments	Rabi				kharif			
	% disease incidence	% disease reduction over contro	Yield kg ha ⁻¹	% yield increase over control	% disease incidence	% disease reduction over contro	Yield kg ha ⁻¹	% yield increase over control
T1	29.43 (32.85) ^{fg}	30.23	510.70 ^h	39.33	30.51 (33.53) ^e	33.15	484.00 ^h	46.37
T2	29.59 (32.95) ^{fg}	29.85	507.93 ⁱ	39.00	30.69 (33.64) ^e	32.76	481.39 ^h	46.08
T3	27.85 (31.85) ^g	33.97	550.17 ^g	43.68	29.22 (32.72) ^f	35.98	500.28 ^g	48.12
T4	18.11 (25.19) ^j	57.06	699.40 ^c	55.70	19.97 (26.54) ^j	56.24	600.45 ^c	56.77
T5	20.31 (26.79) ^j	51.85	671.88 ^d	53.88	23.08 (28.71) ^h	49.43	565.57 ^d	54.11
T6	7.12 (15.48) ^l	83.12	754.74 ^a	58.95	10.28 (18.70) ^k	77.48	697.36 ^a	62.78
T7	14.87 (22.68) ^k	64.75	721.05 ^b	57.03	16.44 (23.92) ^j	63.98	637.86 ^b	59.31
T8	24.18 (29.45) ^h	42.67	600.36 ^f	48.39	26.08 (30.71) ^g	42.86	521.63 ^f	50.24
T9	20.92 (27.22) ^j	50.40	641.03 ^e	51.66	23.33 (28.88) ^h	48.88	550.54 ^e	52.86
T10	32.42 (34.71) ^d	23.14	480.24 ^l	35.48	32.83 (34.96) ^d	28.07	433.77 ^l	40.16
T11	34.28 (35.84) ^c	18.73	461.03 ^m	32.79	35.41 (36.52) ^c	22.41	422.16 ^k	38.52
T12	30.60 (33.58) ^{ef}	27.45	490.82 ⁱ	36.87	31.70 (34.27) ^{de}	30.54	475.61 ^h	45.43
T13	32.11 (34.52) ^{de}	23.87	485.91 ^k	36.23	32.62 (34.83) ^d	28.53	461.28 ⁱ	43.73
T14	36.50 (37.17) ^b	13.47	440.86 ⁿ	29.72	38.04 (38.08) ^b	16.65	400.50 ^l	35.19
T15	42.18 (40.50) ^a	0.00	309.86 ^p	0.00	45.64 (42.50) ^a	0.00	259.55 ^m	0.00
S.Em ±	0.37	—	0.45	—	0.26	—	3.54	—
CD@5%	1.08	—	1.29	—	0.77	—	10.24	—

Table-2: Management of dry root rot disease of chickpea during Rabi and Kharif 2014-15 (Pooled Data)

Treatments	% disease incidence			Yield kg ha ⁻¹			C:B Ratio
	2014-15(Rabi)	2014-15(Kharif)	Mean	2014-15 (Rabi)	2014-15 (Kharif)	Mean	
T1	29.43 (32.85)	30.51 (33.53)	29.97 (33.19) ^{ef}	510.70	484.00	497.35 ^{gh}	1:1.64
T2	29.59 (32.95)	30.69 (33.64)	30.14 (33.30) ^{ef}	507.93	481.39	494.66 ^{gh}	1:1.53
T3	27.85 (31.85)	29.22 (32.72)	28.54 (32.29) ^f	550.17	500.28	525.23 ^{fg}	1:1.62
T4	18.11 (25.19)	19.97 (26.54)	19.04 (25.87) ^j	699.40	600.45	649.93 ^{bc}	1:2.12
T5	20.31 (26.79)	23.08 (28.71)	21.70 (27.76) ^h	671.88	565.57	618.73 ^{cd}	1:2.00
T6	7.12 (15.48)	10.28 (18.70)	8.70 (17.15) ^k	754.74	697.36	726.05 ^a	1:2.37
T7	14.87 (22.68)	16.44 (23.92)	15.66 (23.31) ^j	721.05	637.86	679.45 ^b	1:2.20
T8	24.18 (29.45)	26.08 (30.71)	25.13 (30.09) ^g	600.36	521.63	561.00 ^{ef}	1:1.82
T9	20.92 (27.22)	23.33 (28.88)	22.13 (28.06) ^h	641.03	550.54	595.78 ^{de}	1:1.93
T10	32.42 (34.71)	32.83 (34.96)	32.63 (34.84) ^d	480.24	433.77	457.01 ^{hi}	1:0.39
T11	34.28 (35.84)	35.41 (36.52)	34.85 (36.18) ^c	461.03	422.16	441.60 ^{ij}	1:0.36
T12	30.60 (33.58)	31.70 (34.27)	31.15 (33.93) ^{de}	490.82	475.61	483.21 ^{ghi}	1:0.41
T13	32.11 (34.52)	32.62 (34.83)	32.37 (34.68) ^d	485.91	461.28	473.59 ^{hi}	1:0.38
T14	36.50 (37.17)	38.04 (38.08)	37.27 (37.63) ^b	440.86	400.50	420.68 ^j	1:1.35
T15	42.18 (40.50)	45.64 (42.50)	43.91 (41.50) ^a	309.86	259.55	284.70 ^k	1:0.95
S. Em ±	—	—	0.39	—	—	14.57	—
CD @ 5 %	—	—	1.18	—	—	44.21	—

Treatments are: T1: ST with *T. viridae* @ 10g kg⁻¹ of seed; T2: Application of *T. viridae* 5 kg in 50 kg of FYM ha⁻¹; T3: Application of *T. viridae* 10 kg in 50 kg of FYM ha⁻¹; T4: ST with carbendazim 2g + thiram 1 g kg⁻¹ of seed; T5: ST with carbendazim 2g + captan 1 g kg⁻¹ of seed; T6: ST with tebuconazole 2g kg⁻¹ of seed; T7: ST with tebuconazole 2g + carbendazim 1g kg⁻¹ of seed; T8: ST with vitavax power 2g kg⁻¹ of seed; T9: ST with vitavax power 2g + *T. viridae* 5g kg⁻¹ of seed; T10: Neem cake 250 kg ha⁻¹; T11: Pongamia cake 250 kg ha⁻¹; T12: Neem cake 250kg ha⁻¹ + *T. viridae* 5 g kg⁻¹ of seed; T13: Pongamia cake 250 kg ha⁻¹ + *T. viridae* 5 g kg⁻¹ of seed; T14: Sorghum 1:3 ratio; T15: Control

*Figures in the parenthesis are arcsine transformed values, * ST - Seed Treatment

technique. All the concentrations of tebuconazole completely arrested the growth of all the three fungal species.

Out of 8 treatments tested against *Rhizoctonia bataticola*, the lowest % disease incidence (4.33) was recorded in seed treatment with carbendazim @ 2 g kg⁻¹ of seed + seed treatment with *T. viride* @ 4 g kg⁻¹ of seed + soil application of FYM fortified with *T. viride* and highest yield of 893 kg ha⁻¹ compared to control with highest % disease incidence (35.03) and least yield of 660 kg ha⁻¹. The next

best treatment was recorded in seed treatment with *T. viride* @ 4 g kg⁻¹ of seed + soil application FYM fortified with *T. viride* with diseases incidence of 8.21 % and yield of 850 kg ha⁻¹ followed by seed treatment with *T. viride* @ 4 g kg⁻¹ of seed which recorded diseases incidence of 12.45 % and yield of 813 kg ha⁻¹ Nagamani *et al.*, 2011.

Management of soil borne diseases with host plant resistance and cultural methods have limited value in chickpea. Thus there is a need to formulate effective disease management module by using

chemicals as a first barrier for controlling the plant disease development by treating the seed with chemicals while sowing. The improved practices for disease management will pave a way to mitigate losses caused by dry root rot and improves livelihoods of the poor farmers. In this view seed treatment with tebuconazole 2g kg⁻¹ of seed was found to a best management practice for the control of dry root rot followed by seed treatment with tebuconazole 2g + carbendazim 1g kg⁻¹ of seed.

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