



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.23

TPI 2021; 10(7): 174-177

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www.thepharmajournal.com

Received: 13-05-2021

Accepted: 20-06-2021

Nandeeshha KL

Department of Plant Pathology,
College of Agriculture,
Vijayapura, Karnataka, India

Shalini N Huilgol

Department of Plant Pathology,
College of Agriculture,
Vijayapura, Karnataka, India

Integrated management of fusarium wilt of chickpea

Nandeeshha KL and Shalini N Huilgol

Abstract

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crop grown all over India. Chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceri* is one of the major disease on chickpea in Northern Karnataka, which is soil and seed borne. Heavy inoculum in the soil and favorable environment condition results in the death of infected plant and therefore total yield loss. In this study, integrated management was conducted in both pot culture and in field with two antagonists, one botanical and one fungicide were studied against *Fusarium oxysporum* f. sp. *ciceri* causing chickpea wilt. Pot culture studies found that seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + *Trichoderma harzianum* 4 g/kg of seeds + *Curcuma longa* rhizome extract (Turmeric) @ 150 ml/ kg of seeds gave minimum wilt incidence (1.46%), maximum wilt incidence was noticed in untreated control with 100 per cent wilted plants. Field studies found that seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + *Trichoderma harzianum* 4 g/kg of seeds + *Curcuma longa* rhizome extract (Turmeric) @ 150 ml/ kg of seeds gave minimum wilt incidence (1.46%) and maximum yield (10.34 q/ha) followed by seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds. Bio agents *Trichoderma harzianum* and *Bacillus* sp. @ 4 g/ kg of seeds and aqueous plant extract of *Curcuma longa* (Turmeric) rhizome extract @ 150 ml/ kg of seeds were also significant in reducing wilt incidence and more yield as compared to control.

Keywords: Chickpea wilt, *Fusarium oxysporum* f. sp. *ciceri*, fungicides, bioagents, botanicals

Introduction

Chickpea is (*Cicer arietinum* L.) is one of the most important and oldest pulse crop after beans and peas. Chickpea seeds contain an average of 23 per cent protein, 38-59 per cent carbohydrate, 4.8-5.5 per cent oil, 47 per cent starch, 5 per cent fat, 6 per cent crude fibre, 6 per cent soluble sugar and 3 per cent ash, minerals such as calcium (202 mg), phosphorous (312 mg), iron (10.2 mg), vitamin C (3.0 mg), calorific value (360 cal), small amounts of B complex, fibre (3.9 g) and moisture (9.8 g). There are two main commercial types of chickpea. The Desi type with smaller and darker coloured seeds which may vary from yellow to black and the Kabuli type with large, smooth and light coloured seeds (Singh, 1985) [11].

To increase the production of chickpea qualitatively and quantitatively farmers requires healthy and quality seeds, with high percentage of germination and purity. As *Fusarium* wilt of chickpea is a soil borne disease, literature depicts that its even sometimes known to be transmitted by seeds too (Pandey *et al.*, 2007) [9]. Another adverse effect of seed-borne pathogen is that it will contaminate the areas which were disease free previously. So, it necessitates the eradication of seed-borne inoculum through various seed treatment procedures.

Seed borne diseases of chickpea are important aspects which need more attention. The chickpea crop is attacked by 172 pathogens (67 fungi, 22 viruses, 3 bacteria, 80 nematodes and phytoplasma) from all over the world (Nene *et al.*, 1996) [8]. Many of them infects seed and can provide primary inoculum for infestation of new crop and seed borne pathogens may be dispersed for long distances (Hartman *et al.*, 1999) [4]. Management of *Fusarium* wilt of chickpea is not only possible with host plant resistance and cultural methods only. Thus there is an urgent need to formulate effective integrated disease management module by using botanicals, bioagents and fungicides as a first barrier for plant disease development by treating the seed with fungicides, bioagents and botanicals while sowing. Therefore, experiments were conducted to find out the best fungicide, biocontrol agent and botanicals for effective management of *Fusarium* wilt of chickpea.

Corresponding Author:

Nandeeshha KL

Department of Plant Pathology,
College of Agriculture,
Vijayapura, Karnataka, India

Fusarium oxysporum f. sp. *ciceri* was multiplied on sand sorghum medium (SSM) and thoroughly hand mixed with double sterilized soil separately at 7.5 per cent (W/W) by soil infestation following the procedure given by Haware *et al.* (1980). The seeds were treated with the following treatments. Field trial was conducted in the year 2017-18 during *Rabi* at College of Agriculture, Vijayapura. The experiment was laid out in completely randomized block design with three replications and 7 treatments. Chickpea was planted at a spacing of 30 cm × 10 cm. The following treatments was evaluated under both pot culture and naturally infected field. Treatment and experimental details are given in Table 1.

Results and Discussion

Fusarium oxysporum f. sp. *ciceri* was isolated from wilted plants collected from RARS, Vijayapura was identified based on the morphological characters described by Booth (1971)^[2]. In the current study, among the seven treatments in pot culture, least per cent wilting was noticed in seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + *Trichoderma harzianum* 4 g/ kg of seeds + *Curcuma longa* rhizome extract (Turmeric) @ 150 ml/ kg of seeds with (0.00%), followed by seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds with (16.66%). And maximum per cent wilting was recorded in untreated control with (100%), followed by seed treatment with *Curcuma longa* (Turmeric) rhizome extract @ 150 ml/ kg of seeds with (61.11%) (Table 2).

In field studies it was observed that all the seed treatments were significantly superior over control (untreated seeds). Data presented in Table 3, revealed seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + *Trichoderma harzianum* 4 g/ kg of seeds + *Curcuma longa* rhizome extract (Turmeric) @ 150 ml/ kg of seeds gave

minimum wilt incidence (1.46%) and maximum yield (10.34 q/ha) followed by seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds (2.73%) and (9.18 q/ha), whereas highest wilt incidence (12.73%) and lowest yield (6.02 q/ha) was observed in control, followed by 7.29 per cent of wilt incidence was noticed in seed treatment with *Curcuma longa* (Turmeric) rhizome extract @ 150 ml/ kg of seeds with an yield of (6.25 q/ha).

The present study was conducted in *Rabi* 2017 in RARS Vijayapura, both in pot culture and naturally infected field to study the effective module for management of *Fusarium* wilt of chickpea. In pot culture, among seven different treatments the seeds treated with Carbendazim 12% + mancozeb 63%, @ 2 g per kg of seeds, + *Trichoderma harzianum* @ 4 g per kg of seeds + Turmeric rhizome extract @ 150 ml per kg of seeds, recorded the minimum per cent wilt incidence with 0.00 per cent, followed by seed treatment with Carbendazim 12% + mancozeb 63% recorded 16.66 per cent. Whereas the maximum per cent wilt incidence was recorded in untreated control with 100.00 per cent wilted plants. Similar results were observed by Poddar *et al.* (2004)^[10].

In field studies, lowest per cent disease incidence (1.46%) and 4.35 per cent increase in yield over control was observed in (T₇), seed treatment with Carbendazim 12% + mancozeb 63%, @ 2 g per kg of seeds, + *Trichoderma harzianum* @ 4 g per kg of seeds + Turmeric rhizome extract @ 150 ml per kg of seeds, followed by (T₁) seed treatment with Carbendazim 12% + mancozeb 63% recorded (2.88) per cent wilt incidence with 3.16 per cent increase in yield over control, whereas highest per cent disease incidence (12.73%) with the lowest yield of (6.02 q/ha) was noticed in untreated control. Similar results were observed by Kamdi *et al.* (2012)^[6], Andrabi *et al.* (2011)^[1], Hossain *et al.* (2013)^[5] and Dubey *et al.* (2015)^[3].

Table 1: Details of the treatment and experiment

| Sl. No. | Treatment No. | Treatments |
|---------|----------------|--|
| 1. | T ₁ | Seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds |
| 2. | T ₂ | Seed treatment with <i>Trichoderma harzianum</i> @ 4 g/ kg of seeds |
| 3. | T ₃ | Seed treatment with <i>Bacillus subtilis</i> @ 4 g/ kg of seeds |
| 4. | T ₄ | Seed treatment with <i>Trichoderma harzianum</i> and <i>Bacillus subtilis</i> @ 4 g/ kg of seeds |
| 5. | T ₅ | Seed treatment with <i>Curcuma longa</i> (Turmeric) rhizome extract @ 150 ml/ kg of seeds |
| 6. | T ₆ | Seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + <i>Trichoderma harzianum</i> 4 g/ kg of seeds + <i>Curcuma longa</i> rhizome extract (Turmeric) @ 150 ml/ kg of seeds |
| 7. | T ₇ | Control |

Experimental Details

| | | |
|----------------|---|------------------------------|
| Design | : | RCBD |
| Plot size | : | 5 rows of 4.5 m row length |
| Replications | : | Three |
| Spacing | : | 30 cm × 10 cm |
| Treatments | : | Seven |
| Date of sowing | : | 4 th October 2017 |

The observations on per cent disease incidence (PDI) and yield of chickpea were recorded.

Table 2: Management *Fusarium* wilt of chickpea under pot culture

| Sl.no | Treatments | Per cent wilt incidence |
|-------|--|-------------------------|
| 1 | Seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds | 16.66 (4.2)* |
| 2 | Seed treatment with <i>Trichoderma harzianum</i> @ 4 g/ kg of seeds | 44.44 (6.71) |
| 3 | Seed treatment with <i>Bacillus subtilis</i> @ 4 g/ kg of seeds | 61.11 (7.86) |
| 4 | Seed treatment with <i>Trichoderma harzianum</i> and <i>Bacillus subtilis</i> @ 4 g/ kg of seeds | 27.77 (5.3) |
| 5 | Seed treatment with <i>Curcuma longa</i> (Turmeric) rhizome extract @ 150 ml/ kg of seeds | 66.66 (8.22) |
| 6 | Seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + <i>Trichoderma harzianum</i> 4 g/ kg of seeds + <i>Curcuma longa</i> rhizome extract (Turmeric) @ 150 ml/ kg of seeds | 0.00 (1.00) |
| 7 | Control | 100.00 (10.05) |
| | S. Em. ± | 0.29 |

| | |
|----------|------|
| CD at 5% | 0.90 |
|----------|------|

*Figures in the parentheses indicate original values using $\sqrt{x+1}$ transformation.

Table 3: Integrated management of Fusarium wilt of chickpea during Rabi 2017-18

| Sl.no. | Treatments | Per cent wilt incidence | Yield q/ha | Per cent yield increase over control |
|--------|--|-------------------------|------------|--------------------------------------|
| 1 | Seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds | 2.73 (9.51)* | 9.18 | 3.16 |
| 2 | Seed treatment with <i>Trichoderma harzianum</i> @ 4 g/ kg of seeds | 4.82 (12.69) | 7.70 | 1.68 |
| 3 | Seed treatment with <i>Bacillus subtilis</i> @ 4 g/ kg of seeds | 5.39 (13.43) | 6.40 | 0.38 |
| 4 | Seed treatment with <i>Trichoderma harzianum</i> and <i>Bacillus subtilis</i> @ 4 g/ kg of seeds | 4.08 (11.66) | 7.75 | 1.73 |
| 5 | Seed treatment with <i>Curcuma longa</i> (Turmeric) rhizome extract @ 150 ml/ kg of seeds | 7.29 (15.67) | 6.25 | 0.23 |
| 6 | Seed treatment with Carbendazim 12% + Mancozeb 63% @ 2 g/kg of seeds + <i>Trichoderma harzianum</i> 4 g/ kg of seeds + <i>Curcuma longa</i> (Turmeric) rhizome extract @ 150 ml/ kg of seeds | 1.46 (6.94) | 10.37 | 4.35 |
| 7 | Control | 12.73 (20.91) | 6.02 | |
| | S. Em. \pm | 0.47 | 1.19 | |
| | C.D. at 5% | 1.43 | 3.68 | |

*Arcsine transformed values

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