

# On Farm Demonstration of Management of *Fusarium* Wilt Disease of Chickpea Under Rainfed Conditions in Mid Hill Region of Jammu, Jammu & Kashmir, U.T., India

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**Abstract:** Chickpea is one of the most vulnerable crop to attack of pests and diseases causing huge production losses. Among the diseases, chickpea wilt poses a severe problem in rainfed areas of Jammu region. It was observed that chickpea seeds treated with *Trichoderma viride* (soil application) recorded 21.50% wilt incidence followed by *Trichoderma viride* (seed application) 35.25%, neem seed cake 47.00%, Carbendazim 48.90%, Thiram 50.14% and Captan 56.50%. While *Trichoderma viride* (soil application) gave 78.50% (highest) wilt disease control, followed by *Trichoderma viride* (seed application) 64.75%, neem seed cake 53.00%, Carbendazim 51.10%, Thiram 49.86%, Captan 43.50% and least in check. Recommendations of the results were repeated in the 4 farmers field in Reasi district, disease incidence were 25.40% but after applying of *Trichoderma viride* (soil application) diseases incidence reduced to 7.95% only and it was reduced to 6.75% (Table 2). While yield of chick pea was enhanced from 5.25 to 9.20 q/ha and maximum 9.80 q/ha against least farmers' practices i.e. 5.25% only.

**Keywords:** Chickpea, *Trichoderma viride*, Thiram, Captan, Carbendazim, Neem Seed Cake

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## 1. Background and Justifications

Chickpea is a major and cheap source of protein, accounting for about 45% of total pulses produced in the country. It is best suited to the areas with low to moderate rainfall (60-90 cm per annum) and a mild cold weather. Pulses in general and chickpea in particular are less water and fertilizer consuming. Chickpea help to fix atmospheric nitrogen, resulting in enhancing and maintaining the soil fertility and reduced fertilizer use. Hence, during the Rabi season, chickpea has the potential to mitigate the ill effects of rice-wheat cropping system and to sustain the deteriorating agro-ecosystem of the north India.

India is the largest producer and consumer of chickpea with about 8.35 million tons production (67% of the global

production). The national productivity of chickpea (859 kg/ha) is very less compared to the potential yield of commercially cultivated varieties and with the countries like USA, Canada, etc. Among various factors for the low yield, diseases viz. wilt (*Fusarium oxysporum* f. sp. *ciceri*), root rot (*Rhizoctonia bataticola*) and Ascochyta blight (*Ascochyta rabiei*). Botrytis grey mould (BGM) (*B.cinerea*) are the most serious constraints to chickpea productivity in north India causing losses upto 100%. Chickpea is one of the most vulnerable crops to the attack of pests and diseases causing huge production losses. Among the diseases, chickpea wilt pose a severe problem in rainfed areas of Jammu region [1-5]. In the present investigation *Trichoderma* was effectively used against test fungus. Wilt and root rot are seed and soil borne diseases and may be managed by cultivation of

resistant varieties and seed treatment using fungicides and bio-control agents.

Most of the resistant varieties have been found to be susceptible after some years because of breakdown in their resistance and evolution of variability in the pathogen. There appears to be no apparent reason as to why these already tested wilt resistant material showed such a variable wilt reaction and which creates a doubt about the possibility of existence of physiologic forms of the pathogen. The pathogen with high saprophytic ability can survive in soil for a pretty long period during which it may have to go through different environmental stresses and biological competition which may lead to the existence of physiologic races. Therefore, integrated management strategies are the only solution to maintain plant health [6].

Chickpea, also called garbanzo bean or Bengal gram, is a self-pollinated, annual diploid ( $2n=2x=16$ ) species with a genome size of 738 Mb, While this size is slightly larger than that of the model legume, *Medicago truncatula* Gaertn., (530 Mb). It is much smaller than other major legume crops such as soybean, peanut, garden pea, alfalfa, and lentil. The *Cicer* genus belongs to the family Leguminosae, sub-family Papilionaceae and tribe Cicereae [9].

The pulse crops are invariably grown under risk-prone rainfed environments. Use of bio-agents such as *Trichoderma* spp. is helpful in managing fungal diseases in chickpea, lentil and pigeonpea and also enhances the growth of plants. The inoculation of seeds with antagonists helps in managing externally seed and soil borne pathogens. Talc based formulation of *Trichoderma* spp. has been used to coat seeds. The farmers had lesser knowledge to differentiate between the wilt and dry root rot and generally referred to as wilt. These strategies should include minimum use of chemicals for checking the pathogen population, encouragement of beneficial biological agents to reduce pathogen inoculums, modification of cultural practices and use of resistant varieties. The present investigations were undertaken to formulate promising integrated disease management strategies with following objectives, screening of chickpea germplasm lines against major pathogen involved in wilt complex, management of chickpea wilt complex by fungicides, bioagents and organic soil amendments.

## 2. Materials and Methods

Field trials on management of Chick pea wilt was done at KVK, Reasi during Rabi 2014-15 and 2015-16. Sowing of chickpea var L-550 was done during Rabi 2014-15 and 2015-16 under two replications with row length 5 m and 30

× 10 cm row to row and plant to plant spacing, respectively. The following materials were used during the present investigations. Biocontrol agents *Trichoderma* species (*T.viride*) was obtained from Division of Plant Pathology, SKUAST-Jammu and was used against *F. oxysporium* f. sp. *ciceri* in the field condition. Three fungicides Thiram 3.0% (3.0 g/kg seed), Captan 2.0 (2.0 g/kg seed), Carbendazim 0.2% (2 g/kg seed) were used in the field conditions against *F. oxysporium* f. sp. *ciceri*. Neem seed cake: 500 kg/ha was used against *F. oxysporium* f. sp. *Ciceri* (Table 1).

In fungicidal trial, the seeds of the variety L-550 (Check) was treated with Thiram (0.3%), Captan (0.2%) Carbendazim (0.2%) individually (dry seed treatment) and sown in the field following SKUAST Jammu, Package of Practices along with *Fusarium* contains sick soil. For testing of *Trichoderma* sp. against *F. oxysporium* f. sp. *ciceri* mass culture of *T. viride* was mixed with sterilized soil (ratio 1:3), ten days before the addition of *Fusarium* culture. The inoculums of test pathogen *F. oxysporium* f. sp. *ciceri* mass cultured on sand maize medium (1:1) was added to the soil in the field. The *Fusarium* culture was also added for making sick plot @ 100 g/kg soil which served as control. The variety L-550 was sowing in check plot containing *Fusarium* sick soil. Seed of variety L-550 were treated with the culture of *T. viride* 4g/kg and sown in only *Fusarium* sick soil. Then these plots were inoculated @ 80 g/kg soil with mass culture of test fungus (*F. oxysporium* f. sp. *ciceri*) multiplied on sand: maize medium (1:1) and watered. Ten seeds of variety L-550 were sown in one plot containing untreated (without cakes) but inoculated with test fungus was maintained as check. Observations on per cent seed germination, pre/post emergence wilting, were recorded at 15 days interval from germination up to mortality (Table 2, Figure 1). The seed emergence was recorded 18 days after sowing. Observations on number of plants wilted from each genotype were recorded at 30, 45 and 60 days after sowing. The per cent wilt incidence was calculated on the basis of initial plant count and total number of wilted plants in each genotype and genotypes were graded as follows.

### 2.1. Reaction Percent Wilting (Mortality)

- Resistant (R) 0 - 10% mortality.
- Moderately resistant (MR) 10.1 - 20% mortality.
- Moderately susceptible (MS) 20.1 - 30% mortality.
- Susceptible (S) 30.1 - 50% mortality.
- Highly susceptible (HS) Above 50% mortality.

**Table 1.** In vitro effect of bio-agents, fungicides and organic soil amendments on chickpea wilt incited by *Fusarium oxysporium* f. sp. *ciceri*.

S. No.	Treatments	Mean percent wilt incidence	Percent wilt control
1	<i>Trichoderma viride</i> (Seed treatment)	35.25 (37.25)	64.75
2.	<i>Trichoderma viride</i> (Soil application)	21.50 (25.62)	78.50
3.	Captan @0.2%	56.50 (48.90)	43.50
4.	Thiram @0.3%	50.14 (49.90)	49.86
5.	Carbendazim@0.2%	48.90 (51.88)	51.10

S. No.	Treatments	Mean percent wilt incidence	Percent wilt control
6.	Neem seed cake	47.00 (43.63)	53.00
7.	Control	100 (90.00)	00.00

\*=Average of three replications. Figures in parenthesis are arcsine transformed values.

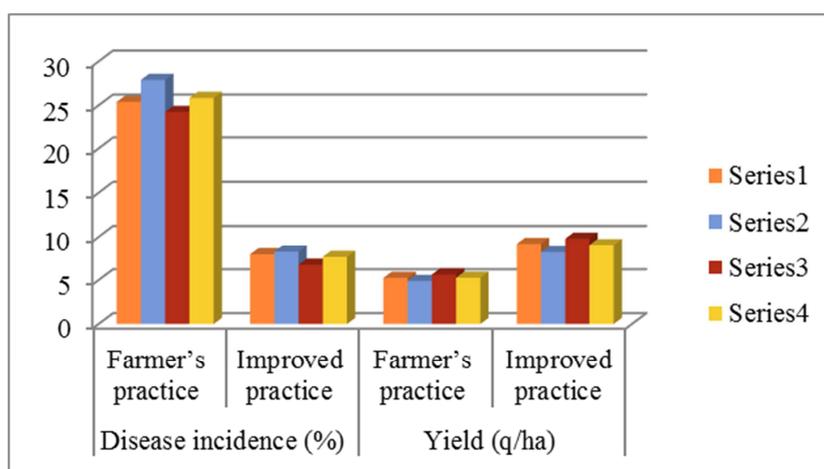
**Table 2.** *Fusarium wilt management in Chickpea in the on-farm trials (farmers' field).*

S. No	Disease incidence (%)		Yield (q/ha)	
	Farmer's practice	Improved practice	Farmer's practice	Improved practice
1	25.40	7.95	5.25	9.20
2	27.90	8.25	4.90	8.20
3	24.25	6.75	5.65	9.80
4	25.85	7.65	5.27	9.06

Yield data with advantage over existing practice:

Reduction in disease incidence (%)=70.41%.

Percent increase in yield=71.92%.



**Figure 1.** *Fusarium wilt management in Chickpea in the on-farm trials (farmers' field).*

### 3. Results and Discussion

Fungitoxic effect of three seed dressing fungicides alone and in combination was tested *in vitro* by applying poisoned food technique. The results obtained on the fungitoxicity of fungicides against *F. oxysporium* f. sp. *ciceri* in the field are presented in Tables 1-2 and Figure 1. It was observed that chickpea seeds treated with *Trichoderma viride* (soil application) recorded 21.50% mean per wilt incidence followed by *Trichoderma viride* (seed application) 35.25%, neem seed cake 47.00%, Carbendazim 48.90%, Thiram 50.14% and Captan 56.50%. While *Trichoderma viride* (soil application) yielded 78.50% (highest) wilt control, followed by *Trichoderma viride* (seed application) 64.75%, neem seed cake 53.00%, Carbendazim 51.10%, Thiram 49.86%, Captan 43.50% and least in check. Recommendations of the results were repeated in the 4 farmers' field in Reasi district (Table 2). Disease incidence were 25.40% but after applying of *Trichoderma viride* (soil application) diseases incidence reduced to 7.95% only and it was reduced to 6.75% (Table 2). While yield of chick pea was enhanced from 5.25 to 9.20 q/ha and highest 9.80 q/ha against farmers' practice i.e. 5.25% only.

It was revealed all *Trichoderma* spp. when used

individually as biocontrol agents also exhibited antagonistic effect against *F. oxysporium* f. sp. *ciceri* leading to reduced radial growth of the fungus. Bioagents *Trichoderma viride* was yielded superior over control in respect to percent inhibition of the test fungus in field conditions. Hence, *Trichoderma viride* (soil application) is recommended for chick pea wilt disease management in rainfed areas of Jammu region.

Grain yield was affected by chickpea varieties, fungicides, and their interaction. Among two-way interaction effects, the maximum grain yield of 4.55t/ha was recorded from Shasho variety treated with Apron Star, followed by Arerti variety treated with Apron Star which resulted in grain yield of 3.94t/ha while the minimum grain yield of 0.21 t/ha were recorded from untreated local chickpea [7, 8, 10].

Management of Fusarium wilt of chickpea is difficult to achieve and no single control measure is fully effective. Fusarium wilt of chickpea is a mono-cyclic disease in which development is driven by the pathogen's primary inoculums. Therefore, management of the disease should be targeted to exclusion of the pathogen as well as by reducing the amount and/or efficiency of the initial inoculums. For such a goal, measure of control should be included. The present results are in accordance with findings of Warda Jendoubi *et al.* [9].



Figure 2. Chick pea field affected by wilt diseases.



Figure 3. Healthy crop of Chick pea after soil application of *Trichoderma viride*.

#### 4. Conclusion and Recommendations

Due to the use of harmful potential and conventional systemic and non-systemic fungicides for managing soil diseases are inadequate, uneconomical and cause ecological problem due to their residues in soil and crops, we should swing towards the use of eco-friendly protection methods. In the present investigation, biological management of chickpea wilt disease with bioagents are safer, economical, effective, easily colonizes in the rhizosphere, the strong mechanism in soil pathogens with no residual effects on the arial plant parts and were taken to minimize the incidence. Seed Treatment with Carbendazim @ 2g/kg and soil application of *Trichoderma viride* @ 4g/kg after one and half months of sowing showed minimum wilt incidence and increased the grain yield of chickpea by 59.08%.

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