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Assessment of Yield Losses Caused by *Fusarium oxysporum* f.sp. *ciceri* (Padwick) in Chickpea

B.D. S. Nathawat, O. P. Sharma, Harshraj Kanwar

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Abstract Studies were carried out to assess chickpea grain yield losses inflicted by *Fusarium oxysporum* f.sp. *ciceri*. Investigations revealed that there exists a direct association between the wilt incidence, grain yield and the yield loss. Pathogen is soil and seed borne in nature. Heavy inoculum in soil and favorable environment condition results in the death of infected plant and therefore total yield loss. In this study, unprotected plot and protected plot were studied against *Fusarium* wilt. Field studies found that protected plot with the carbendazim seed treatment (at 2g/kg seed) gave minimum wilt incidence (19.24% and 18.47%) and maximum yield (719.35 sand 744.4 kg/ha) in both the years 2014-15 and 2015-16 respectively.

Keywords Chickpea, *Fusarium* wilt, Yield losses, Protected, Unprotected plot.

B. D. S .Nathawat*, O. P. Sharma,
Harshraj Kanwar
Division of Plant Pathology,
Rajasthan Agricultural Research Institute,
Durgapura, S. K.N. A. University, Jobner,
Jaipur 302018, India
e-mail : dsnathawat@gmail.com
*Correspondence

Introduction

Chickpea (*Cicer arietinum* L.) is the most important pulse crop grown all over India. It is considered as one of the oldest one cultivated crop both in Asia and Europe. *Fusarium oxysporum* f.sp. *ciceri* (Padw.) Snyd. and Hans.). *cause major* yield constraint in *chickpea.* In India, chickpea is grown in 9.93 M ha with annual production of 9.53 M tonnes and an average productivity of 960 kg ha^{-1} [1]. The major limitations in achieving potential target are biotic and abiotic stresses. India is a big country with different climatic zones each with its own complexity of associated disease. Like many other crops, pulses, especially chickpea have also been reported to suffer stern yield losses due to various insect pests and diseases. Among different diseases, fungi especially, the wilt caused by species of *Fusarium* remains to be a challenging task in terms of management since it is soil-borne in nature [2]. Chickpea wilt caused by *Fusarium oxysporum* f. sp. ciceri was first reported from India by Butler in 1918 [3]. *Fusarium oxysporum* f. sp. *ciceri* is a soil and seed borne disease of chickpea has economic importance [4]. Pathogen colonizing the xylem vessels and blocking them completely to cause wilting. Wilt is one of the serious disease causing heavy loss up to 10-100% depending on fungal inoculum and environmental condition [5]. Susceptibility to disease is one of the major causes of yield lose. In general, estimates of losses varied accoding to the stages of the crop affected. Wilting at seedling stage of the

crop growth causes 77—94% losses while late wilting causes 24—65% loss [6]. Its incidence varied from 14.1 to 32.0% in different states of India [7].

Materials and Methods

The field experiment was conducted at Rajasthan Agricultural Research Institute, Durgapura, Jaipur during *rabi* season 2014-15 to 2015-16.

An experiment on loss evaluation in grain yield of chickpea due to wilt disease was under taken in sick soil condition. Fifteen day old culture, multiplied on sand maize meal medium was placed in furrows at 100 g in each of the one meter row length to increase the disease pressure. Seeds of chickpea susceptible variety L-550 were planted in 2 m × 2.1 m plot in each plot 140 seeds were sown. Row to row and plant to plant spacing were kept 30 cm and 10 cm, respectively. Experiment was laid out in randomized block design (RBD). Protected and unprotected block (Treatments) each with fourteen replication sub-plots (as replications) was maintained.

Treatments

Unprotected plot

Plots inoculated with the *F. oxysporum* f. sp. ciceri culture and sown with untreated seeds of chickpea variety L-550.

Protected plot

Culture of *F. oxysporum* f.sp. *ciceri* was multiplied on sand maize meal medium and applied in furrows before sowing. Seeds of chickpea variety L-550 were treated with carbendazim @ 2 g kg^{-1} seed considered as protected block. Total numbers of germinated seeds were counted in each sub plot after 10 days of sowing. Total number of plant and number of infected plants in each plot were recorded from 7 days of sowing and continued up to 55 days and per cent disease incidence was calculated.

$$\text{Per cent disease incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

In the same way, grain yield per plot in both unprotected and protected blocks was noted after harvesting. Loss in grain yield was computed on the basis of the formula given below

$$\text{Percent loss in yield} = \frac{\text{Average grain yield in protected block} - \text{Average grain yield in unprotected block}}{\text{Average grain yield protected block}} \times 100$$

Results and Discussion

Table 1 indicates that in unprotected plots, cultivars were having more wilt as compared to ones where carbendazim at 2g/ka was seed treatment and there

Table 1. Grain yield loss due to wilt disease of chickpea induced by *F. oxysporum* f.sp. *ciceri* . * Mean of 14 replications.

Treatments	Wilt incidence* (%)		Grain yield* (kg/ha)		Grain yield loss (%)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Unprotected plot						
Plot inoculated with *F. oxysporum* f.sp. *ciceri* and untreated chickpea seeds	54.78	57.40	321.42	295.28	55.31	60.31
Protected plots						
Inoculated with *F. oxysporum* f.sp. ciceri and sown with seed treated with carbendazim (2 g kg^{-1} seed)	19.24	18.47	719.35	744.14	–	–

is negative correlation between disease incidence and chickpea yield.

It revealed that the extent of disease 54.78 and 57.40% respectively resulted loss in grain yield by 55.31% in 2014-15 and 60.31% in 2015-16 over the protected plots. Comparable results were obtained by Garkoti et al. [8] and rafique et al. [9]. They reported yield losses by chickpea wilt ranged 67 to 100%. However, in the protected plots, the incidence of the disease was reduced to 19.24 and 18.47% in both the years, respctively. Harichand and khirbat [10] conducted that yield losses vary between 10% to 100% depending on varietal susceptibility and agro-climatic conditions. When disease occurs at seedling stage, seedlings collapse and lie flat on soil surface. In case of adult plants, characteristic symptom is brown to black discoloration of xylem vessels. In susceptible plants hyphae are inter and intracellular in pith, xylem and cortex. The phytotoxin produced by the pathogen causes wilting and leaf burning. There exists a correlation between pathogen produced pectate lyase with pathogenicity.

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