

Original Research Article

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Quantification of Minimum Inoculum Level and Reaction of Ruling Chickpea Genotypes to Wilt Complex Pathogens

S. Ravichandran and Yashoda R. Hegde*

Department of Plant Pathology, University of Agricultural Sciences,
Dharwad-580005, Karnataka, India

*Corresponding author

ABSTRACT

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Wilt complex of chickpea is caused by *Fusarium oxysporum ciceri*, *Rhizoctonia bataticola* and *Sclerotium rolfsii*. Minimum inoculum levels required for causing 100 per cent wilt in *F. oxysporum ciceri* was 8 per cent *R. bataticola* was 10 per cent and *S. rolfsii* was 4 per cent. Among genotypes, Annigeri 1, BGD 103, BGD 128 and KAK 2 were susceptible to all the pathogens, JG11 and JAKI 9218 were showing moderately resistant reaction to *F. oxysporum ciceri* and susceptible to other pathogens like *R. bataticola* and *S. rolfsii*.

Introduction

Chickpea (*Cicer arietinum* L), also known as Gram or Bengal gram, a self-pollinating diploid is the third most important pulse crop after bean and garden peas. It belongs to the family Fabaceae. Chickpea wilt is a serious disease, which is mostly prevalent in dry weather conditions. It causes significant yield losses in different chickpea areas depending upon its prevalence and intensity.

Occurrence of chickpea wilt has been reported almost all over the world but it was first described in India (Butler, 1918). Dry root rot caused by *Macrophomina phaseolina* (Tassi) Goid. is one of the major limitations in chickpea production causing 10 to 20% annual loss (Dhar and Chaudhary, 2001).

Soilborne diseases like wilt caused by *F. oxysporum* f.sp. *ciceri*, root rot caused by *Rhizoctonia bataticola* and collar rot caused by *Sclerotium rolfsii* are becoming severe in recent years resulting in huge loss. During survey, mixed infection of these pathogens in different combinations was observed resulting in wilt complex (Ravichandran, 2015).

Wilt resistant varieties were showing the susceptible reaction to wilt complex resulting in wilting symptoms. Hence an attempt was made to understand the reaction of ruling varieties to wilt complex pathogens in different combinations and to standardize the inoculum dose required for causing the symptoms.

Material and Methods

Standardization of inoculum density

Giant culture of *F. oxysporum* f. sp. *ciceri*, *Rhizoctonia bataticola* and *Sclerotium rolfsii* was prepared for standardization of inoculum as explained below. Sand and corn meal (90:10) was used as substrate for giant culture preparation in conical flask and sterilized alternatively for two consecutive days. Fresh culture of seven days old *F. oxysporum* f. sp. *ciceri* of 5 mm disc was inoculated to flask and incubated for 20 days for full growth of the fungus, during incubation the culture was mixed thoroughly to get uniform growth. After full growth, it was used for further studies. The same procedure was used for *Rhizoctonia bataticola* and *Sclerotium rolfsii*.

The giant culture was inoculated to each pot with 400 g soil holding capacity. The inoculum was added at the rate of 2, 4, 6, 8, 10 and 12 per cent inoculum density. Five seeds of JG 11 variety were sown in each pot. Healthy plant without adding inoculum was maintained as control. This was followed for three pathogens viz., *Fusarium oxysporum ciceri*, *Rhizoctonia bataticola* and *Sclerotium rolfsii*. Four replications were maintained for each treatment. Observation on per cent disease incidence was recorded.

Reaction of chickpea genotypes to wilt complex pathogens

Pot culture study was conducted to know the reaction of popularly grown chickpea genotypes to wilt complex pathogens viz., *Fusarium oxysporum* f. sp. *ciceri*, *Rhizoctonia bataticola* and *Sclerotium rolfsii*. The details of the experimentation are presented hereunder.

The pathogens were inoculated individually and in combination to the ruling six chickpea varieties viz., Annigeri 1, JG11, JAKI 9218,

BG-103, KAK-2 and BGD 128. Three replications were maintained for each treatment. The observations were recorded at different time intervals on per cent disease incidence and analysed statistically.

Results and Discussion

Standardization of inoculum density

The results presented in table 1 indicate that the inoculum density of *F. oxysporum ciceri* at different levels influenced the development of wilt. Per cent disease incidence increased as the inoculum concentration increased. At 8, 10, and 12 per cent of inoculum, there was cent per cent disease incidence and death of the plants was noticed. Seed germination was completely inhibited at more than 12 per cent.

Rhizoctonia bataticola was inoculated at different concentrations. The wilt incidence was minimum at 2% and increased as the inoculum concentration increased. At 10 and 12 per cent of inoculum, there was cent per cent disease incidence and death of the plants was noticed. Seed germination was inhibited at more than 12 per cent (Table 1).

Wilt incidence differed significantly at different concentrations of *Sclerotium rolfsii*. Wilt was completely absent at 0% concentration and increased as the inoculum concentration increased. Complete death (100%) of plants was recorded at 4 and 6% concentration. Inoculum at more than 6 per cent concentration inhibited the seed germination completely. Similar results were observed by (Rani and Yashoda, 2016) in *Fusarium oxysporum* infecting fenugreek. Hundred per cent inhibition was observed above 8 per cent inoculum in *Rhizoctonia bataticola* and 6 per cent in *Sclerotium rolfsii* infecting *Coleus forskholii* (Ammajamma and Yashoda, 2009), stevia (Shwetha and Yashoda, 2012) and patchouli (Chavan *et al.*, 2009).

Reaction of chickpea genotypes to wilt complex pathogens

Tr. no.	Treatments	Per cent inoculum
1	<i>Fusarium oxysporum</i> f. sp. <i>ciceri</i>	8
2	<i>Rhizoctonia bataticola</i>	10
3	<i>Sclerotium rolfsii</i>	4
4	<i>F. o. ciceri</i> + <i>R. bataticola</i>	4 + 5
5	<i>F. o. ciceri</i> + <i>S. rolfsii</i>	4 + 2
6	<i>R. bataticola</i> + <i>S. rolfsii</i>	5 + 2
7	<i>F. o. ciceri</i> + <i>R. bataticola</i> + <i>S. rolfsii</i>	4 + 4 + 2
8	Untreated	0

Table.1 Assessment of inoculum levels of *Fusarium oxysporum ciceri*, *Rhizoctonia bataticola*, and *Sclerotium rolfsii*

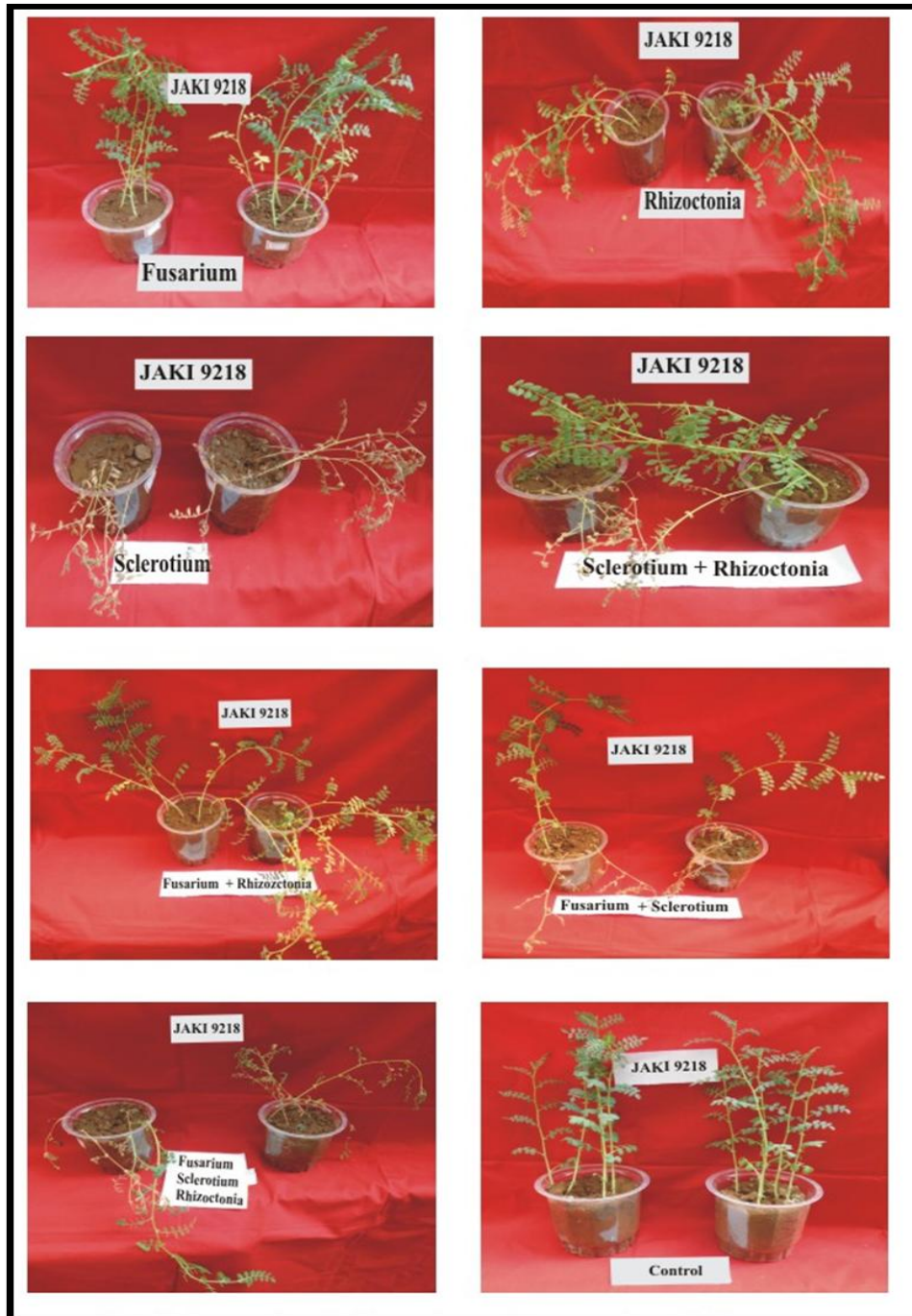
Per cent inoculum level	Per cent wilt incidence		
	<i>F. oxysporum ciceri</i>	<i>R. bataticola</i>	<i>S. rolfsii</i>
0	0.0 (0.00)*	0.0 (0.00)*	0.00 (0.00)*
2	26.7 (30.77)	24.4 (29.45)	53.33 (46.90)
4	44.4 (41.74)	46.7 (43.06)	100.00 (89.96)
6	62.2 (52.07)	66.7 (54.97)	100.00 (89.96)
8	100.00 (89.96)	81.1 (64.23)	100.00 (89.96)
10	100.00 (89.96)	100.00 (89.96)	100.00 (89.96)
12	100.00 (89.96)	100.00 (89.96)	100.00 (89.96)
14	100.00 (89.96)	100.00 (89.96)	100.00 (89.96)
S.Em.±	2.27	2.28	1.36
C.D. at 1%	9.37	9.43	5.71

* Arc sin transformed values

Table.2 Reaction of chickpea genotypes to wilt complex pathogens

Treatments	Per cent wilt incidence in genotypes					
	JG 11	Annigeri 1	BGD 103	BGD 128	JAKI 9218	KAK 2
<i>Fusarium</i> alone	12.22 (3.26) *	50.00 (7.12)	31.11 (5.62)	37.78 (6.22)	13.33 (3.39)	24.44 (5.01)
<i>Rhizoctonia</i> alone	33.33 (5.80)	40.00 (6.40)	58.33 (7.64)	44.44 (6.71)	58.89 (7.73)	20.00 (4.58)
<i>Sclerotium</i> alone	80.00 (9.00)	82.22 (9.09)	91.67 (9.61)	87.78 (9.41)	100.00 (10.05)	88.89 (9.44)
<i>Fusarium</i> + <i>Sclerotium</i>	75.56 (8.74)	80.00 (9.00)	61.67 (7.89)	68.89 (8.35)	71.11 (8.48)	71.67 (8.51)
<i>Fusarium</i> + <i>Rhizoctonia</i>	33.33 (5.80)	46.67 (6.90)	44.44 (6.69)	53.33 (7.34)	41.11 (6.47)	51.11 (7.16)
<i>Rhizoctonia</i> + <i>Sclerotium</i>	76.67 (8.80)	73.33 (8.60)	86.67 (9.35)	70.00 (8.38)	66.67 (8.21)	82.22 (9.12)
<i>Fusarium</i> + <i>Rhizoctonia</i> + <i>Sclerotium</i>	94.44 (9.76)	100.00 (10.05)	100.00 (10.05)	100.00 (10.05)	94.44 (9.76)	82.22 (9.12)
Control	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S.Em	0.53	0.29	0.45	0.36	0.50	0.37
CD@1%	2.20	1.19	1.85	1.49	2.05	1.54

* $\sqrt{X+1}$ transformed values



Reaction of chickpea genotypes to wilt complex pathogens

All the treatments induced wilt incidence except in control, out of six genotypes, *Fusarium oxysporum ciceri* resulted in maximum disease incidence (50.0%) in Annigeri 1 genotype, lowest disease incidence

was observed in JG 11 (12.22%) followed by genotype JAKI 9218 (13.33%). When *Rhizoctonia bataticola* was inoculated, maximum disease was observed in JAKI 9218 (58.89%) followed by BGD 103 (58.33%) and lowest disease incidence was observed in KAK 2 (20.0%). In *Sclerotium rolfsii* inoculation, all the genotypes showed more

disease incidence compared to other pathogens. Genotype like JAKI 9218 exhibited cent per cent wilt incidence due to *S. rolfisii* followed by BGD 103 (91.67%) (Table 2 and Plate 1). In combinations of the pathogens like *Fusarium* + *Sclerotium*, all the genotypes showed more than sixty per cent wilt incidence, highest disease incidence was observed in the Annigeri 1 (80.0%) followed by JG11 (75.56%) and lowest disease was observed in BGD 103 (61.57%). In the combined inoculation of *Fusarium* + *Rhizoctonia*, the maximum disease incidence was recorded in the BGD 128 (53.33%) followed by (51.11%) in KAK 2 genotype. In the combination of the pathogens like *Rhizoctonia* + *Sclerotium* the highest disease was recorded in the genotype BGD 103 (86.67%) and all the genotypes recorded more than sixty per cent disease incidence in this combination. When all the pathogens were inoculated simultaneously (*Fusarium* + *Rhizoctonia* + *Sclerotium*), all the genotypes showed more than eighty per cent disease incidence, genotypes Annigeri 1, BGD 103, BGD 128 revealed cent per cent disease incidence.

JG11 genotype recorded minimum infection by *Fusarium oxysporum ciceri* however exhibiting susceptible reaction to *R. bataticola* and *S. rolfisii*. Same trend was observed in genotype JAKI 9218 also. Genotypes resistant to single pathogen may become susceptible to other pathogens of wilt complex. Disease incidence was more when *Sclerotium rolfisii* was inoculated individually or in combination with other pathogens.

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