The Bioscan 15(2): 245-248, 2020
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

SCREENING OF CHICKPEA CULTIVARS AGAINST WILT AND ROOT ROT COMPLEX DISEASE OF CHICKPEA

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KEYWORDS
Wilt and root rot complex
Host plant resistance
Chickpea cultivars
Germination

Received on :
26.03.2018

Accepted on :
30.04.2020

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ABSTRACT
Ten chickpea cultivars were screened to find out the source of resistance against *F. solani, Fusarium oxysporum* f. sp. *ciceri* (Foc) and *R. solani* causing wilt and root rot complex of chickpea. The experiment was conducted during rabi (2012-13) and (2013-14) using the varieties Dahod Yellow, Pratap Chana -1, Avrodhi, RSG-888, RAJ-1581, BGD-72, BG-391, BG-1053, GMG-469 and P- 1080 under soil inoculation activity growing virulent cultures of *F. solani* (isolate SRH Fs-5), Foc (isolate BNS Foc-1) and *R. solani* (isolate BNS Rs-6). Pooled data revealed among the varieties, the lowest germination (61.0 %) was recorded with Dahod Yellow, followed by variety BG-391 with 62.8 % germination. BGD-72 showed 68.5 % germination, BG-1053 showed 70.0 % germination, Pratap Chana-1 showed 72.5 % germination, P-1080 showed 73.5 % germination, RAJ-1581 showed 75.6 % germination and 78.0 % germination with GNG-469. The highest germination 82.5 % was recorded with Avrodhi. The result showed Avrodhi to be highly resistant to wilt and root rot complex of chickpea. Varieties GNG-469, RAJ-1581, P-1080 and Pratap Chana-1 were moderately resistant, while BG-1053, BGD-72, BG-391 and RSG-888 were moderately susceptible. The popular cultivar Dahod Yellow was highly susceptible.

INTRODUCTION

Chickpea (*Cicer arietinum* L) is the world's third most important grain legume after common bean and pea (Anwar *et al*., 2009). Pulse play a significant role in diet of the Indian vegetarian people and in animal nutrition (Indu *et al*.,2016). Chickpea productivity revealed interesting trend from last four decades like productivity consistently increased in India and Mexico while it is declined in other countries (Mahavir *et al*., 2016). More than 50 pathogens have been reported to infect chickpea crop but only few caused economically important diseases. Among them, wilt and root rot complex caused by *Fusarium oxysporum* f. sp. *ciceri, Fusarium solani* and *Rhizoctonia solani* are of considerable importance (Nene *et al*., 1981). Early infection of the wilt complex pathogens results in death of plant, *i.e*. in total yield loss (Haware and Nene, 1980). Among many factors responsible for lower productivity, lack of disease management is one of the major factors (Patil *et al*., 2016). Management of Fusarium wilt and root rot complex of chickpea is difficult to achieve as the pathogens are soil-borne, surviving through resistant structure *i.e*. chlamydospores and sclerotia in soil for years even in the absence of host and the crop remains susceptible all throughout the growth stages (Kaiser *et al*., 1994 and Haware *et al*., 1996). Use of chemical fungicides for effective management of these pathogens is not possible because of the physical heterogeneity of the soil, which might prevent effective concentrations of the chemical reaching the target pathogen (Tewari and Mukhopadhyay, 2001). Soil applications of fungicides are costly and lead to indiscriminate killing of beneficial soil micro flora. Since most of the commercial cultivars in the country have been found to be susceptible, there is therefore urgent need for an extensive screening of germplasm for the identification of resistant sources (Tariq *et al*., 2009). But screening program of chickpea germplasm has abortive to identify stable and high-level resistance against a number of diseases (Singh and Reddy, 1993; Singh *et al*., 1994). Limited germplasm of chickpea resistant to and Fusarium wilt is found in existing chickpea species so it is, necessary to search out new sources of resistance to this disease. Host plant resistance appears to offer the best practical and economical strategy for control of this disease. Good progress has been made in the identification of sources of resistance to Fusarium wilt (Haware *et al*., 1990; Jimenez-Dýaz *et al*., 1991) in both desi (small, angular, colored seeds) and kabuli (large, ramhead shaped, beige seeds) germplasm, and kabuli cultivars resistant to Fusarium wilt have been developed. Pande *et al*. (2004) evaluated chickpea mini-core collection composed of 211 germplasm to identify sources of multiple disease resistance against Fusarium wilt (Foc) under a controlled environment. High levels of resistance were observed to Fusarium wilt, where 21 accessions were asymptomatic and 25 resistant. Since the last decade of 20th century different strategies have been adopted worldwide by the researchers for screenings of chickpea wilt (Gurha and Misra, 1983). These strategies included development of different disease rating scales to assess the disease incidence and prevalence in the screening of new chickpea germplasm. Disease reactions were classified according to the percentage of dead plants, which at physiological maturity represented the reaction score of each genotype (Nene and Haware, 1980). Disease scoring scales used for phenotype resistance and

susceptibility for race identification varied. Lines rated as resistant in one study might have been categorized as moderately resistant to susceptible in other studies and vice versa (Haware and Nene, 1982). Gurha *et al*. (2002) screened 570 chickpea genotypes for resistance to chickpea wilt at Kanpur and find out 22 cultivars with stable resistance. Iqbal *et al*. (2005) observed resistant sources against Fusarium wilt in the chickpea germplasm originating from national and international research institutes. They identified 14 chickpea lines having resistant against Fusarium wilt at seedling stage but no line was found to be resistant at reproductive stage. Similarly, Chaudhry *et al*. (2007) screened 196 chickpea germplasm for resistance against wilt and found not a single line immune or highly resistant. The disease can be controlled with resistant germ plasmas. Limited or lack of genetic variability is important factor for the limited progress achieved in increasing the productivity of grain legume including chickpea. The use of resistant cultivars appears to be most practical and economical.

MATERIALS AND METHODS

Isolation of Pathogens

The diseased samples of chickpea showing typical wilt and root rot symptoms were collected in *rabi* season of 2012 from farmer's field of different chickpea growing areas of Rajasthan *viz*., Udaipur, Bikaner, Tivari (Jodhpur), Pali, Sirohi and Banswara all from local land races. Isolation from infected root of chickpea plant showing typical root rot symptoms were used to isolate the pathogen by inoculation on the PDA. These infected aerials parts were thoroughly washed in running tap water to remove the adhering soil. These were then cut into small pieces, washed in sterilized water, surface sterilized by dipping in 0.1 per cent mercuric chloride (HgCl2) for two minutes rinsed thrice in sterilized distilled water and transferred on potato dextrose agar (PDA) medium in Petri plates and incubated at 28 ± 1^{o}C. (Anon., 1981). The cultures were purified by single spore method and pathogenicity test was conducted for all the six isolates each of *Fusarium* spp. and R. solani collected from different places. For identification these characters were compared with the standard reference description (Sneh *et al*., 1992 and Mordue, 1988) for *Rhizoctonia solani* and Booth (1971) for *Fusarium* spp.

Evaluation of popular chickpea cultivars for resistance to wilt and root rot pathogens

Ten varieties/ genotypes were evaluated under artificial inoculation conditions using soil inoculation technique of spore cum mycelial of F. solani, Foc and R. solani causing wilt and root rot complex of chickpea. Varieties/ genotypes *viz*., Dahod Yellow, Pratap Chana, Avrodhi, RSG-888, RAJ-1581, BGD-72, BG-391, BG-1053, GMG-469 and P- 1080 from different districts of Rajasthan. Experiment was laid out in Completely Randomized Design (CRD) with 20 g/ pot and three replications were maintained under cage house conditions. The pots were filled with sterilized soil and were inoculated with 20g/kg inoculum grown on corn meal sand (1:1) medium for ten days, alone and in combination three days before sowing. Ten seeds of chickpea for each variety were sown 5 cm at depth in 9-inch pots. The observations on seed germination percentage and plant mortality were recorded after 60 days after sowing by using the formula,

$$\text{Mortality percentage} = \frac{\text{Total number of infected plants}}{\text{Total number of plant assessed}} X100$$

RESULTS AND DISCUSSION

Isolation of Pathogens

The cultures of Fusarium solani and Rhizoctonia solani were obtained from the samples collected from different chickpea growing areas of Rajasthan *viz*., Udaipur, Bikaner, Ajmer Tivari (Jodhpur), Pali and Sirohi. Samples from only one location-Banswara, yielded *Fusarium oxysporum* f. sp. *ciceri* (Foc) and *R. solani*, rest all the samples yielded cultures of F. solani and *R. solani*. The cultures of Foc from Banswara was designated as BNS Foc-1 while the different *F. solani* isolates were designated as given in Table 1.

Evaluation of popular chickpea cultivars for resistance to wilt and root rot pathogens

Foc and *R. solani* causing wilt and root rot complex of chickpea. The experiment was conducted in pots using the varieties Dahod Yellow, Pratap Chana -1, Avrodhi, RSG-888, RAJ-1581, BGD-72, BG-391, BG-1053, GMG-469 and P- 1080 under soil inoculation activity growing virulent cultures of *F. solani* (isolate SRH Fs-5), Foc (isolate BNS Foc-1) and *R. solani*

Table 1: Isolates of Fusarium spp. and R. solani recovered from samples collected from different fields in chickpea growing areas of Rajasthan

Sl.	Pathogens isolated	Place of collection	Isolate designation	Isolate code
1	*Fusarium solani*	Udaipur	UDP	UDP Fs-1
	Fusarium solani	Bikaner	BKN	BKN Fs-2
	Fusarium solani	Tivari (Jodhpur)	TIB	TIB Fs-3
	Fusarium solani	Pali	PAL	PAL Fs-4
	Fusarium solani	Sirohi	SRH	SRH FS-5
2	*Fusarium oxysporum* f.sp. *ciceri*	Banswara	BNS	BNS Foc-1
3	*Rhizoctonia solani*	Udaipur	UDP	UDP Rs-1
	Rhizoctonia solani	Bikaner	BKN	BKN Rs-2
	Rhizoctonia solani	Tivari (Jodhpur)	TIB	TIB Rs-3
	Rhizoctonia solani	Pali	PAL	PAL Rs-4
	Rhizoctonia solani	Sirohi	SRH	SRH Rs-5
	Rhizoctonia solani	Banswara	BNS	BNS Rs-6

Table 2: Evaluation of popular chickpea cultivars for resistance to wilt and root rot pathogens in pot-culture during rabi 2012-13 and 2013-14

Sl. no.	Varieties	Seed germination* (%)			Plant mortality*(%)		
		2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
1	Dahod Yellow	62 (51.9)	60 (50.8)	61 (51.4)	63 (52.6)	65 (57.8)	64 (55.2)
2	Pratap Chana-1	74 (9.4)	73 (58.7)	73.5 (59.1)	43 (41)	46 (52.4)	44.5 (46.7)
3	Avrodhi	85.2 (67.5)	83 (65.8)	84.1 (66.6)	21 (27.3)	22 (52)	21.5 (39.7)
4	RSG-888	64.6 (53.5)	61 (51.4)	62.8 (52.5)	59 (50.2)	61 (50)	60 (50.1)
5	RAJ-1581	79 (62.9)	77 (61.4)	78 (62.2)	34 (35.7)	36 (48)	35 (41.8)
6	BGD-72	71 (57.4)	69 (56.2)	70 (56.8)	52 (46.2)	57 (40)	54.5 (46.2)
7	BG-391	70 (56.8)	67 (55)	68.5 (55.9)	55.5 (48.2)	58 (52.4)	56.8 (44.1)
8	BG-1053	73 (58.7)	72 (58.1)	72.5 (58.4)	47 (43.3)	50 (52)	48.5 (47.9)
9	GNG-469	83 (65.7)	82 (65)	82.5 (65.3)	27 (31.3)	30 (52)	28.5 (41.7)
10	P-1080	76.2 (60.9)	75 (60)	75.6 (60.5)	39 (38.7)	42.5 (70)	40.8 (54.3)
	CD (p = 0.05)	4.3	4.2	2.9	1.9	3.9	2.1
	C.V (%)	3.4	3.4	4.2	2.2	3.5	3.9

* Mean of three replications; Figures in parentheses are arcsine " per cent angular transformed values.

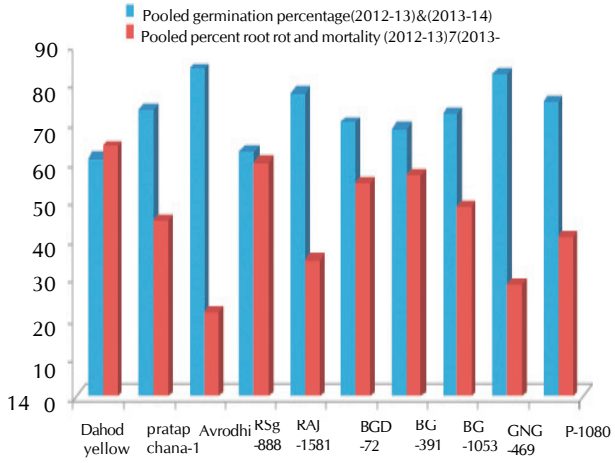

Figure 1: Screening of ten chickpea genotypes against Fusarium spp. and Rhizoctonia solani causing wilt and root rot complex during rabi (2012-13) and (2013-14)

(isolate BNS Rs-6). The experiment was conducted in rabi (2012-13) and (2013-14). Pooled data revealed among the varieties, the lowest germination (61.0 %) was recorded with Dahod Yellow, followed by variety BG-391 with 62.8 % germination. BGD-72 showed 68.5 % germination, BG-1053 showed 70.0 % germination, Pratap Chana-1 showed 72.5 % germination, P-1080 showed 73.5 % germination, RAJ-1581 showed 75.6 % germination and 78.0 % germination with GNG-469. The highest germination 82.5 % was recorded with Avrodhi. Among the varieties tested, the highest mortality (64.0 %) was recorded with variety Dahod Yellow, followed by 56.8 % mortality with BG-391. Variety BGD-72 showed 54.5 % mortality, BG-1053 showed 48.5 % mortality, Pratap Chana-1 showed 44.5 % mortality, P-1080 showed 40.8 % mortality, RAJ-1581 showed 35.0 % mortality and GNG-469 with 28.5 % mortality. The lowest 21.5 % mortality was recorded with variety Avrodhi.

The management of the diseases through host plant resistance is considered as a dependable choice in all the crop improvement programme. Utilization of resistant cultivars in farming is simple, effective and economical method for management of diseases. The resistant cultivars reduce the cost, time and energy when compared to the other methods of disease management. Screening was done taking ten chickpea cultivars with inoculations of all the three pathogens using soil inoculation technique of spore cum mycelial of Foc, F. solani and R. solani. The result showed Avrodhi to be highly resistant to wilt and root rot complex of chickpea. Varieties GNG-469, RAJ-1581, P-1080 and Pratap Chana-1 were moderately resistant, while BG-1053, BGD-72, BG-391 and RSG-888 were moderately susceptible. The popular cultivar Dahod Yellow was highly susceptible. Screening of large number of genotypes has been done by several workers Nene, (1980); Nain and Agnihotri, (1984); Reddy and Reddy, (1987) and Bala and Kalia, (2014) and some sources of resistance identified for individual pathogens. In our studies, these evaluations for resistance were done under inoculations of three pathogens. In this screening no variety was immune or highly resistant. Limited success has been achieved in use of resistant varieties for soil borne pathogens, two were found promising in the present study. Similar study was conducted by Iqbal *et al*. (2005) where one hundred and forty-five genotypes obtained from various sources. Disease observations were recorded at seedling and reproductive stages. Disease incidence ranged from 0% to 57.2% at reproductive stage and it varied from 0% to 100% at seedling stage. Five genotypes were identified with genes for tolerance against both the diseases which could be tested under wide range of environments and be utilized for developing high yielding cultivars with dual tolerance through building pyramid

resistance.

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