Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 1030-1032
Received: 19-11-2018
Accepted: 21-12-2018

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Screening of chickpea lines against dry root rot of chickpea caused by *Rhizoctonia bataticola* (Taub.) butler

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Abstract
Chickpea is an important pulse crop, ranking first among pulse crops in Madhya Pradesh and third in India. Chickpea dry root rot caused by *Rhizoctonia bataticola* is the most important disease and causes severe losses in yield In the investigation, 126 chickpea genotypes were evaluated to find out the resistance reaction against dry root rot under dry root rot sick micro-plots during rabi season of 2014-2015 and 2015-2016. Out of 126 genotypes tested against root rot disease 22 were found resistant, 43 were moderately resistant, 37 were moderately susceptible, 7 were susceptible and 17 were highly susceptible to dry root rot disease.

Keywords: Chickpea, dry root rot, genotypes, screening, *Rhizoctonia bataticola*

Introduction
Chickpea (*Cicer arietinum* L.) is the premier pulse crop grown in more than 50 countries, originated in south west Asia and cultivated from ancient times both in Asia and European countries. It is the world's second most important food legume next to French bean. Asia accounts 89.20% of the chickpea area and 84.47% of production. The major chickpea producing countries, which contribute about 88% of the global chickpea production, include India (64.58%), Australia (7.22%), Myanmar (4.62%), Pakistan (4.27%), Turkey (3.76%), and Ethiopia (3.67%) (Anonymous, 2015-16) [2]. Dry root rot of chickpea caused by *Rhizoctonia bataticola* (Taub.) Butler is emerging as a serious threat to the chickpea production worldwide (Pande and Sharma, 2010) [8]. Dry root rot mostly appears at late flowering and podding stages and the infected plants appear completely dried. Among the several constraints affecting the productivity of chickpea, 10-35 per cent loss in yields are due to wilt and dry root rot diseases (Pal, 1998) [7]. Among them, dry root rot caused by *Rhizoctonia bataticola* is becoming severe in most of the chickpea growing regions of Madhya Pradesh. *R. bataticola* is a polyphagous soil borne pathogen infecting over 500 plant species worldwide causing huge losses. Though, the fungus is seed and soil borne (Dhingra and Sinclair, 1994) [4], however, soil borne inoculum is more important in causing infection and disease development. Management of dry root rot thought chemicals is not effective as *R. bataticola* has a broad host range and survives in soil for extended periods in the form of sclerotia. The scleratia will survive up to ten months even within the absence of the host plants and beneath prevailing dry soil conditions. Use of host plant resistance is that the most economical approach for management of dry root in chickpea. The present investigation was undertaken to find out the resistance source against dry root rot disease.

Material and methods
In the investigation, 126 chickpea germplasm/varieties were evaluated to find out the resistance reaction against dry root rot under dry root rot sick micro-plots. The experiment was laid out in randomized block design which was replicated twice during 2014-15 and 2015-16. The soil sterilized with formaldehyde (2 per cent) was filled in cemented pits. Inoculum of *R. bataticola* was multiplied on sorghum grain for artificial inoculation. The sorghum grains were washed in the tap water. After washing, sorghum grains were soaked in tap water for 12 hrs, and filled into polythene bags (300 g/bag). The grains were autoclaved for 2 subsequent days at 1.1 kg/cm^2 for 30 minutes and inoculated with 3-days old culture of *R. bataticola.* Inoculated polythene bags were incubated at 25 $\pm 1^0$ C for 15 days. The *R. bataticola* inoculated sorghum seeds were placed in each line. The seeds of the test line were sown in infested soil.

In order to ensure the spread of the pathogen a highly susceptible variety L 550 was sown as a check after every two rows. Root rot incidence was recorded as per the following formula:

$$\text{Root rot incidence (\%)} = \frac{\text{Infected plants}}{\text{Total number of plant}} \times 100$$

Disease rating scale for dry root rot of chickpea

Reaction	Per cent mortality
Resistant (R)	0-10
Moderately resistant (MR)	10.1-20
Moderately susceptible	20.1-30
Susceptible (S)	30.1-50
Highly susceptible (H.S)	Above 50

Results and Discussion

Management of dry root rot of chickpea through Chemical is not effective as *R. bataticola* includes a broad host range and survives in soil for long periods in the form of sclerotia. The sclerotia will survive up to ten months even in the absence of the host plants and beneath prevailing dry soil conditions. Use of host plant resistance is the most economical strategy for management of dry root in chickpea. A few chickpea lines with field tolerance to dry root rot have been identified, but high levels of resistance are rare in cultivated genotypes (Anonymous, 2010) [1]. In the experiment, total 126 chickpea entries were screened against dry root rot during *Rabi* season 2014-15 and 2015-16. During 2014-15, twenty four entries *viz*, Phule G 0405, GL 10023, RSG 888, BAUG 15, DBGV 102, GJG 1209, GJG 1202, NBeG 453, JG 41, Phule G 08108, BGD 1082, GNG 2215, BG 372, GNG 2261, BG 3054, NDG 13-21, GNG 2263, GJG 1205, GJG 1207, NBeG 439, HK 4, NBeG 460, HK 10-124, NBeG 399, BG 3059 showed resistant reaction (Table-1). Forty nine entries found moderately resistant reaction. Thirty two entries have been found moderately susceptible. Sixteen entries showed susceptible reaction and five entries have been found to show highly susceptible reaction, while during 2015-16, seventeen entries *viz*, GL 10023, RSG 888, BAUG 15, GJG 1209, GJG 1202, JG 41, GNG 2215, BG 372, GNG 2261, BG 3054, NDG 13-21, GNG 2263, GJG 1205, NBeG 460, HK 10-124, NBeG 399, BG 3059 were found resistant (Table-2). Forty two entries found moderately resistant reaction. Forty two entries have been found moderately susceptible, seventeen entries showed susceptible reaction and eight entries have been found to show highly susceptible reaction.

Table 1: Reaction of chickpea entries against dry root rot during 2014-15

Reaction	No. of entries	Entries
Resistant (R)	24	Phule G 0405, GL 10023, RSG 888, BAUG 15, DBGV 102, GJG 1209, GJG 1202, NBeG 453, JG 41, Phule G 08108, BGD 1082, GNG 2215, BG 372, GNG 2261, BG 3054, NDG 13-21, GNG 2263, GJG 1205, GJG 1207, NBeG 439, HK 4, NBeG 460, HK 10-124, NBeG 399, BG 3059,
Moderately resistant (MR)	49	GNG 469, GNG 2171, RSG 931, Phule G 0408, PBG 5, GL 10006, DCP 92-3, Phule G 12107, AKG 1106, H 11-58, IPC 2011-138, GNG 2249, NBeG 780, Pusa 547, GJG 0831, GNG 2219, PG 0109, IPC 2010-62, CSJ 769, JG 14, GJG 1208, IPC 2010-134, H 11-41, NBeG 454, Phule G 0609-15, IPC 2010-72, GAG 1107, GNG 2226, Phule G 0611, IPC 2010-112, BG 3055, GNG 2258, GNG 2237, HK 10-103, BG 1053, PKV Kabuli-2, IPCK 2010-92, JGK 1, GNG 2285, IPCK 2009-165, GNG 2281, IPCK 2002-29, Phule G 12310, HK 11-104, DBGV 151, JSC 26, NBeG 179, BGD 1097
Moderately susceptible (MS)	32	DKG 876, NBeG 452, GNG 2207, DKG 964, RSG 963, BG 3044, IPC 2010-14, BG 3043, Phule G 12110, GNG 2264, KGD 2011-1, DIBG 202, BGD 1088, H 12-63, H 10-22, GNG 2259, IPC 2007-28, BGD 1091, H 10-41, IPC 2009-191, NBeG 47, Phule G 0302, BG 3056, H 11-22, DIBG 201, GNG 2228, PKV Kabuli-4, CSJK 4, JGK 29, BG 3057, IPCK 2009-79, NBeG 177
Susceptible (S)	16	GNG 1581, GNG 1958, BDNG 804, GAG 1107, BG 3051, HC 5, BG 3046, JG 16, DBGV 101, BG 1003, HK 09-211, CSJK 77, JGK 28, IPCK 2010- 124, Phule G 12407, Phule G 12404
Highly susceptible (HS)	5	AKG 1108, BDNG 2013-1, PG 071, GNG 1969, HK 4

Table 2: Reaction of chickpea entries against dry root rot during 2015-16

Reaction	No. of entries	Entries
Resistant (R)	17	GL 10023, RSG 888, BAUG 15, GJG 1209, GJG 1202, JG 41, GNG 2215, BG 372, GNG 2261, BG 3054, NDG 13-21, GNG 2263, GJG 1205, NBeG 460, HK 10-124, NBeG 399, BG 3059,
Moderately resistant (MR)	42	GNG 2171, RSG 931, DCP 92-3, Phule G 12107, IPC 2011-138, GNG 2249, NBeG 780, GJG 0831, GNG 2219, PG 0109, IPC 2010-62, CSJ 769, GJG 1208, H 11-41, NBeG 454, Phule G 0609-15, IPC 2010-72, GAG 1107, GNG 2226, IPC 2010-112, GNG 2258, GNG 2237, HK 10-103, BG 1053, PKV Kabuli-2, IPCK 2010-92, GNG 2285, IPCK 2009-165, GNG 2281, IPCK 2002-29, Phule G 12310, HK 11-104, JSC 26, NBeG 179, Phule G 0405, DBGV 102, NBeG 453, Phule G 08108, BGD 1082, GJG 1207, NBeG 439, HK 4,
Moderately susceptible (MS)	42	NBeG 452, DKG 964, RSG 963, BG 3044, IPC 2010-14, BG 3043, Phule G 12110, GNG 2264, KGD 2011-1, DIBG 202, BGD 1088, H 12-63, GNG 2259, IPC 2007-28, BGD 1091, H 10-41, IPC 2009-191, NBeG 47, BG 3056, H 11-22, DIBG 201, GNG 2228, PKV Kabuli-4, CSJK 4, JGK 29, BG 3057, IPCK 2009-79, NBeG 177, GNG 469, Phule G 0408, PBG 5, GL 10006, AKG 1106, H 11-58, Pusa 547, GNG 2219, JG 14, IPC 2010-134, Phule G 0611, BG 3055, JGK 1, DBGV 151, BGD 1097,
Susceptible (S)	17	GNG 1581, GNG 1958, BDNG 804, BG 3051, BG 3046, DBGV 101, BG 1003, HK 09-211, CSJK 77, JGK 28, IPCK 2010- 124, Phule G 12407, Phule G 12404, DKG 876, GNG 2207, H 10-22, Phule G 0302,
Highly susceptible (HS)	8	AKG 1108, BDNG 2013-1, PG 071, GNG 1969, HK 4, GAG 1107, HC 5, JG 16,

Table 3: Reaction of chickpea entries against dry root rot (Average of 2014-15 and 2015-16)

Reaction	No. of entries	Entries
Resistant (R)	22	GL 10023, RSG 888, BAUG 15, GJG 1209, GJG 1202, JG 41, GNG 2215, BG 372, GNG 2261, BG 3054, NDG 13-21, GNG 2263, GJG 1205, NBeG 460, HK 10-124, NBeG 399, BG 3059, NBeG 439,
Moderately resistant (MR)	43	GNG 2171, RSG 931, DCP 92-3, Phule G 12107, IPC 2011-138, GNG 2249, NBeG 780, GJG 0831, GNG 2219, PG 0109, IPC 2010-62, CSJ 769, GJG 1208, H 11-41, NBeG 454, Phule G 0609-15, IPC 2010-72, GAG 1107, GNG 2226, IPC 2010-112, GNG 2258, GNG 2237, HK 10-103, BG 1053, PKV Kabuli-2, IPCK 2010-92, GNG 2285, IPCK 2009-165, GNG 2281, IPCK 2002-29, Phule G 12310, HK 11-104, JSC 26, NBeG 179, Phule G 0405, DBGV 102, NBeG 453, Phule G 08108, BGD 1082, GJG 1207, HK 4, Phule G 0408, H 11-58, Pusa 547, GNG 2219, DBGV 151, BGD 1097,
Moderately susceptible (MS)	37	NBeG 452, DKG 964, RSG 963, BG 3044, IPC 2010-14, BG 3043, Phule G 12110, GNG 2264, KGD 2011-1, DIBG 202, BGD 1088, H 12-63, GNG 2259, IPC 2007-28, BGD 1091, H 10-41, IPC 2009-191, NBeG 47, BG 3056, H 11-22, DIBG 201, GNG 2228, PKV Kabuli-4, CSJK 4, JGK 29, BG 3057, IPCK 2009-79, NBeG 177, GNG 469, PBG 5, GL 10006, AKG 1106, JG 14, IPC 2010-134, Phule G 0611, BG 3055, JGK 1, GNG 2207,
Susceptible (S)	17	GNG 1581, GNG 1958, BDNG 804, BG 3051, BG 3046, DBGV 101, BG 1003, HK 09-211, CSJK 77, JGK 28, IPCK 2010- 124, Phule G 12407, Phule G 12404, DKG 876, H 10-22, Phule G 0302, JG 16,
Highly susceptible (HS)	7	AKG 1108, BDNG 2013-1, PG 071, GNG 1969, HK 4, GAG 1107, HC 5,

Average of two year data was taken for all the entries and according to disease incidence the entries were classified in five groups *viz.*, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible. 126 entries of chickpea were evaluated against dry root rot during 2014-15 and 2015-16. Out of 126 entries, twenty two entries *viz.*, GL 10023, RSG 888, BAUG 15, GJG 1209, GJG 1202, JG 41, GNG 2215, BG 372, GNG 2261, BG 3054, NDG 13-21, GNG 2263, GJG 1205, NBeG 460, HK 10-124, NBeG 399, BG 3059, NBeG 439 were found resistant [Table-3]. Forty three entries found moderately resistant reaction. Thirty seven entries have been found moderately susceptible. Seventeen entries showed susceptible reaction and seven entries have been found to show highly susceptible reaction. Mishra *et al.* (2005) [6] tested 470 germplasm lines and found KG-86 KWR-4, KWR-108 and KWR-277 as a resistant genotype. Chaturvedi and Dua (2009) [3] reported 25 resistant cultivars including Radhey, KPG-59 and K-50 against dry root rot. Khan *et al.* (2012) [5] screened sixty germplasm lines of chickpea for their resistance against dry root rot disease in pot. Out of sixty germplasm lines, only nine lines namely, KGD-1189, KGD-1201, KGD-1209, KGD-1215, KGD-1217, KGD-1220, KGD-1221, KGD-1248 and KGD-1289, were found resistant. Ten lines *viz.*, KWR-7, KWR-26, KWR-28, KWR-50, KGR-18, KGR-48, KGR-159, KKG-103, KKG-111 and KGD-1201 were found moderately resistant. Seven lines *viz.*, KWR-54, KWR-55, KWR-60, KWR-63, KWR-77, KWR-78, KLWR-79 were found moderately susceptible. 17 lines *viz.*, KGD-1238, KGD-1239, C-304, KWR-12, KWR-14, KWR-15, KWR-16, KWR-17, KWR-18, KWR-22, KWR-61, KWR-65, KWR-70, KWR-71 KWR-1111, KWR-1211 were found susceptible and rest 17 lines were found highly susceptible against the disease.

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