

Screening for resistance against *Rhizoctonia bataticola* causing dry root-rot in chickpea

OM GUPTA, MANISHA RATHI and MADHURI MISHRA

Department of Plant Pathology, JNKVV, Jabalpur 482 004 (MP), India; Email: omgupta_jnkvv@rediffmail.com

(Received: January 30, 2012; Accepted: May 31, 2012)

ABSTRACT

One hundred seventy chickpea genotypes procured from AICRP-Chickpea Unit, NBPGR and ICRISAT were evaluated for locating new and better sources of resistance against dry root rot through blotter paper technique and in multiple disease sick fields at JNKVV, Jabalpur during 2007 to 2010. The susceptible cultivar BG 212 showed 100 per cent mortality *i.e.* rating 9 in 1-9 scale. The studies led to conclusion that out of 170 accessions, 68 genotypes exhibited resistant reaction (<10% mortality), out of which 26 are the promising lines namely (JG 1-14, 2-125, 2-4-110, 14-11, 14-10, 2001-13, 2001-13, 2001-18, 2001-80, 2001-115, 2002-20, 2003-95, 2003-14-16, 2004-110, 210, 9605, 1-9, 99-115, 2001-04, 2003-14-2, JG 2000-07, JSC 37, MPJG 89-11551, MPJG 89-9023, CSJ 592 and Rajas) from JNKVV, Jabalpur. These lines further evaluated for their performance in sick field for three consecutive years and revealed six lines *viz.*, JG 2000-07, JSC 37, MPJG 89-11551, MPJG 89-9023, CSJ 592 and Rajas as resistant exhibiting <10 per cent mortality, however 14 lines showed moderately resistance reaction. Resistant genotypes had white healthy root system with greater number of lateral roots. All other lines having >20% mortality showed necrotic root lesions leading to extensive root rotting. The genotypes identified as resistant are of great value and may be exploited in breeding programme for developing high yielding resistant varieties.

Key words: *Cicer arietinum*, Dry root rot, Resistance, *Rhizoctonia bataticola*

Chickpea (*Cicer arietinum* L.) is the world's third most important food legume after soybean and pea. Out of total production of pulses, chickpea accounts for 37 per cent and area wise 28.28 per cent. India contributes the major share to the global chickpea area (about 65%) and production (68%). In India, it is grown in 8.75 mha area with a production of 8.25 mt (DAC 2011). Among states, Madhya Pradesh (3.09 mt) and Maharashtra (1.11 mt) contribute maximum to the total production (Agricultural Statistics at a Glance 2011) during 2009-2010. Chickpea is prone to several fungal diseases, among them dry root rot caused by *Rhizoctonia bataticola* (Taub.) Butler is one of the major production constraints that cause 10-20 per cent annual loss (Vishwadhari and Chaudhary 2001). Looking at present expanding area in South zone, cropping system and the changing climatic scenario, dry root rot is becoming more severe in the central and southern parts of India. Gupta *et al.* (1983) reported the incidence of dry root

rot ranging from 3.2 to 20.6 per cent in 30 villages of northern Madhya Pradesh. Nene *et al.* (1984) also recorded heavy losses to chickpea crop due to this disease.

Combining useful economic traits with multiple disease resistance and wider adoptability is the demand of the day particularly in soybean-chickpea based cropping system as this pathogen survives in the soil year after year. Sources of resistance to vascular wilt have been reported from different part of the country but only a few moderate resistant lines/germplasms to dry root rot are available. Therefore, commercial cultivars with genetic resistance to the disease have not yet been developed (Pande *et al.* 2004). Keeping the above facts in view, an investigation was undertaken with an objective to identify the sources of resistance in different genotypes of *desi* and *kabuli* chickpea.

MATERIALS AND METHODS

Chickpea dry root rot infected plants were collected from field of JNKVV, Jabalpur and the isolations were made from roots showing characteristics symptoms of disease. The purified culture of *Rhizoctonia bataticola* was maintained on PDA slants for screening the germplasms line. In preliminary screening, 170 accessions of the *desi* and *kabuli* chickpea genotypes were evaluated against dry root rot by using blotter paper technique (Nene *et al.* 1981). Promising lines exhibiting resistant/moderately resistant reactions under blotter paper technique were further screened to see their performance under multiple disease sick fields for three years.

Blotter paper screening technique: A 5mm disc of the culture was placed on PDA poured Petri-plates and incubated at 25±1°C for five days. A mycelial disc from this culture was transferred to 250ml flasks each containing 100ml of sterilized PDB. After five days of incubation at 25±1°C mycelial mats were removed from the flask, were added to 100 ml sterilized distilled water in a beaker after its proper crushing for one minute in the blender.

Five-days old chickpea seedlings of each genotypes were surface sterilized with 2.5% sodium hypochlorite for 5 min of each genotype, alongwith susceptible check BG 212 grown on plastic trays containing sterilized soil + sand (1:1) and were uprooted carefully and washed in running water. Roots of 20 seedlings of each test line dipped at a time in the freshly prepared inoculum for 30 seconds. Inoculated seedlings were placed in folded, moist blotting paper (size

45cm x 25cm with one fold), so that the cotyledons and roots were covered, while the green tops remain exposed. Each plastic tray contained heaps of ten blotters with seedlings and an inoculated susceptible check BG 212 was kept in each heap. The seedlings inoculated with the culture of *R. bataticola* were kept into trays in an Environmental Test Chamber (ETC) at 30°C with 12 h artificial light/day for 8 days. The blotter paper was moistened adequately with sterilized distilled water on alternate day. Individual seedlings were scored for the extent of root infection eight days after incubation on the basis of 1-9 rating scale (Nene *et al.* 1981).

Field screening: Promising lines exhibiting resistant and moderately resistant reaction were further screened in the consecutive years (2007-2010) in the multiple disease sick fields at Seed Breeding Farm, JNKVV, Jabalpur. Each test entry was sown in a plot of two rows of 5 meter length at 30 cm apart with one row of susceptible check BG 212 after every two test entry and replicated twice in randomized block design. Observations on emergence count were recorded at 20 DAS and per cent mortality due to *R. bataticola* recorded at 20 days interval upto maturity of the crop plant and finally computed as follows:

$$\text{Per cent mortality} = \frac{\text{Number of diseased plants}}{\text{Total number of plants}} \times 100$$

RESULTS AND DISCUSSION

The results of *in-vitro* screening indicated that out of 170 genotypes, 68 were found resistant (< 10 per cent mortality) out of which 26 are promising lines *viz.*, JG 1-14, 2-125, 2-4-110, 14-11, 14-10, 2001-13, 2001-13, 2001-18, 2001-80, 2001-115,

2002-20, 2003-95, 2003-14-16, 2004-110, 210, 9605, 1-9, 99-115, 2001-04, 2003-14-2, JG 2000-07, JSC 37, MPJG 89-11551, MPJG 89-9023, CSJ 592 and Rajas) from JNKVV, Jabalpur. No symptom of necrotic lesion on roots were observed in resistant lines as the root system was quite healthy, completely developed and exhibited white appearance. Seventy five genotypes were found moderately resistant (>10.1 to 20% mortality). In these lines the disease rating is recorded 1 (resistant) but the average per cent mortality due to root rot has been observed in the range of 10-20 per cent, that's why they are scored as resistant to moderately resistant (Table 1). Pande *et al.* (2004) evaluated 29 chickpea germplasm accessions for resistance against dry root rot caused by *R. bataticola* under *in vitro* conditions and 22 lines were either susceptible or highly susceptible to dry root rot (0-100 per cent mortality). While remaining 16, 4 and 7 germplasms were tolerant, moderately susceptible and susceptible, respectively (Table 1). Many lesions on roots were seen in moderately susceptible and susceptible genotypes though the new roots were generally free from these lesions. The roots were completely discoloured and rotten in highly susceptible genotype BG 212 (check) which had a disease rating of 9 at eight days after incubation at 30°C. Chickpea genotypes have been screened and identified as resistant to dry root rot by various workers on the basis of *in vitro* and field conditions (Nene *et al.* 1981, Anand Rao and Haware, 1987, Reddy *et al.*, 1990, Bhatt, 1993, Gupta, 1997, Khalid and Ilyas, 2000 and Gupta *et al.*, 2003).

Among 170 chickpea germplasms lines evaluated against *R. Bataticola*, 26 promising lines exhibiting resistance were further evaluated under disease sick field for three consecutive years. The data revealed that six lines *viz.*, JG 2000-07, JSC 37, MPJG 89-11551, MPJG 89-9023, CSJ 592 and

Table 1: Reaction of chickpea entries/genotypes against dry root rot through blotter paper screening technique

Rating	Disease Reaction	Entries/genotypes	Total
1	Resistant	BG 112, C ₂ 14-83, 25, 25-1, CSJ 426, 427, 438, 440, CSJ 592, JSC 37, IC 269263, 327069, 327073, 327290, 327332, 327583, 327654, 327675, 327944, ICC 03104, 03105, 03106, 03112, 03205, 03206, 03207, 04107, 04109, 11322, 12467, 14374, 14376, 14391, 14432, 14433, 16124, 950106-49P-BP, 950106-64P-BP, ICCV 87315, IPC 2000-6, 2004-54, 2004-68, 2005-68, 2005-74, JG 2000-07, MPJG 89-11551, MPJG 89-9023, 1-14, 2-125, 2-4-110, 14-11, 14-10, 2001-13, 2001-18, 2001-80, 2001-115, 2002-20, 2003-95, 2004-110, 210, 9605, 1-9, 99-115, 2001-04, 2003-14-2, PG 00109, Vishal, Rajas,	68
2 - 3	Moderately Resistant	BCP 91, 114, C ₂ 25(IPC), 1-41-32, CSJ 433, 437, 458, H 82-2, GJG 0205, 0312, GL 24080, 97016, IC 269240, 322-16, 327056, 327116, 327673, 327703, 327821, 327829, 327933, 327960, 327968, ICC 03111, 11324, 12233, 14344, 14404, 14409, 14434, 14436, 950102-43P-BP, ICCV 87316, 92944, 95992, IPC 9391, 98-58, 2005-34, 2005-36, 2005-41, 2005-59, JG 74, 63, 1-18, 1-55, 2-14-1, 2-14-115, 2002-108, 2003-210, 98003, 2-25, 2004-03, 2004-110, 2004-944, MPJGK3, Simpleleaf, Compacta, Broad few leaflets, A ₃ (MPxV ₁)xA ₆ , Fasciated stem, Outward curved, JG 2003-14-16, JG 2001-12, JG 315, MPJG 2001-04, H02-14, CSJ 556, CSJ 558, GNG 1488 PG01108, HK- 02-201, HK 03-45, HK 03113 WCG 2000-07, IPC 2005-28	75
4 - 5	Tolerant	BCP 17, JG 2003-95, C ₂ -44, IC 327070, 327074, 327100, 327104, 327337, 327364, 327383, 327393, 327446, 527582, ICC 12450, IPC 98-22, 2004-77	16
6 - 7	Moderately Susceptible	Chaffa, JG 200-14, PG 9425-5, 9425-9	04
8 - 9	Susceptible	BCP 21, 49, BG 212, Cracked, C ₂ -97, 2003-196, 2004-24, 99-213	07

Test lines showing ratings: 1-3 – Acceptable for the breeding programme, 4-5 – Acceptable if lines with rating 1-3 are not available, 6-9 – Not acceptable.

Rajas were resistant exhibiting <10 per cent mortality, however 14 lines showed moderately resistant reaction (JG 2003-14-16, JG 2001-12, JG 315, MPJG 2001-04, H02-14, CSJ 556, CSJ 558, GNG 1488, PG01108, HK-02-201, HK 03-45, HK 03113, WCG 2000-07 and IPC 2005-28) against *R. bataticola* during the testing years under high disease pressure.

Gangwar *et al.* (2002) screened 35 chickpea cultivars for resistance to dry root rot in a field experiment, only 10 cultivars (ICC 2644, 10384, 10630, 112244, 11332, ICCL 81002, 810810, ICC 12263, 12441 and ICCV 90254) were found resistant however, Phule G9504, 96020, 96105, 96313 and GL 91059 were moderately resistant. Prajapati *et al.* (2003) and Gupta and Babbar (2006) identified broad-based stable resistant lines to wilt and root rots on the basis of multi-location evaluation. In the present study, chickpea lines that possessed consistent resistant reaction to dry root rot may be used in breeding programme to incorporate the resistance to dry root rot in high yielding varieties of chickpea.

REFERENCES

- Anand Rao PK and Haware MP. 1987. Inheritance of dry root-rot *Rhizoctonia bataticola* resistance in chickpea. *Plant Breeding* **98**: 349-352.
- Agricultural Statistics at a Glance, 2011. Ministry of Agriculture Government of India, NewDelhi.
- Bhatt J. 1993. Reaction of chickpea cultivars of *Rhizoctonia bataticola* (Taub) Butler (*Macrophomina phaseolina*) (Tassi) Goid. *Indian Journal of Pulses Research* **6**: 118-119.
- Gangwar RK, Prajapati RK, Shrivastava SSL, Kumar Kumud and Kumar K. 2002. Resistance in chickpea germplasms against dry root rot. *Annals of Plant Protection Sciences* **10**: 393-394.
- Gupta Om. 1997. Occurrence of combined resistance to wilt and dry root rot in chickpea. *Indian Journal of Pulses Research* **10**: 125-126.
- Gupta Om and Babbar A. 2006. Identification of desi and kabuli chickpea genotypes for multiple disease resistance against soil borne disease. *Indian Journal of Pulses Research*. **19**: 129-130.
- Gupta Om, Jharia HK and Sharma ND. 2003. *Bacillus subtilis*: An effective antagonist of *Rhizoctonia bataticola* (Taub) Butler causing dry root rot of chickpea. *Indian Journal of Pulses Research* **16**: 42-46.
- Gupta RN, Gupta JS and Sharma BL. 1983. Studies on wilt and root rot incidence of *Cicer arietinum* of Madhya Pradesh. *Indian Phytopathology* **36**: 82-84.
- Khalid Iftikhar and Ilyas MB. 2000. Screening of chickpea germplasm against dry root rot disease (*Macrophomina phaseolina*) in pots/ glass house. *Pakistan Journal of Phytopathology* **12**: 66-70.
- Nene YL, Haware MP and Reddy MV. 1981. Chickpea disease resistance screening techniques. *Information Bulletin ICRISAT* **10**: 10-11.
- Nene YL, Shukla VK and Sharma SB. 1984. Pulse pathology progress report, ICRISAT, Patancheru, A.P., India.
- Pande S, Rao JN and Kishore GK. 2004. Evaluation of chickpea lines for resistance to dry root rot caused by *Rhizoctonia bataticola*. *International Chickpea and Pigeonpea Newsletter* **11**: 37-38.
- Prajapati RK, Shrivastava SSL and Gangwar RK. 2003. Resistant source of chickpea against dry root rot. *Farm Science J.* **12**: 86.
- Reddy MV, Raju RN and Pundir RPS. 1990. Additional sources of resistance to wilt and root rot in chickpea. *International Chickpea Newsletter* **22**: 36-38.
- Vishwadhara and Chaudhary RG. 2001. Disease resistance in pulse crops-current status and future approaches. In: S Nagrajan and DP Singh (eds.), *Role of Resistance in Intensive Agriculture*. Kalyani Publisher, Ludhiana, India, Pp 145-157.