



Exploration of resistance sources against dry root rot and stunt disease of chickpea

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Abstract: A field experiment was conducted for two consecutive years to evaluate resistance in chickpea genotypes against dry root rot and stunt virus. Total one hundred and fifty one (151) genotypes were evaluated against dry root rot in which only JG315 showed resistant reaction. Based on the pooled incidence data of two year experiment one hundred twenty nine entries including seventy four Desi and fifty five Kabuli type were found moderately resistant while fifteen genotypes consisted of eight Desi and seven Kabuli type under tolerant category. Moreover six Desi type viz., GJG1001, GNG2171, DC2012-4, IPC2007-13, CSJ647, RSG931 and one Kabuli type genotype (JGK18) were found under susceptible category. A separate evaluation trial was conducted for stunt disease and response of total one hundred fifty (158) genotypes has assessed for disease reaction. Among evaluated entries only GCP105 showed resistant reaction while fifty eight entries including thirty three Desi and twenty five Kabuli type were found under the category of moderately resistant. Total eighty five entries included fifty five Desi and thirty Kabuli type, eleven entries consisted of six Desi and five Kabuli type, three entries having one Desi and two Kabuli type were depicted as tolerant, susceptible and highly susceptible respectively. Based on findings of both experiments eight Desi type viz., CSJ513, G10023, JG38, GNG469, IPC2009-191, H10-41, JG40, H10-57 and five Kabuli type viz., NBeG176, HK10-124, CSJK74, IPCK2006-143, IPCK2009-164 were found promising against both devastating diseases of chickpea. The information generated under both experiments can be exploited in breeding programme for the development of new variety having resistance against these diseases.

Key words: Chickpea, Resistance, Root rot and Stunt

Introduction

Chickpea (*Cicer arietinum* L.) is an edible legume and the only cultivated species within the genus *Cicer*. It is the third most important legume crop in the world and grown mainly in the Indian subcontinent, West Asia and North African (WANA) region as a major cool season legume. India is the largest producer of chickpea with 67 percent of the global production. It occupies nearly 31 per cent of the total pulse area and contributes over 37 per cent of the national pulse production (Jeewesh *et al.*, 2013). The lower productivity of chickpea is attributed to several biotic and abiotic stresses. Among them, the crop is affected by more than 50 diseases (Nene *et al.*, 1989). Dry root rot (DRR) caused by *Rhizoctonia bataticola* (Taub.) Butler a necrotrophic fungus is emerging and a serious threat to the chickpea production worldwide (Pande and Sharma, 2010). The disease appear generally in late flowering stage and the infected plants become completely dried. Among viral diseases, chickpea stunt disease (CpSD) has been identified as major constraint for lower productivity (Nene *et al.*, 1991). Chickpea stunt disease was first reported from Iran, and it occurs in North Africa, the Middle East, South Africa, Australia, Indian subcontinent, Spain, Turkey, and the United States (Kumar *et al.*, 2008). The causal agent of stunt was originally attributed to Pea leaf roll virus (syn. Bean leaf roll virus, BLRV) (Horn and Reddy, 1996; Nene & Reddy, 1987; Reddy and Kumar, 2004). In India CpSD is caused by bean (pea) leaf roll mosaic virus (Reddy M.V., Nene Y.L. and Verma J.P., 1979). The disease is endemic in Indian and WANA growing regions and causes around 75– 95 per cent yield loss (Horn *et al.*, 1995, 1996). Stunt disease is categorized as an acute-emerging disease that irregularly occur as both temporally and spatially (Savary *et al.*, 2011). It might cause massive disruption in

system, performances and expanded to new areas. It is an important limiting factor for the chickpea and emerged as a serious threat to production in many parts of India particularly in Bihar and other Eastern States (Sahoo *et al.*, 2014). The characteristic symptoms are stunted growth in plant due to shortening intermodal length, small, brittle leaves, leaf reddening in Desi and yellowing in Kabuli type, phloem browning in the collar region and necrosis of the conductive tissues. Plants infected at an early stage showed poor growth and such plants often die prematurely. The involvement of virus transmitted by vector makes it a tough challenge for the management (Kanakala *et al.*, 2014). Looking at the potential ill effect of both diseases associated with the crop, a programme has designed to explore the resistance source in various genotypes. The outcome of investigated findings may be beneficial for chickpea breeding to improve the varieties.

Materials and Methods

The experiments were conducted under field conditions for two years (2012-13 and 2013-14) during *Rabi* season at pulses section, Bhatti, Bihar Agricultural University, Sabour. The selected field was having a history of high disease pressure of dry root rot and stunt disease. Germplasm was obtained from All India Coordinated Research Project (AICRP) on chickpea for evaluation against DRR and CpSD.

Screening against DRR: Sick plot technique was followed for the evaluation of entries against dry root rot. All genotypes were sown in sick plot along with susceptible and resistant check. Each entry was sown in two lines of five meter row with 30 × 10 cm spacing.

Screening against CpSD: Infector row technique was employed for the screening of chickpea entries against CpSD. Each chickpea entry was sown in 2 rows of 5m with a spacing 100 × 10 cm and after each entry an infector row of *Lathyrus var. Moti* was sown to attract

the aphid population and allowing the natural infection of virus to enhance disease pressure.

In both the experiments, all recommended package of practices were followed except application of plant protection measures. The disease incidence/severity was observed at regular intervals and the final disease incidence was calculated by using given formula. Based on the percent disease incidence (PDI), genotypes were grouped into different categories using (1-9) scale as recommended by AICRP on chickpea.

$$\text{Incidence of DRR/CpSD (\%)} = \frac{\text{Number of plants infected} \times 100}{\text{Total Number of plants}}$$

Results and Discussion

A high disease pressure of DRR (62%) and CpSD (75%) was observed in chickpea genotypes under both trial during year 2012-13 and 2013-14 respectively. Total 151 genotypes have been evaluated against DRR under epiphytotic conditions in which maximum incidence 59.6 and 63.5 percent was observed in susceptible check K850 respectively in two consecutive years. However, resistant check JG315 having disease incidence 7.8 and 8.1 percent showed minimum incidence. None of the evaluated genotypes confirmed the resistance except JG315. The collective data of two year experiments on DRR showed that the majority of genotypes categorized under moderately resistant. Findings revealed that among 151 evaluated genotypes a total of 129 (74 Desi and 55 Kabuli type) were moderately resistant, 15

(08 Desi and 07 Kabuli-type) were tolerant and 11 genotypes (06 Desi and 05 Kabuli type) were categorized under susceptible category. Moreover, genotype K850 (Desi) and L550 (Kabuli type) expressed severe symptoms and has recorded under the highly susceptible category (Table 2). Khan *et al.* (2014) has reported some resistant source against dry root rot after screening 60 germplasm/genotypes in which 09 genotypes *viz.* KGD-1189, KGD-1201, KGD-1209, KGD-1215, KGD-1217, KGD-1220, KGD-1221, KGD-1248 and KGD-1289 shown resistant reaction against the disease. Pande *et al.*, (2004) evaluated total 47 test entries but none of the entry was found resistant against the disease. However, one accession (ICC 14395), one cultivar (ICCV 2) and an advance breeding line (ICCX 830203-BH-BH-11H) showed moderately resistant reaction.

In another set of experiment, total 158 genotypes were evaluated against CpSD for two consecutive years (2012-13 and 13-14) in which maximum incidence/severity 74.5 and 75.6 per cent in susceptible check JG315 and minimum incidence 8.5 and 8.8 per cent incidence was recorded in resistant check GCP105. Among evaluated genotypes none of test entries were resistant except GCP105 which showed foremost resistance against the disease. Based on the pooled disease incidence data of two years the maximum number of genotypes were found under the category of moderately resistant. A sum of 58 genotypes (33 Desi and 25 Kabuli type) were found under moderately resistant and maximum number of genotypes *i.e.* eighty five (55 Desi and 30 Kabuli type) exhibited tolerant reaction. Eleven entries including six Desi type *viz.*, GJG1001, GNG2171, DC2012-4, IPC2007-13, CSJ647, RSG9 and five Kabuli type *viz.*, JGK18, HK2, RVSSG24, NBeG402 and HK09-211 were found under susceptible category. Moreover, only one Desi (JG315) and two Kabuli type genotypes (JGK18, GLK10103) were categorized as highly susceptible (Table 3). Over 10,000 germplasm lines have been screened for resistance to CpSD in which line GG669 and ICC10 were found

Table-1: Disease rating scale of DRR and CpSD

Disease Incidence (%)	Grade	Reaction
0-10	1	Resistant (R)
11-20	3	Moderately resistant (MR)
21-30	5	Tolerant (T)
31-50	7	Susceptible (S)
>50	9	Highly susceptible (HS)

Table-2: Reaction of different chickpea entries/genotypes against dry root rot

Reaction/Disease incidence	Entries/genotypes	
Resistant (0-10 %)		JG315 (Resistant check)
Moderately Resistant (11-20 %)	DESI	CSJ513, GJG1114, GNG2216, PG0127, IPC2010-14, GNG2237, JG37, GNG2215, JG16, CSJ769, NDG12-23, JG14, PG0109, IPC2010-62, NDG12-24, JG38, GL29095, H10-05, PantG186, H10-22, GNG2146, RSG931, GJG1012, RKG27-99, PhuleG10114, CSJ515, GAG1107, IPC2010-72, PhuleG11117, CSJ74, JG39, Vijay, CSJ778, GNG2210, GNG1115, NBeG147, GNG2226, RKG27-12, IPC2009-191, H10-41, JG40, RSG931, H10-57, RVSSG21, NDG11-21, GJG1013, GNG2127, IPC2008-69, DC2012-4, NDG11-24, RSG963, IPC2007-13, IPC2006-77, CSJ647, PhuleG0405, GJG0820, PhuleG0511, IPC2010-181, GJG0831, GNG2219, DCP92-3, GNG1958, IPC2010-217, JG36, RVSSG20, GNG2207, GNG469, GJG1001, GL28295, GJG1010, NDG11-12, H09-96, H09-96, GNG2171 (Total: 74 entries).
	KABULI	JGK1, JGK18, NBeG119, IPCK2002-29, IPCK2004-29, BG3022, BG3028, GLK10082, N BeG176, GNG2228, JGK1, RVSSG23, HK09-211, GLK27234, GNG1969, HK10-103, RVSSG24, NBeG402, CSJK6, IPCK2004-29, BG3022, PKV4, BG3028, BG1053, BG1003, HK09-201, BG3042, IPCK2009-164, Kripa, Vihar, HK09-219, BGD1078, IPCK2006-143, HK09-219, BGD1078, IPCK2006-143, BGD1079, BG1053, BG3026, CSJK27, BG3039, CSJK72, BG3040, GLK2721, BG3041, CSJK4, PhuleG0625-6, PG071, PhuleG0625-9, CSJK77, HK4, CSJK54, BDNGK798, CSJK74, JAKI9218 (Total: 55 entries).
Tolerant (21-30%)	DESI	PG0120, GL28297, IPC2006-126, DC2012, H10-21, JG35, GNG2144, and CSJ564 (Total: 8 Entries).
	KABULI	RVSSG23, PKV2, BG1003, HK2, GLK27234, PhuleG0627-3, HK10-124 (Total: 07 Entries)
Susceptible (31-50%)	DESI	GJG1001, GNG2171, DC2012-4, IPC2007-13, CSJ647, RSG931 (Total: 06 Entries)
	KABULI	JGK18 (Total: 01 Entries)
Highly Susceptible (>50%)	DESI	K850 Susceptible Check
	KABULI	L550 Susceptible Check

Table-3: Reaction of different chickpea entries/genotypes against stunt disease

Reaction/Disease incidence	Entries/genotypes	
Resistant (0-10 %)		GCP105 Resistant check
Moderately Resistant (11-20 %)	DESI	DC2012-3, GNG1581, IPC2006-126, GJG1010, GL28297, GL28295, H09-96PG0120, H09-96, H01-01, CSJ513, CSJ821, GJG1107, JG35, NBeG452, G10023, BG3032, PhuleG0405, GJG0820, GJG0831, CSJ769, NDG12-23, PG0109, JG38, GNG2146, RSG888, GNG469, IPC2010-72, CSJ778, GNG2226, IPC2009-191, H10-41, JG40, H1057 (Total 33 entries).
	KABULI	NBeG119, NBeG176, HK4, HK10-124, JGK27, CSJK73, CSJK46, CSJK74, CSJK72, CSJK6, IPCK2006-143, IPCK2009-164, IPCK200229, JGK1, BGD1078, BGD1079, PKV4, PKV2, BG1053, BG3039, BG1003, BG3041, BG3022 (Total 25 entries).
Tolerant (21-30%)	DESI	PhuleG08108, NDG11-12, BGD1074, GCP101, IPC2010-217, JG36, RVSSG20, JG16, GNG1958, GL1006, IPC2010-14, PG0127, GJG1114, GNG2216, H10-21, PhuleG0408, Phule G0405, GNG2207, GNG2144, NDG11-21, BG3037, GJG1013, GNG2127, IPC2008-69, NDG11-24, RSG963, BGD1075, IPC2006-77, H10-22, GL29095, H10-05, IPC2010-62, GNG2219, CSJ564, JG37, GNG2215, PhuleG0511, RSG963, GNG2146, GJG1012, RSG931, GNG2210, GNG1115, NBeG147, PhuleG11117, CSJ741, JG39, PhuleG10114, CSJ515, GAG1107, GNG1969, NBeG402, NBeG27, PhuleG0627-3 (Total: 55 Entries)
	KABULI	JGK26, GLK10100, JGK1, GLK10103, HK10-103, RVSSG24, IPCK2004-29, HK09-19, HK09-219, BGD1078, HK09-201, BG3042, CSJK4, PhuleG0625-6, PG071, CSJK77, GLK10082, RVSSG23, HK09-211, GLK27234, CSJK54, BG1053, BG1003, BDNGK798, BG3040, GLK27211, BG3026, CSJK27, JAKI9218, G3028 (30 Entries)
Susceptible (31-50%)	DESI	GJG1001, GNG2171, DC2012-4, IPC2007-13, CSJ647, RSG931 (Total: 06 Entries)
	KABULI	JGK18, HK2, RVSSG24, NBeG402, HK09-211 (Total: 5 Entries)
Highly Susceptible (>50%)	DESI	JG315 Susceptible check
	KABULI	JGK18, GLK10103 (Total: 02 entries).

resistant from hot spot Hisar, Haryana and Junagarh, Gujarat (Reddy *et al.*, 2004). CpSD resistant genotype has expressed a slower symptom development as compared to the susceptible genotype JG315. Horn *et al.*, (1996) has also reported about chickpea lines exhibited different degree of resistance against CpSD. Total nine (9) test entries resistant and thirty three (33) entries were found moderately resistant in field screening conducted at Junagadh during the years 2008 and 2009 (Anonymous, 2009). Kanakala *et al.* (2013) has screened seventy chickpea genotypes in which only SCGP-WR-29 showed resistance against the disease under field conditions. The true virus resistance was also identified in genotypes L550, IPC 09-07 and GNG-1499 which did not express any symptom. Many entries have been screened against stunt disease at ICRSAT and AICRP on chickpea in which few entries viz., GLK 26155, BGM 568, HK 06-159, JGK 2006-301, CSJ 303, IPC 2004-52, RSG 959, IPC 2000-6, CSJ 140, CSJD125 and CSJ313 were found resistant (Anonymous, 2015). The management of DRR and CpSD also relies upon identification of resistant sources and introgression of these genes into desired genotypes. Present investigation on both challenging disease provides resistance sources which needs to be exploited for generating DRR and CpSD resistant chickpea genotypes.

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