International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 3313-3318

Received: 22-07-2019
Accepted: 24-08-2019

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Screening of promising lines of chickpea against *Fusarium oxysporum*

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Abstract
Chickpea (*Cicer arietinum* L.) is the premier pulse crop of Indian sub continent, throughout the country; six states viz., Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh together contribute 92% of the production and 95% of the area in the country. The experiment was carried out on wilt of chickpea caused by *Fusarium oxysporum* f. sp. *ciceri* to study the host plant resistant in chick pea towards wilt. A total of sixty two entries of chickpea were screened against *Fusarium oxysporum* f. sp. *ciceri* were evaluated under field condition during *Rabi* 2014 and further found Resistant to highly susceptible. In given experiment we revealed that out of 62 entries, two entries viz., GPVT-I-D-IVT-379(18), JG-315 were found resistant and showed below 10 % wilt incidence under field condition. Thirty two entries were found moderately resistant viz., Demo-6, Demo-13, Demo-16, IVT-(RF)-P-123, IVT-(RF)-129-P, IVT(RF)-P-131, IGP-284, IGP-301, IGP-694, IGP-187, IGP-320, Demo -IG-6, Demo-(D)-IG-226, Demo-(D)-IG-474, (D)-VISHL-Desi, BGD-112, (D)-Local-Green, JAK-9218, Demo(D)-IG-370, IG-338, (D)-IG-593-2, JG-11, GPVT-I(D)-MPIG-99-213(24), GPVT-(I)(D) IG-573-1-(15), GPVT-(I)(D) MPJ-99-199(14), GPVT-(D)-IG-337(2), GPVT-I-D-IG-597(8), GPVT-I-(D)-JG-226(17), GPVT-(D)-IG-226(20), GPVT-(D)-IG-551(13), GPVT-(D)-IG-379(10), GPVT-(D)-IG-338(9), GPVT-I-(D)-IG-474-(7) and showed 11-20% wilt incidence. Twenty two entries were susceptible viz., Demo-5, IGP-479(101), IGP-267, IGP-29, JG-130, IG-379, C-418, C-825, IG-593-4, IG-370-GPVT- (D)-(21), ICCV-0311-GPVT-I-(D)-(25), MPIG-5931-(31)-GPVT-I-D-23, IG- 5931-31-GPVT-(D), ICCV-3102-GPVT-I-(D)(11), GPVT-I(D)IG-592(27), GPVT-I-(D) ICCV-3105(12), JG-6-GPVT-(D)(30), GPVT-IG-631-1-(3), CPV-I-(D)-JG-412-(19), GPVT-(D)IG-625-(4), GPVT-I-(D)-IG-593-(1), GPVT-I-(D)-IG-519-66-1(5). Remaining six entries viz., JG-62, P-122(IVT)(RF), AVT×406×C-418 IG-06-1, Demo-JG-218, GPVT-(D)-ICCV-3103-(26).

Keywords: Wilt incidence, susceptible, tolerance, relative humidity, screening

Introduction
Chickpea (*Cicer arietinum* L.) is the major legume crop of India, 38% and 50% of national pulse acreage and production, respectively. It is predominantly consumed as a pulse, dry chickpea is also used in preparation of variety of snacks, sweets and condiments and green fresh chickpea are commonly consumed as vegetable. It is one of the most. It is a rich source of proteins, vitamins and minerals containing 17-22% protein, 60-64% carbohydrate and 3-4% fat. India is the largest chickpea producer as well as consumer in the world. Among the biotic stresses, diseases are the most serious constraints to enhance chickpea productivity causing huge losses. Chickpea is infected by more than 50 pathogens causing different diseases in all the chickpea growing areas. The crop is subjected to infection by several fungi, among them Fusarium wilt incited by *Fusarium oxysporum* Schlecht. Friesment Snyder and Hansen f. sp. *Ciceri* (Padwick) Matuo and Sato is an important disease and is considered relatively a more serious disease in most of chickpea growing countries with yield losses ranging from 10 to 90 % (Singh and Dahiya, 1973) [13]. This disease was reported for the first time in India by Butler (1918) [2].

The most efficient method for the management of disease is using resistant cultivars (Karimi, *et al*. 2012) [10]. The cheapest, economical and the most ideal way of managing chickpea wilt, is the use of resistant cultivars. Chemical control of wilt is not feasible and economical because of the soil as well as seed-borne nature of the pathogen. Fungal chlamydospores can survive in soil up to 6 years in the absence of the host plants (Haware *et al*., 1996). The most practical and cost-efficient method for management of Fusarium wilt of chickpea is the use of resistant cultivars (Nene and Haware, 1980; Nene and Reddy, 1987; Bakhsh *et al*., 2007) [12, 11, 1].

Materials and methods

The present studies on development of wilt in relation to weekly soil temperature and soil moisture, optimization of combination of temperature, relative humidity and inoculum load for development of wilt in chickpea, screening of chickpea lines and variability of isolates of *Fusarium oxysporum* f.sp. *ciceri in vitro* on the basis of differentials were conducted.

Materials

The materials used included seeds of seventy chickpea lines and five races of *Fusarium oxysporum* f. sp. *ciceri*, Seeds of chickpea variety, chemicals for culture media, glass wares, equipments and few miscellaneous articles.

Different races of *Fusarium oxysporum* f. sp. *Ciceri*

The cultures of *Fusarium oxysporum* f. sp. *ciceri* five isolates, Isoloate-1, Isolate-2, Isolate-3, isolate-4 and isolate-5 collected from neighbouring area of indore were cultured and used during the course of study. The details of the places from which isolate of *Fusarium oxysporum* f. sp. *ciceri* isolated are given in detail in table-1

Table 1: Detail of isolate of *Fusarium oxysporum* f. sp. *ciceri* isolated from neighbouring area of indore.

Isolates	Place of isolation
Isolate-1	Farmers field Depalpur, Indore
Isolate-2	Farmers field, Ashtha, Sehore
Isolate-3	Farmers field, Sehore
Isolate-4	Farmers field, Nagda, Ujjain
Isolate-5	Farmers field, Ujjain

Seed

The seeds of seventy promising entries/lines of chickpea and susceptible check were collected from Regional Pulse Research Project, College of Agriculture, Indore (M.P.).

Chemicals

a) Cleaning solution- Cleaning solution contained potassium dichromate 80 g, distilledwater 300 ml and concentrated sulphuric acid 400 ml. This was used to clean the glass wares.
b) Mercuric chloride solution- A 1:1000 solution of $HgCl_2$ was prepared and used for pretreatment of samples.
c) Mounting medium- Lacto phenol and cotton blue with the following composition were used as the staining media for studying the characteristics of the pathogen.
d) Lactophenol- Phenol (pure crystals, liquefied by 20 ml gentle heating on a water bath)

Lactic acid	20 ml
Glycerol	40 ml
Distilled water	20 ml

e) Cotton blue

Anhydrous lacto phenol	67 ml
Distilled water	20 ml
Cotton blue	0.1 g

Glasswares

Standard "Borosil" make glasswares like Petri dishes, beakers, *funnels*, pipettes, Erlenmeyer flasks, culture tubes, measuring cylinder etc. were used during the course of study.

Equipments and miscellaneous articles

Equipments used during the course of investigation included research Binocular microscope, refrigerator, autoclave, hot air oven, BOD incubator, Laminar air flow, weighing balance, LPG gas burner and hot plate. Small instruments like inoculation needle, scalper, razor, glass cavity slides, glass rod, cork borer, wash bottle, forceps, scissor, knife, polyproplene bags, desiccators, glass marking pencils, cover slips, brush, dropper, match box, plastic pots etc were also used during the study

Composition and preparation of different media

a) Potato dextrose agar medium

Potato dextrose broth (PDA) medium having the following ingredients was used for few physiological studies.

Peeled and Sliced potato (extract)	200 g
Dextrose	20 g
Agar –agar	20 g
Distilled water	1000 ml
pH (adjusted to)	6.5

b) Potato dextrose broth medium

Potato dextrose agar (PDB) medium having the following ingredients was used for few physiological studies.

Peeled and Sliced potato (extract)	200 g
Dextrose	20 g
Distilled water	1000 ml
pH (adjusted to)	6.5

Methods

Cleaning and sterilization of glassware

The glasswares were cleaned by dipping them in cleaning solution for 5 minutes and finally rinsed with running tap water for 30 minutes. The Petri dishes were sterilized in a hot air oven at 180 ± 2°C for 1.5 to 2 hours. The inoculation needle, cork borer and other metallic instruments were sterilized by dipping them in alcohol and heating red hot over flame of the spirit lamp/Bunsen burner.

a) Glassware cleaning

Borosil and Corning glassware were kept in the cleaning solution containing 60 g of potassium dichromate ($K_2Cr_20_7$) and 60 ml of concentrated sulphuric acid (H_2SO_4) in one litre of water for whole day. Then they were cleaned by washing with detergent powder followed by rinsing several times in tap water and finally in distilled water.

b) Sterilization

All the glasswares were sterilized in an autoclave at 1.1 kg per sq cm pressure for 20 minutes. All the media were sterilized for 15 minutes at 1.1 kg per sq cm pressure, except those containing sugars and nitrogen sources which were sterilized at 0.7 kg per sq. cm pressure for 10 minutes and soil used for experiment was sterilized at 1.33 kg/sq cm pressure for two hours.

Pretreatment of plant parts

Plant materials were pre-treatment using 0.1 per cent mercuric chloride solution for 20-30 seconds and then washed in sterile water thrice.

Collection of wilt infected plants

Wilted plants of chickpea were collected from Indore, Dhar and Ujjain districts of M.P. Samples of infected roots were collected from fields from the rhizosphere of chickpea crops to the root depth. Total 10-15 spots were selected randomly for taking root samples representing the whole field.

Wherever required, the complete infected plants were also collected for isolation of the pathogen.
Each sample was kept in polythene bag and tied with a rubber band and labeled immediately. Information's pertaining to the locality; crop history, etc. were also obtained about the samples. Samples and roots were analyzed on the day of collection or after keeping for a few days under refrigerated conditions. Root samples were used for detection of the fungi associated with collar rotted plants.

Periodic isolation of isolates of *Fusarium oxysporum* f. sp. *ciceri* and maintenance of isolates used under study
The pathogen *Fusarium oxysporum f.* sp. *ciceri* was isolated from vascular tissues of diseased plants by time segment method and later purified by single spore isolation method and maintained on potato dextrose slants. The affected portions of diseased plants were collected, cut with the help of a sharp razor and rinsed with sterile water to remove traces of dirt. These were surface sterilized by dipping in 1:1000 mercuric chloride solution for one minute and washed twice with sterile water. These pieces were transferred aseptically on to the sterilized Petri dishes containing solidified PDA in a laminar air flow. The Petri dishes were incubated at 28 ± 2^0C. The isolates were purified by single spore from developing colonies. The cultures were identified on the basis of the descriptions given in the monograph on the genus *Fusarium* (Booth, 1971).

Screening against Fusarium wilt under Field Condition
Prepared mass cultures of isolates of wilt fungus to develop wilt sick bed in an augmented design. Seventy three lines/cultivars of chickpea obtained from department of plant pathology, College of Agriculture were screened for the sources of resistance against chickpea wilt disease in a wilt sick plot developed with cultures of *Fusarium oxysporum* f. sp. *ciceri*. Each of the test line was sown in two rows of 3 meter length with row to row spacing 60cm and plant to plant distance 15cm. The nursery was raised following general agronomic practices. The data on the number of wilted plants in each test line were recorded at 15 days interval and the reaction of all the entries all categories by disease incidence for each test line were calculated by the use of following formula.

$$\text{Incidence \%} = \frac{\text{Number of diseased plants}}{\text{Total number of plants}} \text{x} 100$$

The level of resistance and/or susceptibility for each line was determined by using 1-9 rating scale of Iqbal *et al.*, (1993) [9] and calculating AUDPC where,

1 Highly Resistant	= Less than 1% of plant wilted
3 Resistant	= 1-10% of plants wilted.
5 Moderately Resistant	= 11-20% of plants wilted.
7 Susceptible	= 21-50% of plants wilted.
9 Highly Susceptible	= 51% or more of plants wilted.

Area under disease progress curve (AUDPC)
Calculated Area under disease progress curve (AUDPC) value for sixty two lines/cultivars to find slow wilting chickpea lines/cultivars. The data of disease incidence was recorded seven times at 15 days intervals and AUDPC was calculated by the use of following formula.

$$\text{AUDPC} \sum_{I=1}^{K} 0.5\,(y_1 - y_{I-1}) \times d =$$

Where, yi = mortality percent at i th day
K = number of successive days
d = interval between i and i-1 evaluation of disease

Result and discussion
To identify resistant varieties against wilt sixty two entries of chickpea were screened in wilt sick plot by following standard methodology.
The data presented in Table-2 indicates that out of 62 entries, two entries *viz.*, GPVT-I-D-IVT-379(18), JG-315 were found resistant and showed below 10 % wilt incidence under field condition. Thirty two entries were found moderately resistant *viz.*, Demo-6, Demo-13, Demo-16, IVT-(RF)-P-123, IVT-(RF)-129-P, IVT(RF)-P-131, IGP-284, IGP-301, IGP-694, IGP-187, IGP-320, Demo -IG-6, Demo-(D)-IG-226, Demo-(D)-IG-474, (D)-VISHL-Desi, BGD-112, (D)-Local-Green, JAK-9218, Demo(D)-IG-370, IG-338, (D)-IG-593-2, JG-11, GPVT-I(D)-MPIG-99-213(24), GPVT-(I)(D) IG-573-1-(15), GPVT-(I)(D) MPJ-99-199(14), GPVT-(D)-IG-337(2), GPVT-I-D-IG-597(8), GPVT-I-(D)-JG-226(17), GPVT-(D)-IG-226(20), GPVT-(D)-IG-551(13), GPVT-(D)-IG-379(10), GPVT-(D)-IG-338(9), GPVT-I-(D)-IG-474-(7) and showed 11-20% wilt incidence. Twenty two entries were susceptible *viz.*, Demo-5, IGP-479(101), IGP-267, IGP-29, JG-130, IG-379, C-418, C-825, IG-593-4, IG-370-GPVT-(D)-(21), ICCV-0311-GPVT-I-(D)-(25), MPIG-5931-(31)-GPVT-I-D-23, IG-5931-31-GPVT-(D), ICCV-3102-GPVT-I-(D)(11), GPVT-I(D)IG-592(27), GPVT-I-(D) ICCV-3105(12), JG-6-GPVT-(D)(30), GPVT-IG-631-1-(3), CPV-I-(D)-JG-412-(19), GPVT-(D)IG-625-(4), GPVT-I-(D)-IG-593-(1), GPVT-I-(D)-IG-519-66-1(5). Remaining six entries viz., JG-62, P-122(IVT)(RF), AVT ×406×C-418 IG-06-1, Demo-JG-218, GPVT-(D)-ICCV-3103-(26), L-550 have been found to show highly susceptible reaction (more than 50% disease incidence.

AUDPC value
AUDPC value of wilt disease was calculated for sixty two lines and calculated data tabulated here under. Data presented in table-3 showed that minimum AUDPC value recorded in JG-315 (274.39), GPVT-I-D-IG-597(8) (383.93), GPVT-I-D-IVT-379(18) (393.29), GPVT-(D)-IG-551(13) (396.43), GPVT-(I)(D) IG-573-1-(15) (472.60), (D)-IG-593-2 (475.35), GPVT-(D)-IG-337(2) (481.48), and Demo -IG-6 (490.38), while, maximum AUDPC value recorded in JG-62 (7148.82), GPVT-(D)-ICCV-3103-(26) (7083.33), P-122(IVT)(RF) (5288.46), Demo-JG-218 (5250.00), JG-62 (4788.46), AVT ×406×C-418 IG-06-1 (4025.00), L-550 (3000.00), IG-370-GPVT-(D)-(21) (2316.18), ICCV-0311-GPVT-I-(D)-(25) (2179.69), MPIG-5931-(31)-GPVT-I-D-23 (1875.00) and GPVT-I(D)IG-592(27) (1607.14). The AUDPC values of promising lines of chickpea expressed the tolerance level of chickpea lines against wilt pathogen and genetic potentiality of the lines, for instance line GPVT-I-D-IG-597(8) categorised in resistant, but genetic potentiality by mean of AUDPC comes before the highly resistant line GPVT-I-D-IVT-379(18).
The pathogen is highly variable and consists of several races (Colina *et al*., 1985; Haware and Nene, 1982) [4, 8] and a total of eight races have been reported (Haware and Nene, 1982) [8]. Due to prolonged nature of survival of the pathogen, cultural control such as crop rotation is not feasible and chemical control is costly. The only and the most economical control measure of chickpea wilt is the use of durable and stable host resistance (Govil and Rana, 1994) [6]. In the present investigation 62 entries of chickpea were screened in wilt sick

plot by following standard methetology. Out of 62 entries, two entries viz., GPVT-I-D-IVT-379(18), JG-315 were found resistant and showed below 10 % wilt incidence under field condition.

Thirty two entries have been found moderately resistant viz., Demo-6, Demo-13, Demo-16, IVT- (RF)-P-123, IVT-(RF)-129-P, IVT(RF)-P-131, IGP-284, IGP-301, IGP-694, IGP-187, IGP-320, Demo -IG-6, Demo-(D)-IG-226, Demo-(D)-IG-474, (D)- VISHL-Desi, BGD-112, (D)-Local-Green, JAK-9218, Demo(D)-IG-370, IG- 338, (D)-IG-593-2, JG-11, GPVT-I(D)-MPIG-99-213(24), GPVT-(I)(D) IG-573- 1-(15), GPVT-(I)(D) MPJ-99-199(14), GPVT-(D)-IG-337(2), GPVT-I-D-IG- 597(8), GPVT-I-(D)-JG-226(17), GPVT-(D)-IG-226(20), GPVT-(D)-IG- 551(13), GPVT-(D)-IG-379(10), GPVT-(D)-IG-338(9), GPVT-I-(D)-IG-474-(7). Twenty two entries were susceptible and remaining six has been found to show highly susceptible reaction. Chaudhry & Singh (2008) screened one hundred and ninety six chickpea germplasm lines/cultivars for resistance to wilt disease caused by *Fusarium oxysporum* f.sp. *ciceri* in a wilt sick plot and reported none of the test line was found immune or highly resistant, while lines 03001, 03006, 03009, 03012, 03016, 03020 and 03045 found to be resistant. Dubey and Singh (2004) identified H 99-9, Pusa-212, JG-315, JG- 322, PCS-1, PCS-2, PCS-5 and PCS-5 as resistant to vascular wilt using susceptible check BGD-1005 and JG-62 with high inoculum potential in soil.

Table 2: Reaction of chickpea entries against wilt under field condition

Categories	Reaction %	No. of entries	Entries	AUDPC value
Highly resistant	Less than 1% of plant wilted	0	--------	0.00
Resistant	1-10% of plants wilted	2	GPVT-I-D-IVT-379(18), JG-315	274.39-487.50
Moderately resistant	11-20% of plants wilted	32	GPVT-I(D)-MPIG-99-213(24), Demo-6, Demo-13, GPVT-I-D-IG-597(8), Demo-16, IVT-(RF)-P-123, IVT-(RF)-129-P, IVT(RF)-P-131, IGP-284, IGP-301, IGP-694, IGP-187, IGP-320, Demo -IG-6, Demo-(D)-IG-226, Demo-(D)-IG-474, (D)-VISHL-Desi, BGD-112, (D)-Local-Green, JAK-9218, Demo(D)-IG-370, IG-338, (D)-IG-593-2, JG-11, GPVT-(I)(D) IG-573-1-(15), GPVT-(I)(D) MPJ-99-199(14), GPVT-(D)-IG-337(2), GPVT-I-(D)-JG-226(17), GPVT-(D)-IG-226(20), GPVT-(D)-IG-551(13), GPVT-(D)-IG-379(10), GPVT-(D)-IG-338(9), GPVT-I-(D)-IG-474-(7)	383.93-1113.28
Susceptible	21-50% of plants wilted	22	Demo-5, IGP-479(101), IGP-267, IGP-29, JG-130, C-825, IG-593-4, IG-370-GPVT-(D)-(21), ICCV-0311-GPVT-I-(D)-(25), MPIG-5931-(31)-GPVT-I-D-23, IG-5931-31-GPVT-(D), IG-379, C-418, ICCV-3102-GPVT-I-(D)(11), GPVT-I(D)IG-592(27), GPVT-I-(D) ICCV-3105(12), JG-6-GPVT-(D)(30), GPVT-IG-631-1-(3), CPV-I-(D)-JG-412-(19), GPVT-(D)IG-625-(4), GPVT-I-(D)-IG-593-(1), GPVT-I-(D)-IG-519-66-1(5)	867.19-2316.18
Highly susceptible	51% or more of plants wilted	6	JG-62, P-122(IVT)(RF), AVT ×406×C-418 IG-06-1, Demo-JG-218, GPVT-(D)-ICCV-3103-(26), L-550	3000.00-7083.33

Table 3: AUDPC value of different chickpea lines

S. No.	Name of entry	AUDPC value
1	JG-315	274.39
2	GPVT-I-D-IG-597(8)	383.93
3	GPVT-I-D-IVT-379(18)	393.29
4	GPVT-(D)-IG-551(13)	396.43
5	GPVT-(I)(D) IG-573-1-(15)	472.60
6	(D)-IG-593-2	475.35
7	GPVT-(D)-IG-337(2)	481.48
8	Demo -IG-6	490.38
9	Demo-(D)-IG-226	520.00
10	GPVT-(D)-IG-338(9)	524.10
11	IGP-694	547.30
12	GPVT-(D)-IG-226(20)	559.52
13	(D)-Local-Green	567.57
14	BGD-112	575.34
15	GPVT-I-(D)-IG-474-(7)	607.14
16	(D)-VISHL-Desi	638.06
17	IGP-187	640.00
18	Demo-(D)-IG-474	714.84
19	GPVT-(I)(D) MPJ-99-199(14)	719.39
20	GPVT-I-(D)-JG-226(17)	724.58
21	Demo(D)-IG-370	738.81
22	IG-338	738.81
23	IGP-320	760.27
24	JAK-9218	760.42
25	IVT-(RF)-129-P	760.42
26	IVT-(RF)-P-123	760.56
27	JG-11	762.10

28	GPVT-I(D)-MPIG-99-213(24)	814.66
29	Demo-16	875.00
30	IGP-29	888.46
31	IG-379	890.63
32	Demo-6	909.09
33	IG-593-4	911.54
34	IVT(RF)-P-131	961.27
35	GPVT-I-(D)-IG-593-(1)	964.29
36	GPVT-(D)-IG-379(10)	964.29
37	Demo-13	976.19
38	GPVT-I-(D) ICCV-3105(12)	987.80
39	ICCV-3102-GPVT-I-(D)(11)	1005.68
40	JG-130	1008.20
41	C-825	1052.08
42	IGP-301	1052.08
43	IGP-284	1113.28
44	Demo-5	1137.50
45	IGP-267	1159.09
46	GPVT-(D)IG-625-(4)	1209.68
47	IGP-479(101)	1237.50
48	C-418	1241.38
49	IG-5931-31-GPVT-(D)	1353.66
50	GPVT-IG-631-1-(3)	1416.67
51	CPV-I-(D)-JG-412-(19)	1440.79
52	GPVT-I-(D)-IG-519-66-1(5)	1476.56
53	GPVT-I(D)IG-592(27)	1607.14
54	MPIG-5931-(31)-GPVT-I-D-23	1875.00
55	ICCV-0311-GPVT-I-(D)-(25)	2179.69
56	IG-370-GPVT-(D)-(21)	2316.18
57	L-550	3000.00
58	AVT ×406×C-418 IG-06-1	4025.00
59	Demo-JG-218	5250.00
60	P-122(IVT)(RF)	5288.46
61	GPVT-(D)-ICCV-3103-(26)	7083.33
62	JG-62	7148.82

AUDPC value

AUDPC value of wilt disease was calculated for 62 lines. Minimum AUDPC value recorded in JG-315 (274.39), GPVT-I-D-IG-597(8) (383.93), GPVT-I-D-IVT-379(18) (393.29) and GPVT-(D)-IG-551(13) (396.43) while, maximum AUDPC value recorded in JG-62 (7148.82), GPVT-(D)-ICCV-3103- (26) (7083.33), P-122(IVT)(RF) (5288.46) and Demo-JG-218 (5250.00). The AUDPC values of promising lines of chickpea expressed the tolerance level of chickpea lines against wilt pathogen and genetic potentiality of the lines, for instance lines GPVT-I-D-IG-597(8) categorised in resistant, but genetic potentiality by mean of AUDPC comes before the highly resistant line GPVT-I- D-IVT-379(18).

References

1. Bakhsh A, Iqbal SM, Haq IK. Evolution of chickpea germplasm for wilt resistance. Pak. J Bot. 2007; 39(2):583-593.
2. Butler EJ. Fungi and disease in plants, Thacker spink and Co., Calcutta, India, 1918, 547p.
3. Choudhary RG, Singh RK. Effect of media on growth and pigmentation of *Fusarium oxysporum f*, sp. *lentil* isolates. J food legumes. 2008; 21(4):259-261.
4. Colina JC, Trapero-Cases A, Jimenediaz RM. Races of *Fusarium oxysporium* f sp. *ciceri* in Andalucia, Southerm Spain. Int. Chickpea Newsletter. 1985; 13:24-26.
5. Dubey SC, Singh B. Reaction of chickpea genotypes against *Fusarium oxysporum* f. sp. *ciceri* causing vascular wilt. Indian Phytopath. 2004; 57(2):233.
6. Govil JN, Rana BS. Stability of host plant resistance to wilt (*Fusarium oxysporium* of sp. *ciceri*) in chickpea. Int. J Trop. Pl. Dis., 1994; 2:55-60.
7. Haware MP, Nene YL, Pundir RPS, Rao JN. Screening of world chickpea germplasm for resistance to fusarium wilt. Field Crops Res. 1992; 30(1-2):147-154.
8. Haware MP, Nene YL. Races of *Fusarium oxysporum* f. sp. ciceri. Pl. Dis. 1982; 66:809-810.
9. Iqbal MJ, Iftikhar K, Ilyas MB. Evaluation of the chickpea germplasm for resistance against wilt disease. J Agric. Res. 1993; 31(4):449-453
10. Karimi R, Owuoche JO, Silim SN. Importance and management of fusarium wilt (*Fusarium udum* Butler) of pigeonpea. Int. J Agr. & Agri. R. 2012; 2(1):1-14.
11. Nene YL, Reddy MV. Chickpea diseases and their control. in The chickpea. M.C. Sexena and K. B. Singh eds. CAB International, oxon, U.K, 1987, 223-270.
12. Nene YL, Haware MP. Screening chickpea for resistance to wilt. Pl. Dis. 1980; 64:379-380.
13. Singh KB, Dahiya BS. Breeding for wilt resistance in chickpea.In Symposium on Wilt Problem and Breeding for Wilt Resistance in Bengal Gram. I. A.R.I. New Delhi, India, 1973, 13-14.
14. Snyder WC, Hansen HN. The species concept in Fusarium. J Bot. 1940; 27:64-67.
15. Dennis C, Webster J. Antagonistic properties of species group of Trichoderma and hyphal interaction. Trans. British Mycol. Soc. 1971; 57:363-369.
16. Kehri HK, Chandra S. Antagonism of *Trichoderma viride* to *Macrophomina phaseolina* in the control of dry root rot of mung. Indian Phyto path. 1991; 44:60-63.

17. Mathew K, Gupta SK. Biological control of root rot of Frenchbean caused by *Rhizoctonia solani*. J Mycol. Pl. Pathol. 1998; 28:202-205.
18. Mukhopadhyay AN, Shrestha SM, Mukherjee PK. Biological seed treatment for control of soil born plant pathogens. FAO Pl. Protec. Bull. 1992; 40:221-230.